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Region II Office
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Air

EPA

Particulate Source Contributions in the Niagara Frontier

ERRATA

An error has been discovered in the calibration factor which was used during the x-ray fluorescence analysis for bromine in the particulate air filters. At the time that the xrf system was operated, an incorrect response slope had been programmed into the computer software which lead to the high values observed for bromine. Subsequent reanalysis of two bromide standards has confirmed the error and has given rise to the correction factor 0.62. This factor should be used to multiply all bromine concentrations as they appear in appendices B and C. As a result of this action, bromine concentrations less than 0.017 micrograms/cubic meter should be considered to lie below the analytical detection limit within this project.

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PARTICULATE SOURCE CONTRIBUTIONS IN THE NIAGARA FRONTIER

by

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ABSTRACT

Several areas throughout the Niagara Frontier Air Quality Control Region have consistently been faced with air particulate concentrations which exceed the Federal primary AAQS. Within this region there is much heavy industry associated with electric power production, coking, steelmaking, graphitizing, and bulk material handling. An attempt to investigate the nature of the particulate composition at six receptor sites was initiated for an eighteen-month period beginning January, 1978. Dichotomous samplers employing teflon filter membranes were utilized to provide two size fractions of air particulates -- 0-4 and 4-15 micrometers particle diameter. At least two sampling runs were conducted each week from summer through spring. Approximately 550 pairs of air particulate filters were subjected to x-ray fluorescence analysis for twelve metals -- lead, bromine, zinc, nickel, iron, manganese, chromium, vanadium, calcium, sulfur, silicon, and aluminum. Extraction of these filters and analysis by ion chromatography yielded data for fluoride, chloride, nitrite, bromide, phosphate, nitrate, sulfate, ammonium, potassium, and sodium ions.

A chemical element balance approach was used to model the chemical composition of various particulate source categories - iron and steel, soil, lime, oil, refuse, and automobile. The chemical fingerprints of the particulates derived for each of these categories were used to resolve the total particle mass observed at each receptor site into the component categories.

Major differences were observed in site-to-site concentrations of various metals, especially lead, iron, and zinc. Various patterns were observed for trace metal levels with respect to wind direction. Sulfate loadings, when expressed as a percent of TSP, exhibited only minor fluctuations throughout the test area regardless of wind direction, and serve as a indicator of background particulate levels which are transported into New York State.

This report was submitted in fulfillment of Contract No. 68-02-2880 by the New York State Department of Environmental Conservation under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from January 1978 to December 1979, and work was completed as of December 1979.

CONTENTS

FIGURES

TABLES

LIST OF ABBREVIATIONS AND SYMBOLS

SIP -- State Implementation Plan

NFAQCR -- Niagara Frontier Air Quality Control Region

AAQS -- Ambient Air Quality Standard

TSP -- Total Suspended Particulates (Glass Fiber Data)

IP -- Inhalable Particulates (Dichotomous Sampler Data; IP = FSP + CSP)

FSP -- Fine Suspended Particulates (Dichotomous Sampler Data)

CSP -- Coarse Suspended Particulates (Dichotomous Sampler Data)

SP -- Suspended Particulate (Whatman-41 Data)

CEB -- Chemical Element Balance

Hi-Vol -- High-Volume Air Sampler

SEM -- Scanning Electron Microscopy

RH -- Relative Humidity

xrf -- X-Ray Fluorescence

BR-S -- Soluble Bromide as measured by Ion Chromatography

Kev -- Kilo Electron Volts

Kv -- Kilovolts

ma -- Milliamperes

sec -- Seconds

HR -- Hours

CFM -- Cubic feet per minute

μm -- Micrometer

LPM -- Liters per minute

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SECTION 1

INTRODUCTION

Traditional source dispersion models have been used in the Buffalo-Lackawanna region of New York State to estimate TSP concentrations from emissions inventory and meteorological data. This approach balances its total predicted TSP to 100% of actual observed concentrations, but suffers from an inherent inability to describe in more detail the impact of various individual contributors on any specific receptor site. In order to provide a more accurate assessment of the individual influences of various emission source categories on receptor sites in the NFAQCR, it is necessary to define the chemical composition of the source categories and of the TSP for each particulate filter sample. This approach has been attempted in the past by various groups (1-5) with increasing success. Basically, a computer model is used to resolve each air particulate sample among the various major source categories which are located within the region. Resolution is accomplished by the use of a set of simultaneous equations which represent a "chemical fingerprint" for each of the major source categories. The chemical composition observed in the TSP sample is reconstructed from these equations until a best fit is obtained.

To provide detail in particle size, dichotomous samplers were employed at each site to permit monitoring of the inhalable particulate fraction, 0-15 micron particle diameter. The field stations were equipped with hi-vol samplers employing both Whatman-41 and glass fiber filter media to permit the intercorrelation of all particulate measurements. All of the particulate filters collected by the dichotomous samplers were analyzed by x-ray fluorescence for the following elements - lead, bromine, zinc, nickel, iron, manganese, chromium, vanadium, calcium, sulfur, silicon, and aluminum. Subsequent ion chromatographic analysis of the filter samples yielded concentrations for fluoride, chloride, nitrite, bromide, phosphate, nitrate, sulfate, ammonium, sodium, and potassium ions. Chemical fingerprints, descriptive of the major particulate source categories, were derived in terms of the latter chemical components and were used to resolve the particulate concentrations observed at the receptor sites into the respective source category contributions.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations which arise from an interpretation of the final results of the Niagara Frontier study are presented below. Since many of the facts here are unrelated to each other, no attempt was made to write this section in a continuous manner. The facts are simply stated in list form with no order of importance.

1. From the final analysis of all project data, it is concluded that the six field stations have provided a wealth of high quality data for the characterization of sources which contribute to the overall TSP observed in the Niagara Frontier. Because of the predominant southwesterly winds and the intense industrial emission sources within the urban area, it is recommended that any future efforts attempt to set up at least two more stations. One station should be located on the lake shore west of the area defined by Sites 2, 3, 4, and 5. The second additional station should be situated south of the Bethlehem Steel complex below Site 5. The purpose here is to provide additional TSP measurements which are close to the existing sites and which provide upwind (background) data from areas which are adjacent to major emission sources. Coke oven emissions do not appear to be adequately described by the present data base and future investi-

gations may wish to consider upwind-downwind sites that are closer to this industrial operation. These additional sites will be difficult to install and must consider the availability of power and the use of private lands.

2. Data for suspended particulates which supercede that produced within this project represents information based on the use of glass fiber filter media. The use of dichotomous samplers in this study has produced data which is size fractionated and previously unavailable to us. From the final results of this study, it is concluded that the fine and coarse particulate fraction and data are essential if one is to resolve emission sources contributing to TSP. However, dichotomous samplers represent a non-standard methodology and results must be related to glass fiber data from current hi-vol monitoring. As in the Niagara Frontier study, it is recommended that stations be simultaneously equipped with instrumentation which provides particle size classification as well as hi-vol glass fiber data. Such a data base permits some comparisons to be made between the two independent systems in regard to current air quality standards. Without these comparisons, the results from size classified data are almost impossible to relate to standard hi-vol data. It is further recommended that dichotomous samplers be used which are better designed and possess a coarse-fine separation at 2.5 microns particle diameter. This separation value would permit data to be correlated with that arising from projects outside the state and would allow a comparison of particulate data from regions throughout the nation.

3. Because size classified data has been judged so important, a further aspect to be considered in the collection of particulates is the diurnal variation of particulate concentrations. The use of automatic dichotomous samplers should be used which have the capacity to collect samples on some multiple hour basis. Samples collected in this manner would offer more source category information by permitting a closer accounting of variations in wind direction.

4. One observes from the chemical analyses in this project that many components of TSP were monitored - 12 metals and 10 ions. It is concluded that these 22 variables represent the main core of parameters with which one should be concerned and that a reasonable characterization of SP has been achieved. From knowledge of the application and function of the CEB model, it's expected that more accurate source resolutions will be obtained as the number of parameters in the chemical profiles is expanded. Therefore, it is recommended that chemical analyses be expanded to include more components and that detectable limits be pushed to levels consistent with time and funding requirements.

5. It is concluded that sulfate comprises the single major species (50-99%) of all possible forms of sulfur-containing particulates. Sulfate and sulfur particles are primarily found in the fine fraction (>95%) and are most likely representative of long range transport of material arising from gas-to-particle conversion processes. Site averages of sulfate throughout the course of this project have shown that similar levels are observed at all six stations. One concludes that major emissions of sulfur particulates

from industrial processes are not readily discernible in project data, and local emission sources may possibly be negligible despite such activities as coking and the use of bulk sulfuric acid. After consideration of wind direction data, it is concluded that greater than 75% of all sulfate material enters New York State from west of Buffalo. It is further observed that the overall project sulfate concentrations form approximately 18% of IP concentrations. When ammonium and nitrate concentrations are included with sulfates as representing background particulate concentrations, this fraction represents one of the largest single groups which contribute to the overall observed IP levels.

6. The following list of chemical components was found to occur predominantly (>60%) in the fine particle fraction - lead, bromine, zinc, vanadium, sulfur, sulfate, nitrate, nitrite, potassium, and ammonium. On the other hand, calcium, silicon, aluminum, and iron were found mainly in coarse particles. The segregation of particle size and the different chemical compositions afford one the opportunity to make distinctions in the contributing sources. The remaining components were fairly equally dispersed between the fine and coarse fractions - nickel, manganese, chromium, and sodium.
7. The effects of the steel industry are evident at all urban sites. Project data permits the conclusion that Sites 4 and 5 in Lackawanna experience heavy localized concentrations of IP that are rich in iron, manganese, and calcium. These metals implicate the respective raw materials used in the production of steel.
8. The elevated ammonium concentrations that are observed at Sites 1

and 2 lead one to suspect that emissions from coking operations are responsible for the observed increases. It is felt that project results have not adequately addressed the contribution to IP of emissions from coke production. Filter samples from Sites 1 and 2 were often quite black and suggestive of carbon from coal/coke. However, no chemical data currently resulting from this project appears to be useful in estimating the percentage contribution of coke emissions to observed TSP. It is recommended that future studies concerned with this aspect may make use of analysis for polynuclear aromatic hydrocarbon components or other similar classes of compounds which are peculiar to coke production, thereby serving as a tracer.

9. The increased levels of calcium within Lackawanna implicate lime and/or slag operations at Bethlehem Steel Corp. An initial data analysis in Section 8 of this report suggests that Ca/Fe and Ca/Mn ratios may help to distinguish between these two emission sources in future work.

10. Major chemical components which are observed at the background station are silicon, aluminum, ammonium, and sulfate. The conclusion can be drawn at Site 6 that the bulk of the SP is composed of contributions mainly from soil and the long range transport of particulates.

11. Silicon data is found to increase in the direction of increasing traffic density. Observed site variations are attributed to an increase in re-entrainment and permit one to conclude that silicon is mainly representative of soil particulates. To be sure, silicon

is used in the steel industry. However, site data currently indicate that silicon contributions from steel emissions are negligible. Support for these statements is also drawn from the aluminum data. Site data suggest that the bulk of all aluminum originates from soil and that any industrial emissions of this metal within the study area are also negligible. Because of the importance of these two elements in distinguishing among all emission source categories, it is recommended that future studies make use of improved analytical sensitivities for both components so that any subtle variations in concentrations may be followed more accurately.

12. The interpretation of zinc data is rather confusing at this time. The high metal levels at Site 1 are expected to arise chiefly from abraded rubber tire particles since this station is usually downwind of the nearby New York State Thruway. However, zinc occurs at similar high levels only at Sites 4 and 5 in Lackawanna. Although major roadways exist upwind of these two sites, the realization that galvanizing operations are located nearby results in confusion in the distinction of the two source categories. It is recommended that future investigations accurately define the importance of zinc from automotive emissions and determine whether or not galvanizing operations make any contributions at all.

13. An analysis of the SP data permits the conclusion that dichotomous samplers collect approximately 60% of the particulate weight at all urban sites which is similarly collected by conventional hi-vols employing glass-fiber filter media. This fact must be well understood by anyone wishing to interpret the dichotomous data and to make

extrapolations to standard hi-vol data. While one may multiply IP data by 100/60 to estimate comparable glass fiber TSP, one may introduce large errors by applying a similar procedure to individual chemical components. For example, sulfates are essentially fine particles and dichotomous sampler values in $\mu g/m^3$ should compare directly to glass fiber data. Presumably there is little or no sulfate in the 40% additional mass which is collected on glass fiber filters. The application of the factor 100/60 to dichotomous-derived sulfate in order to obtain hi-vol (glass fiber)-derived sulfate would be incorrect. More generally, a component of a particular size fraction of IP cannot be so simply "scaled up" to a value which is expected for TSP since the factors are frequently different for each particle size fraction.

14. The CEB model attempts to distribute observed chemical component concentrations among pre-defined emission source categories, using as a basis the chemical profiles which are characteristic of each source category. A detailed knowledge of the coefficients which comprise the chemical profiles used in this study lead one to conclude that this aspect of the CEB model is deficient, both in terms of accuracy and in the necessary detail. Despite these deficiencies, the resulting distribution of IP among the potential source categories appears highly reasonable for all sites. However, improvements in the overall resolution can be expected from the recommendation that chemical profiles should be used in the future which are specific for the Buffalo region. This action would necessitate the collection of bulk samples which adequately represent

the bulk emissions for each source category. Such an approach is expected to provide more accurate results in terms of emission source resolution. It is impossible to determine at this time whether the accuracy would be improved 10% or even 500%. The degree of improvement involves the relationship of the data which is presently used in the chemical profiles with any such changes found necessary in profile data which is specifically determined for the Niagara Frontier.

15. On the basis of the results of the CEB analyses of FSP which was performed on project-average data for each site, one may state the following conclusions for a six source category resolution. Soil components average 45% of the observed FSP at the three Buffalo sites. This material becomes airborne from the action of lake breezes on the shore and barren lands and is assisted inland by re-entrainment from vehicular activities. Steel, oil, and liming emission source categories account for a combined total of 10% of the observed FSP in Buffalo. Automotive particulates represent approximately 40% of the contributions to FSP throughout all the urban sites, decreasing to 25% at the rural station. Emissions from the steel category do rise within Lackawanna (Sites 4 and 5) and form an appreciable portion (21%) of FSP. One further concludes that industrial steel-making contributions to FSP are comparable to those which are estimated from soil as well as auto categories.

16. On the basis of the results of the CEB analysis of CSP on project-average data, the following statements can be concluded for the six-source resolution. Soil components at the Buffalo sites comprise

the single largest contribution (80%) to observed CSP. Contributions from steel, oil, refuse, and auto exhibit only minor inputs to the coarse particle fraction. The liming category reveals a significant contribution (15%) to CSP within Buffalo. One should realize that, while the steel category itself does not reveal much impact, any possible contributions from slag operations would appear in the liming category. A steel emission contribution is observed in Lackawanna but barely reaches 5%. Again, slag particles would appear in the liming category and the 10% rise noticed here, above the Buffalo values, is believed to represent slag and/or limestone operations which are associated with steel production.

17. The CEB analysis was extended to seven sources with the inclusion of a category for particulates arising from the combustion of coal during power generation. Interpretation of the CEB results becomes more difficult. The seventh category, coal, permits a reasonable distribution of particulates in the FSP fraction without significantly changing the estimates derived from the six category resolution. While designed specifically for coal-fired power plant emissions, the coal profile results in observed increases at Sites 4 and 5 and may reflect some contributions from the coal/coke processing operations in that area. A similar attempt to analyze the CSP fraction results in an overall poor fit so that the value of the addition of a coal source category is questionable.

SECTION 3

SITE DESCRIPTION

Six field sites were chosen in the NFAQCR for the installation of air sampling equipment. The major consideration in the sitings was the knowledge that there were only several "hot-spots" in the Buffalo-Lackawanna region where excessive TSP levels were frequently observed. After reviewing several additional factors such as the availability of electrical power, ease of access by personnel, and the time schedule, field stations were eventually located in close proximity to existing and approved New York State network sites. The added benefit could then be realized of the direct comparison of the TSP measurements to the State's hi-vol system using standard fiberglass filter media.

A description of each site is provided in Table 1, where the location, height above ground, and other characteristics are presented. Table 2 presents New York State's site identification numbers which are renumbered 1-6 to aid in establishing the north-south relationship of sites. Site 1 is the northernmost station while Site 6 is the southernmost and rural background station.

TABLE 1. Sampler Location

City	Site Identification	Location	Height	Land Use	Comments
Buffalo	1401-13	Public School #28 1515 South Park Avenue UTME 186915 UTMN 4752215	12 m	Industrial	No obstructions.
Buffalo	1401-11	Public School #26 84 Harrison Street UTME 187100 UTMN 4750700	10 m	Industrial-residential	Although other buildings are nearby, PS #26 is tallest.
Buffalo	1401-02	Holy Family Church & School 920 Tift Street UTME 185800 UTMN 4748600	15 m	Residential-commercial	No obstructions.
Lackawanna	1402-10	Friendship House 264 Ridge Road UTME 185800 UTMN 4748600	5 m	Commercial	No obstructions.
Lackawanna	1402-01	Lackawanna Sewage Treatment Plant 252-282 Lehigh Street UTME 186100 UTMN 4747700	5 m	Industrial-residential	No obstructions.
Angola-On-The-Lake	1463-02	Big Sister Creek Waste Water Treatment Plant Old Lake Shore Road, near Benett Road UTME 170000 UTMN 4722300	6 m	Residential	No obstructions.

TABLE 2. SITE IDENTIFICATION NUMBERS

State I.D. #	Project I.D. #
1401-11	1
1401-13	2
1401-02	3
1402-10	4
1402-01	5
1463-02	6

Figures 1 and 2 reveal the spatial relationship among the five urban stations and the single rural background station, respectively. The urban sites follow an approximate north-south line about 7.2 kilometers in length. The rural station, Site 6, is located approximately 24 kilometers south of Site 5, well removed from the heavy industrial and populated urban centers. Each site was installed according to EPA siting guidelines, with special attention paid to height above ground, distance from walls and other obstructions, and proximity to major emission sources.

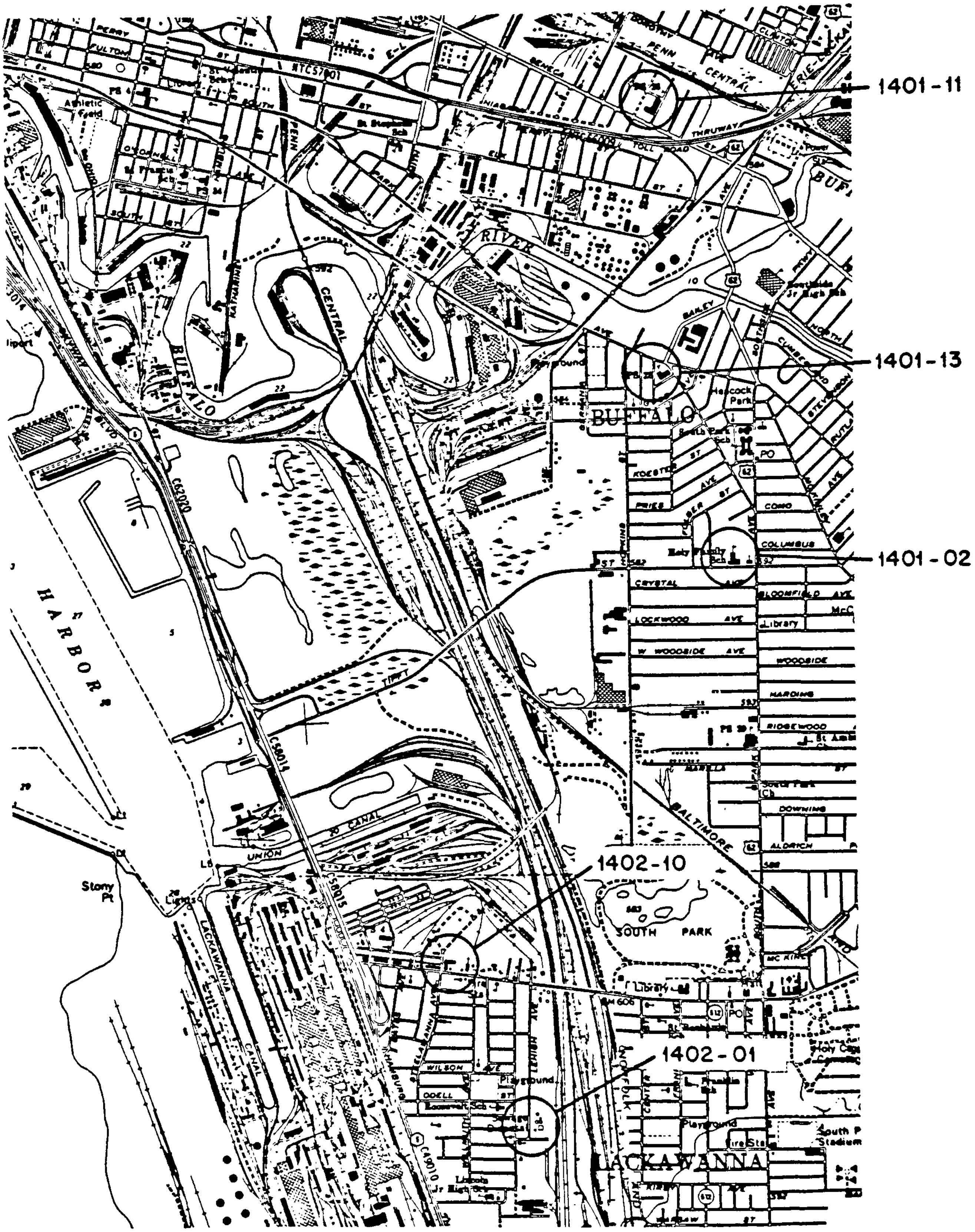


FIGURE 1. LOCATION OF URBAN SITES IN BUFFALO AND LACKAWANNA.

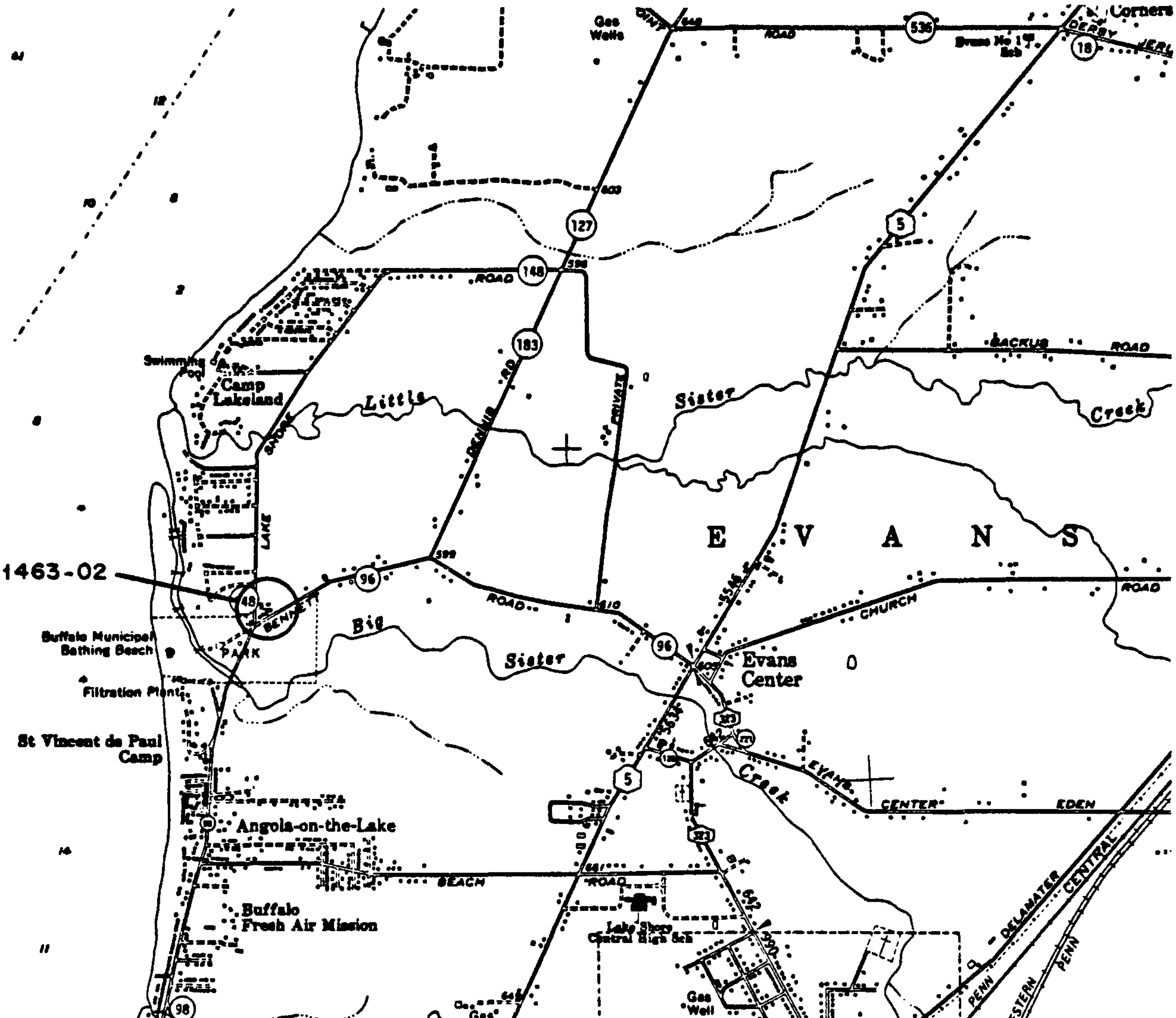


FIGURE 2. LOCATION OF RURAL (BACKGROUND) SITE IN ANGOLA.

SECTION 4

COLLECTION OF AIR PARTICULATES

HI-VOL SAMPLERS (GLASS FIBER FILTERS)

The locations of five project sites (Site 4 is excluded) were coincident with stations in the Department's statewide particulate monitoring network. The State's hi-vol samplers at the five locations used conventional glass fiber filters. This equipment was calibrated and operated according to procedures(7) set forth by the Environmental Protection Agency. The glass fiber filters collected 24-hour suspended particulate samples and the resultant loadings were determined by the New York State Department of Health. Access to this TSP data permitted comparisons to be made with the project's Whatman-41 and dichotomous data, respectively.

HI-VOL SAMPLERS (WHATMAN-41 FILTERS)

Each of the project's six sites was equipped with a second hi-vol unit which was operated using Whatman-41 cellulose filter media. All of these samplers were essentially maintained and operated according to EPA procedures(7) mentioned in the preceding section. The project's hi-vol sampling schedule was altered in August, 1978 so that one of the two weekly sampling runs would always coincide with the State's once-every-six-day schedule.

Several differences in the operation of the equipment are presented here. Instead of the standard Visi-float guages, each hi-vol was upgraded with the more accurate manometer system for determining flow. The hi-vol orifice manometer adapters were calibrated by passing a known quantity of air (100 ft^3) through the adapter and recording the elapsed time required for passage. A Roots-Connersville positive, rotary dry gas meter was used to guage the volume of air. A calibration curve was generated by operating the system and varying the number of filters in place to simulate an increase in flow resistance. The calibration curve for each hi-vol adapter was obtained by plotting flow rate (CFM) versus manometer readings on logarithmic paper. The resultant curve is described by the equation $y = ax^b$, where y = air volume (CFM), x = manometer reading, a = intercept, and b = slope. A total of five calibration points were obtained by operating the hi-vol motor (110 volts) with 0, 1, 2, 3, and 4 filters (Whatman-41) in place. All flow rates are then corrected to standard conditions of temperature and pressure (STP).

The manometer-equipped hi-vols had the following advantages over their rotameter counterparts:

(1) Worn brushes or armatures could be replaced in the motors for preventive maintenance in the field without the necessity of flow rate recalibration;

(2) A complete motor could be replaced without recalibration;

(3) The manometer-equipped adapters offer a more reliable and accurate measurement of air flow through the system.

DICHOTOMOUS SAMPLERS (TEFLON FILTERS)

All six sites were equipped with a dichotomous sampler in order to obtain size classification data on suspended particulates. Thus, each site had two hi-vols (one with glass fiber and one with Whatman-41 filters) and one dichotomous sampler, all spaced approximately 2-8 meters from each other to minimize inter-sampler effects from pump and motor exhausts. Site 4 was not part of the State's hi-vol network system and was not equipped to produce hi-vol glass fiber data.

These dichotomous samplers (manufactured by Environmental Research Corp.) operate by removing particles larger than 3.5μ from the main airstream by inertial separation. Figures 3 and 4 show the inlet system and the main features of the air flow internal to the dichotomous sampler. The larger particles are directed into a region of relatively stagnant, low-flow air which is then drawn through a filter, giving rise to the coarse particulate fraction. All remaining air containing the smaller particles is drawn through a second filter to give rise to the fine particulate fraction. One should realize that the air flow directed to the coarse particulate filter represents approximately 5% of the total inlet air flow and therefore contains 5% of all fine particulates. A correction was made for the 5% fine particulates deposited in the coarse particulate filter by use of the "uncontaminated" 95% fine particulate weight.

The total volumetric flow through the dichotomous sampler determines the cut point for size separation as well as the portion of fine particles deposited on the coarse filter. It was originally intended that the samplers would operate at a total flow rate of 50 lpm which would have resulted in a 50% cut point at 3.5μ*. When calibration was attempted, however, it was found that the samplers could not achieve a 50 lpm flow rate when using 0.5μ

*This result is based on calculations using unit density, aerodynamic particle diameters as determined by the manufacturer.

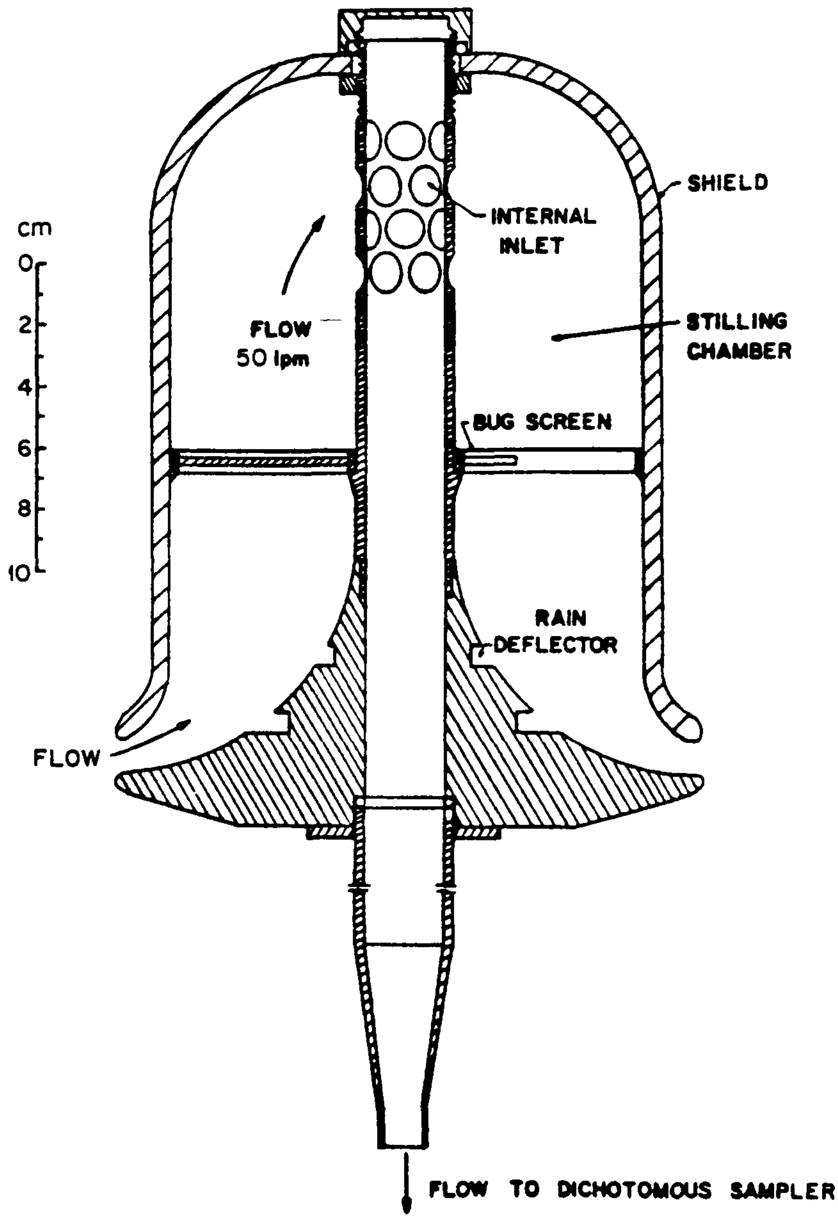


FIGURE 3. BELL INLET SYSTEM

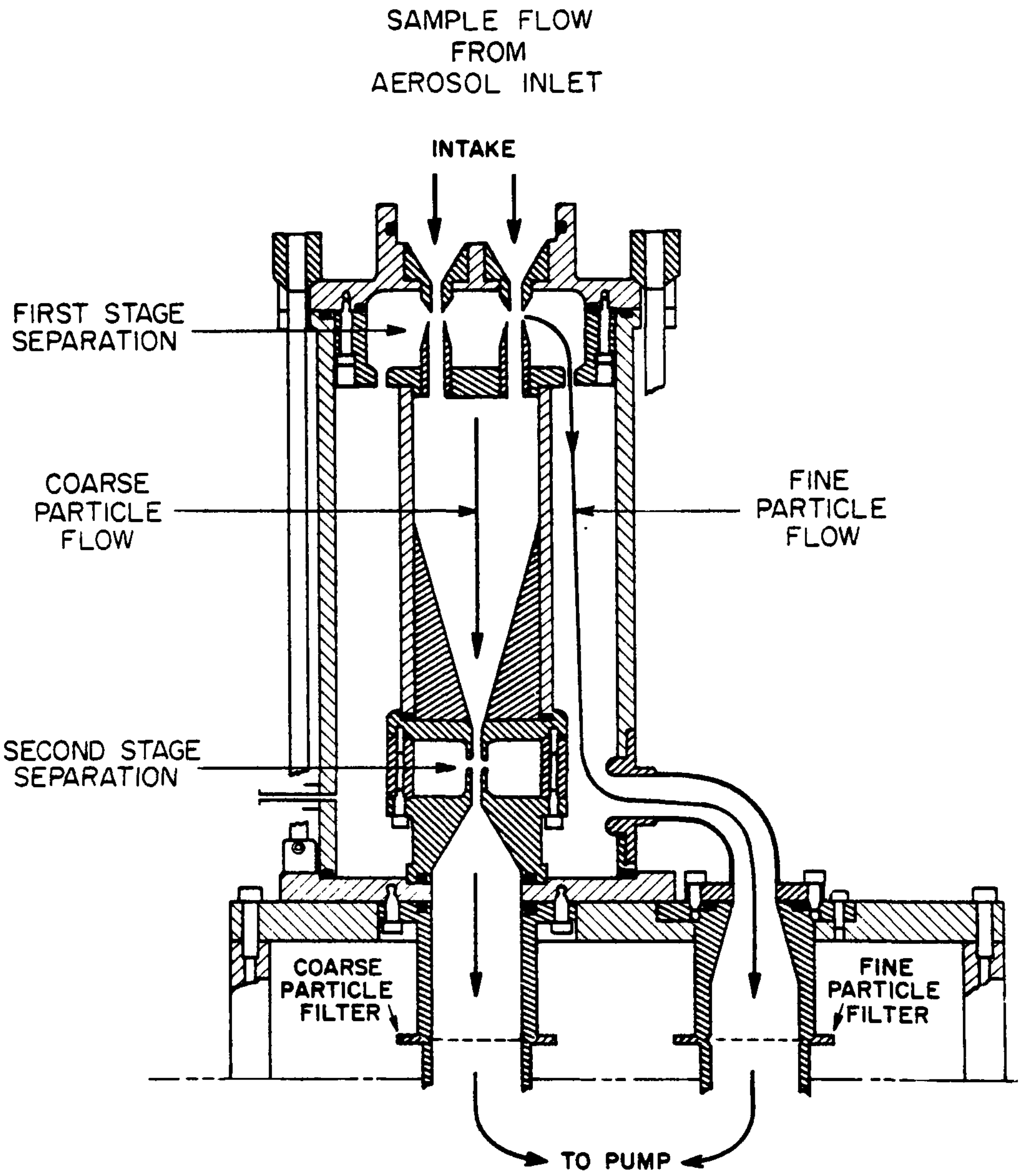


FIGURE 4. DETAILS OF DICHOTOMOUS SAMPLER

teflon filters. The highest flow rate that could be maintained was 35 lpm which resulted in a 50% cutpoint at about 4μ as determined from the manufacturer's performance data.

Each unit was equipped with rotometers for fine and coarse flow adjustment and a vacuum gauge to measure the pressure at the fine flow rotometer. The fine flow rotometer and its pressure gauge were used for field measurement of flow and were calibrated using a wet test meter. The inlet head was removed from the sampler and tubing attached to the inlet of the virtual impactor head. Air was drawn through the wet test meter and into the instrument. It was not possible to measure the flow on the exhaust side because of leaks in the carbon vane pump which was incorporated into the system. The coarse flow rotometers were not calibrated but set at a constant value equivalent to 5% of the nominal total flow. Because of the light loading of the coarse filter and its low flow rate, it was assumed that changes in the coarse flow would be small and would have a negligible effect on the total flow.

Even though the dichotomous samplers reject particles with diameters greater than 15μ and, therefore, collect fewer particles, they are more susceptible to filter overloading. The teflon filters employed in this study have a higher initial pressure drop and lower particulate loading capacity than either glass fiber or Whatman-41 filters. Because frequent filter plugging occurred at the onset of this investigation, the filters were switched from 0.5μ pore diameter to 1.0μ pore diameter to increase the flow through the filter and yet retain high capture efficiency. However, this charge in porosity did not result in all subsequent samples having elapsed times of 24 hours. Plugging of filters still occurred but with reduced frequency. The dichotomous samples as delivered had no mechanism to detect a low air flow condition caused by excessive particulate loadings. The pump and its timer would continue to operate even though the flow controllers could no longer maintain the desired flow rate. This situation resulted in an inability to calculate the final total air volume. The samplers were, therefore, modified so that operation of the pump and timer would cease if the flow rate through the fine particulate filters dropped below 90% of the preset value. This modification was accomplished by monitoring the pressure drop in the inlet above the filter with a pressure transducer set to terminate power when the inlet pressure drop indicated a decreasing flow condition. The preset value was obtained from calibration data for flow rate versus pressure data and was selected to permit a maximum 10% decrease in the flow rate. Thus, the data represented by a filter which was beginning to plug could be saved by terminating any further operation. A valid air volume and particulate concentration could then be computed. It is possible that all six sites operated for 14 hours on a given date. The trace metal data contained in such samples can be invaluable but would otherwise have been lost.

Because of the low temperatures encountered in the Buffalo area during the winter months, problems were anticipated for operation of the dichotomous sampler pumps. These pumps, unlike hi-vol motors, consist of high tolerance carbon vanes which were not designed for such extreme temperature conditions. It was expected that moisture and low temperatures could cause the vanes to freeze solid. Upon start-up, it is conceivable that the pump motors could then burn out from excessive power consumption or the pump could spin freely with the vanes frozen in the retracted position. To circumvent this problem, a 100 watt thermostated heating tape was attached around the pump head assembly.

The tape supplied heat to the carbon vanes whenever the air temperature dropped below 35°F. The wiring was performed in such a manner that electrical power to the heating tape was interrupted whenever the sampler was operating and was re-supplied when the sampler had ceased operation. This heating scheme was judged a success since only one pump had failed during the entire project.

GCA AIR PARTICULATE MONITOR (APM)

The APM was provided for our use on this study through the courtesy of GCA Corporation for the automatic and continuous monitoring of the concentration of ambient air particulates. Particulate matter is divided into fine and total particle fractions by a cyclonic device and is collected on a tape filter from a known volume of air. The resultant attenuation of low energy beta radiation by the particulates is converted into suspended particulate concentration units ($\mu g/m^3$). This entire system was pre-calibrated by the manufacturer.

The APM was installed at Site 5 on June 28, 1978 for an approximate 6-week period. Since this equipment was somewhat cumbersome, Site 5 was selected for the installation because of its relative ease of access and its proximity to heavy industrial operations. The instrument parameters were selected to provide hourly suspended particulate data on a 24-hour basis, seven days per week. Data was only obtained at Site 5 over this 6-week period. It was thought to be of less value to gather a little data at each of the six sites since only one instrument was available. The objective here was to monitor and establish the diurnal variations in suspended particulate concentrations. Operations involving the APM ceased on September 7, 1978 and the equipment was returned to the manufacturer at that time.

SECTION 5

LABORATORY ANALYSES

SUSPENDED PARTICULATE WEIGHTS

Whatman-41 Filters

Whatman-41 cellulose filters were chosen for use in the high-volume air samplers in order to facilitate x-ray fluorescence analysis. Although these filters have been found to be satisfactory for use in hi-vols, their use greatly complicates weight measurements. The cellulose fibers readily sorb/desorb water with a consequent change in weight for which a correction must be made. A previous study (6) found the filter weight to change linearly and reproducibly with relative humidity in the 35-55% range. Comparable results were obtained in this study when the RH was changed slowly in small stages. The weight change was found to average 7.7 mg per 1% increment in RH. Further studies indicated that the history of the filter affected any subsequent equilibration attempts with water vapor. All filters in this study were equilibrated for 24 hours in an enclosed chamber which was maintained at 21 ± 1°C (52-60% RH); weighings were conducted to the nearest 0.1 mg. Although the corrective weight term only approximated a first-order attempt, project data demonstrated sufficient accuracy in this approach for our purposes.

Millipore Fluoropore Filters

Fluoropore filters consist of teflon bonded to high density polyethylene netting. The filter weights do not change appreciably with R H and the filters equilibrate rapidly. These filter media were stored before weighing at 21 ± 1°C and 52-60% RH in order to achieve accurate weights and to minimize static charge. During weighing, the filter samples were exposed to β-radiation from a 10 mc Kr^{85} source to eliminate any residual static charge. Weights of these filters were measured on a microbalance to a accuracy of ± 2 μg and were not corrected for relative humidity.

X-RAY FLUORESCENCE ANALYSIS

Energy dispersive x-ray fluorescence was used to analyze all of the fine and coarse particulate filters of the dichotomous samplers. The xrf equipment consisted of a Siemens Kristalloflex 4 x-ray generator and a Siemens VRS Vacuum X-ray Spectrometer with a ten sample tray and automatic sample changer. A lithium-drifted silicon detector (United Scientific Spectrace Model 105-42) was used with a Nuclear Semiconductor Model 513 amplifier and the data was processed on a Tracor Northern TN 2000 X-Ray Analyzer. All initial and final data were stored on floppy disks.

The TN 2000 software included a package (Super ML) which allows for background correction and the deconvolution of overlapping x-ray spectra. This system permits the simultaneous quantitative analysis of several elements, even when their spectra overlap. Input into the program consists of element peak shapes generated from pure samples, and calibration curve slopes and intercepts.

Each sample was analyzed twice, once for the transition metals (vanadium, chromium, manganese, iron, nickel, and zinc) and again for the other elements (calcium, silicon, sulfur, aluminum, lead, and bromine). The transition metals were analyzed with an aluminum filter inserted over the x-ray tube to reduce spectral lines inherent from the geometry of the equipment and to enhance the analytical sensitivity toward these metals. No filter was used in the analysis for bromine, lead, and the lighter elements. Semiquantitative data were also obtained and stored for titanium, cobalt, and copper; these metals were not of immediate concern and, therefore, calibration factors are not currently available.

The majority of the quantitative xrf calibration standards were prepared in this laboratory by aerosol generation. The procedure involved the deposition of aerosols of the desired elements onto 142 mm filters. Several deposition times were used to produce a graded series of loadings. Smaller samples were cut from each large filter and analyzed semiquantitatively by xrf techniques. One sample in each concentration range was analyzed by the New York State Department of Health (typically by atomic absorption spectroscopy) to produce a calibration curve for that metal. The calibration curves were generated from the least-squares straight line of the data and forced through the zero intercept. The remaining filters for that metal were then normalized to this resultant curve.

Detection limits were calculated in Table 3 from the formula D.L. = $2m\sqrt{C_B}$, where m is the slope (micrograms/sq. centimeter/pulse count) of the calibration curve and C_B is the background pulse count.

TABLE 3. XRF DETECTION LIMITS

ELEMENT	LINE	DETECTION LIMITS $\mu g/Cm^2$	ng/m^3 *
Al	$K_{\alpha\beta}$	1.40	600
Si	$K_{\alpha\beta}$	1.50	650
S	$K_{\alpha\beta}$	0.09	40
Ca	$K_{\alpha\beta}$	0.02	10
V	K_{α}	0.02	10
Cr	K_{α}	0.01	5
Mn	K_{α}	0.01	5
Fe	K_{α}	0.01	5
Ni	K_{α}	0.02	10
Zn	K_{α}	0.03	15
Br	K_{α}	0.33	145
Pb	L_{β}	0.15	65

*Approximate airborne concentration detection limits when based on a 37 cubic meter average air volume.

Energy calibration of the multichannel analyzer system was performed daily using a titanium-zirconium standard. All xrf spectra of all filter samples were accumulated for 200 sec under vacuum over the energy range 0 to 20 Kev. The xrf tube (molybdenum) was operated at 35 Kv and 10 ma without an aluminum xrf filter for the analysis of the non-transition elements. When the aluminum filter was employed in the analysis of the transition metals, the current was increased to 16 ma. A coarse collimator was used for all analyses.

ION CHROMATOGRAPHY

Ion chromatography was used to analyze aqueous extracts of both the dichotomous fine and coarse particulate filters after these filters had already been analyzed by xrf spectroscopy. The apparatus consisted of a Dionex Model 10 Ion Chromatograph which was interfaced to a second similar unit that had been constructed in this laboratory. Sample loops and a splitting valve allowed for simultaneous sample injection into each of the two units. The Dionex unit was equipped with analytical and suppressor columns for anion analysis while the second unit was equipped for cation analysis. This system permitted the simultaneous analysis of anions (fluoride, chloride, bromide, nitrite, nitrate, phosphate and sulfate) and cations (sodium, potassium and ammonium) in a single sample.

Samples were extracted on a shaker table for 24 hrs. with 25 ml of distilled deionized water. The extracts were loaded into a Technicon Sampler IV from which they were drawn through the rotary injection valve by a small pump. Sample injection was pneumatically activated by a pre-programmed integrator.

Output of the conductivity meter was recorded graphically and simultaneously analyzed with an integrator (Columbia Scientific Industries Supergrator 3). Quantitative data was obtained by comparison of sample peak heights to the peak heights of standards. Calibration standards were prepared gravimetrically from analytical reagent grade chemicals and were processed after every 10 samples to provide a system check.

The anion chromatography system consisted of a 3 x 150 mm precolumn, a 3 x 500 mm separator column and a 6 x 250 mm suppressor column. The eluent was a aqueous $NaCO_3$ - $NaHCO_3$ buffer and the suppressor regenerent was dilute H_2SO_4. The cation chromatographic system consisted of a 3 x 150 mm precolumn, a 6 x 250 mm separator column and a 9 x 250 mm suppressor column. The cation eluent was dilute HNO_3 and the suppressor regenerent was dilute NaOH.

SCANNING ELECTRON MICROSCOPY AND ELECTRON MICROCROPROBE ANALYSIS

The xrf analysis of the dichotomous filters provides much information about the total particulate composition but provides little direct information on the composition of individual particles. Knowledge of the physical and chemical characteristics of individual particles is more useful in defining source categories than are the xrf properties. Therefore, individual particles were analyzed by scanning electron microscopy and electron microprobe analysis. Instrumentation consisted of a Coates and Welter field emission scanning electron microscope interfaced with a Princeton Gammatech energy dispersive x-ray analyzer.

In order to obtain an extremely flat field and a sample of particulates with good spacial separation, a special sample collection was conducted. The samples were collected by dichotomous samplers using Nucleopore filters (1 micron diameter pore size, 1 x 10^7 pores/cm^2). The field run was conducted for a period of six hours on January 25, 1979 from 9:00 a.m. to 3:00 p.m. Portions of the fine and coarse particulate filters exposed at Sites 5 and 6 were coated with carbon and examined by sem and by electron microprobe analysis using energy dispersive x-ray spectroscopy. About 25 particles on each filter were selected at random to represent various size and shape categories. For each particle, the beam was placed on the area of interest and counts above background for each of the elements of interest were recorded.

SECTION 6

SUSPENDED PARTICULATE DATA

WHATMAN-41 HI-VOL DATA

With the exception of Site 4, each of the sampling sites which were used in this study were also maintained by New York State as hi-vol air sampling stations using glass fiber filters. A summary and comparison of this data appears in Table 4 and are shown graphically in Figure 5.

Site	No. of Samples	Whatman-41 Average SP ($\mu g/m^3$)	Glass Fiber Average TSP ($\mu g/m^3$)	Ratio Ave. TSP/ Ave. SP
1	42	76.62	98.10	1.28
2	38	76.21	92.10	1.20
3	45	68.93	82.67	1.20
5	103	100.54	126.37	1.26
6	40	45.92	37.22	.81

TABLE 4

STATISTICAL CHARACTERISTICS OF HI-VOL MEASUREMENTS
USING WHATMAN-41 AND GLASS FIBER FILTER MEDIA

It is evident from the ratio data in Table 4 that the urban sites (1,2,3, and 5) differ markedly from the rural background station (Site 6). Application of a test for homogeneity of variance indicated that the urban site data could be grouped for subsequent regression analysis but that the background site could not be so grouped.

Linear regression analysis of the urban data yields the least squares line:

$$Y = 1.34 + 1.22X$$

where: Y = TSP concentration using glass fiber filters
X = SP concentration using Whatman-41 filters

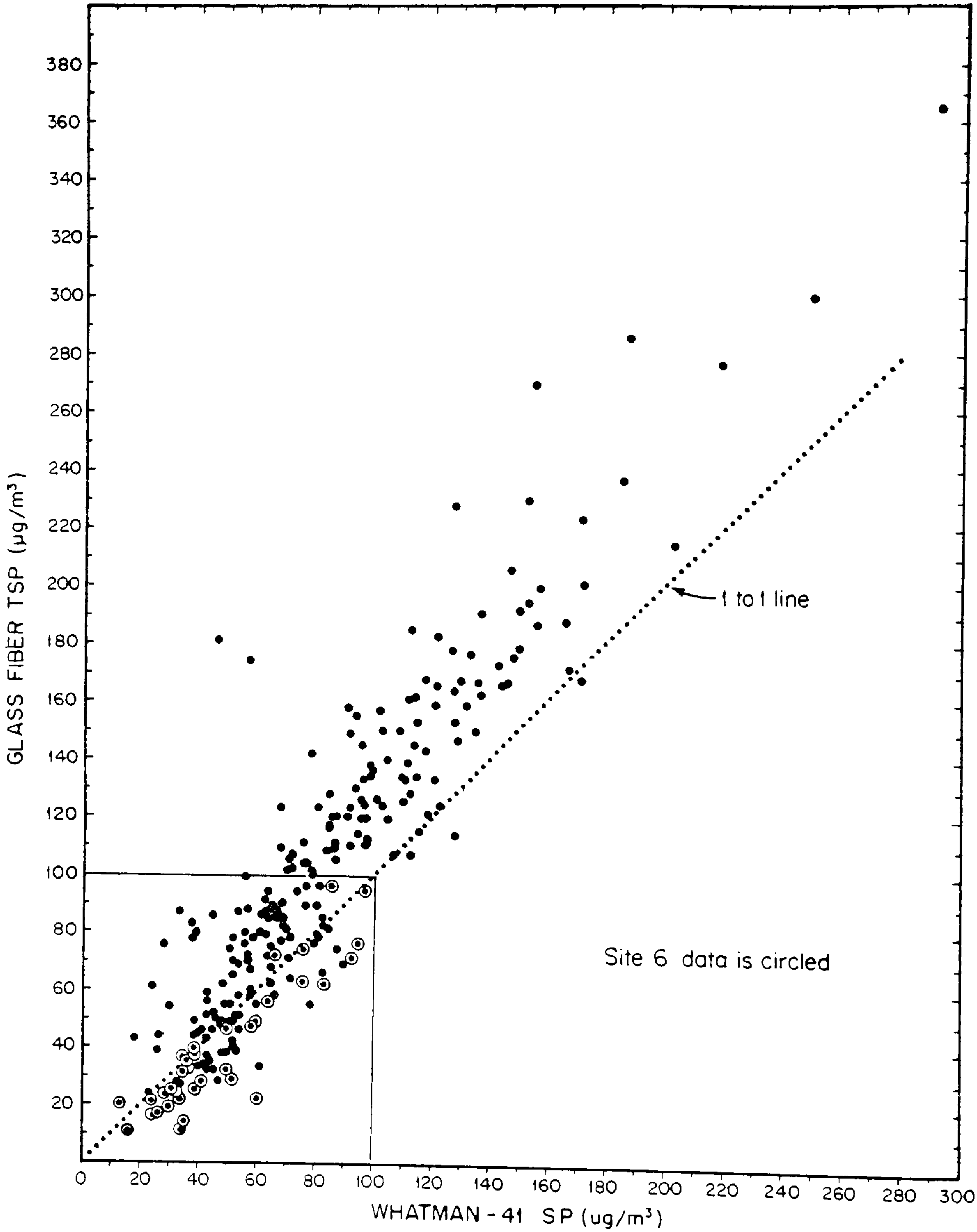


Figure 5. RELATIONSHIP OF SUSPENDED PARTICULATE CONCENTRATIONS USING GLASS FIBER AND WHATMAN - 41 FILTER MEDIA

The correlation coefficient of .91 and corresponding R^2 value of .83 are indicative of a very good linear fit explaining some 83% of the variation inherent in the data. Because the intercept value 1.34 is comparatively low, forcing the regression line through the origin produces very little change in the final results. The resulting equation is:

$$Y = 1.24X$$

where Y and X are as above. The correlation coefficient and R^2 value did not change significantly from the least squares result. This latter equation indicates that on the average, glass fiber filter media at the urban sites will lead to concentrations of TSP about 24% greater than that resulting from the use of Whatman-41 filters.

Separate regression of the Site 6 data yielded the least squares line:

$$Y = .91X - 4.63$$

where X and Y are as above. The fit is also quite good as indicated by its correlation coefficient of .91 and R^2 value of .84. Forcing this line through the origin results in the equation:

$$Y = .83X$$

with no significant reduction in the correlation coefficient or R^2 value. Site 6 data in Figure 5 is circled to show that most of it lies below the 1:1 line within a region bounded by 100 $\mu g/m^3$. This observation contrasts with the urban data within this graphical region as indicated by the ratio data in Table 4. The regression equation for Site 6 indicates that hi-vols equipped with Whatman-41 cellulose filters collect 17% more particulates at the rural station than hi-vols employing glass fiber filters. These analytical results are provided here so that one may relate the Whatman-41 data in the project in terms of standard glass fiber data.

Whatman-41 suspended particulate (SP) averages are shown in Figures 6 and 7. It should be noted that all averages in this report are arithmetic unless otherwise stated. Figure 6 illustrates the means of the monthly SP averages among the six sites, together with the maximum and minimum month averages. Figure 7 compares the means of the average urban monthly SP values observed at Sites 1-5 and similar monthly data from the rural station (Site 6).

In Figure 6 the urban averages fall into two categories: Sites 1,2, and 3 (Buffalo) and Sites 4 and 5 (Lackawanna). The SP data at the Lackawanna sites is approximately 30% greater than the SP data at the Buffalo sites. These large differences are certainly due to local effects since the urban sites are located over an aerial distance of only 3.5 miles. In contrast to the urban sites, the SP loadings observed at Site 6 are considerably lower. All sites have maximum monthly averages which are 2-3 times the respective minimum monthly averages. In Figure 7 the maximum monthly average for all sites occurred in May. The minimum for all sites occurred in September, except Site 3 where it occurs in January. The month-to-month variations (Figure 7) for a composite of the urban sites (1-5) are compared against the rural site data. The two traces follow each other fairly well with a deviation noted in December when the urban SP remains high while the background value drops sharply. This SP difference is not readily explainable at this time although it may somehow be related to the "lake" effect.

The effects of Lake Erie on TSP measured in the Buffalo-Lackawanna area have been studied. Anderson (8,9) developed a mathematical model for predicting monthly TSP arithmetic averages at Site 5. The model included a term containing the lake temperature minus the land temperature (Δ T), a parameter for steel production (P), and a constant. His equation is:

$$TSP_{(\mu g/m^3)} = P(0.20 + 0.0123\,\Delta T) + 76$$

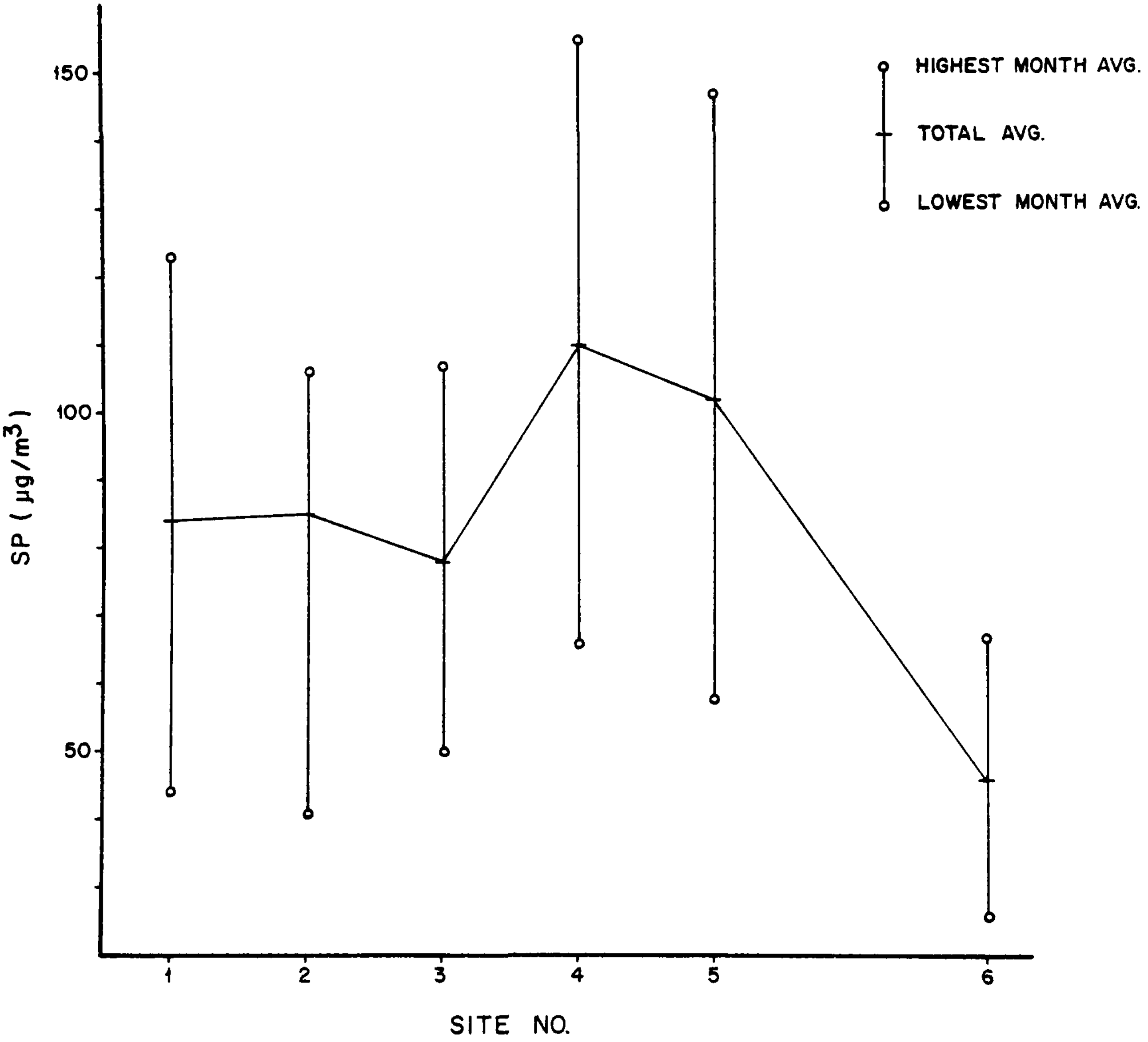


FIGURE 6. WHATMAN-41 SP - MONTHLY AVERAGES AND EXTREMES

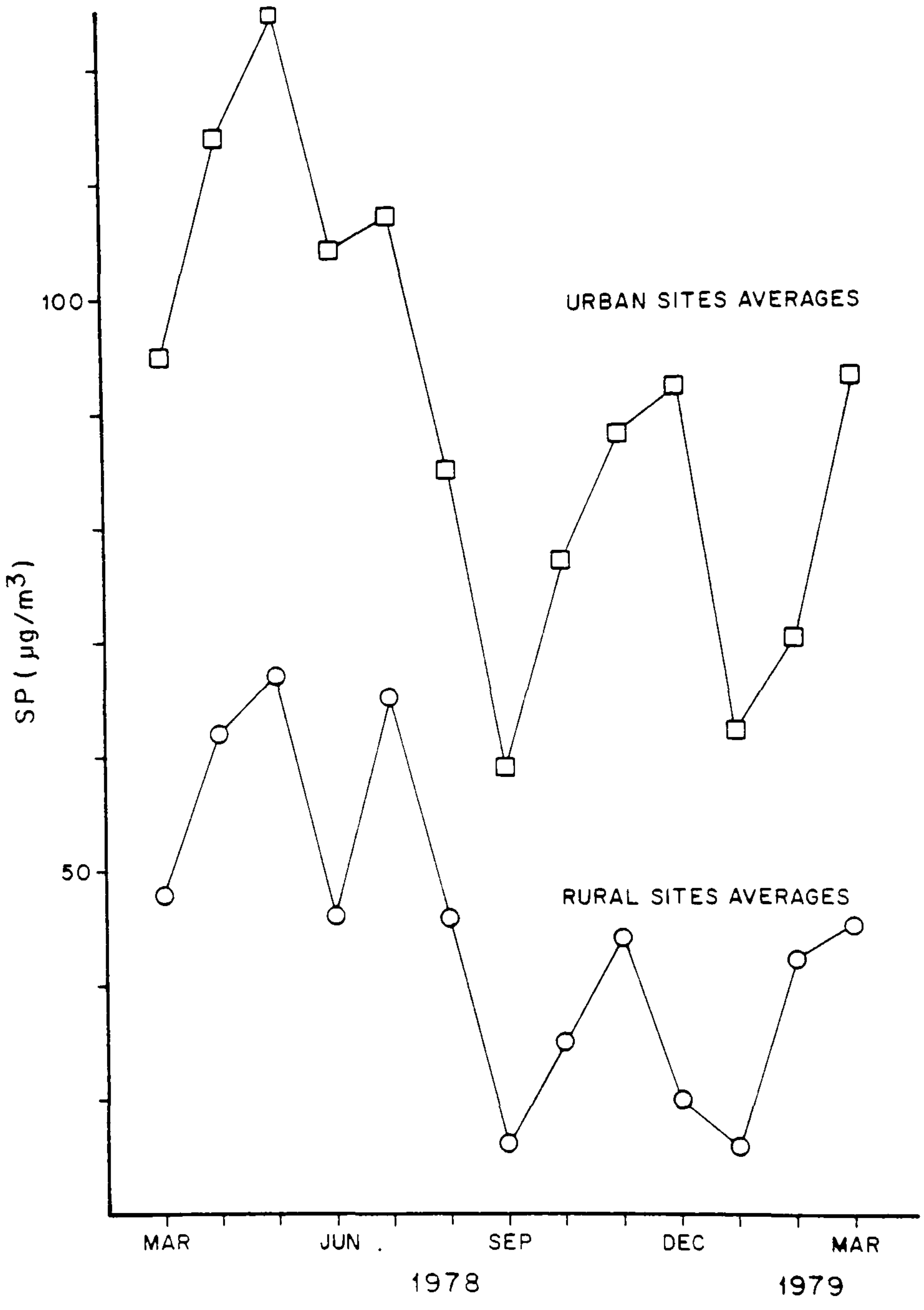


FIGURE 7. WHATMAN-41 SP - MONTHLY VARIATIONS

According to the model, the relatively cold lake water chills the lower atmosphere in the spring, stabilizes it, and thereby prevents good mixing of emissions. The TSP therefore is expected to be elevated in March, April and May. In the fall when the water is still warm, the lake heats and humidifies the lower atmosphere and generates instability and turbulence. The resultant mixing and dispersion of particulate emissions causes the decrease in TSP for October, November, and December. This trend assumes that steel production does not vary significantly. The model predicts that steel production will have a much greater effect on the observed TSP during the warm months than during the cold months. The model predicts that TSP will be independent of steel production if $\Delta T = -16^{o}F$ and that TSP will decrease with increased steel production if $\Delta T < -16^{o}F$. Such predictions begin to show the limitations of the model. However, such conditions for ΔT occur infrequently and are expected to have a minor effect on the model's fit to the observed data. If the factor for steel production in the model equation is set equal to zero, the resulting TSP value is 76 $\mu g/m^3$ (arithmetic average or 68 $\mu g/m^3$ geometric average).

The data collected within this project has an overall annual pattern which is consistent with the model although no quantitative checks were made. While it is obvious that steel production should affect TSP and reasonable that the lake have an effect, the background TSP concentration of 76 $\mu g/m^3$ is more difficult to rationalize. This value must be looked upon as a "background" which is not affected by atmospheric turbulence or steel production. The value of 76 $\mu g/m^3$ appears too high when considering the TSP data in Figure 7 for the background site.

DICHOTOMOUS SAMPLER DATA

The main reason for employing dichotomous samplers in this study was to obtain chemical composition data for two size fractions of particulates. Various emission sources, both natural and anthropogenic, have characteristic particle size distributions and chemical compositions which can aid in determining their respective contributions to the overall particulate burden. This section is concerned with the dichotomous sampler data from a gravimetric standpoint only, while a later section will consider the composition of the particulates which is distributed between the fractions.

Table 5 summarizes the dichotomous sampler data for each of the six sites. Probably the most important aspect of this data is the ratio of the fine particle weight to the total particle weight. This ratio is a function of:

(a) the fine to coarse particle cut point of the dichotomous sampler;

(b) the upper particle size exclusion limit of the dichotomous sampler; and

(c) the size distribution of the particulates in the air being sampled.

TABLE 5. SITE DATA SUMMARY FROM DICHOTOMOUS SAMPLERS

	Site #					
	1	2	3	4	5	6
No. Samples	54	46	70	64	66	68
Fine ($\mu g/m^3$)	41	42	34	44	47	24
Coarse ($\mu g/m^3$)	20	22	19	26	27	9
Total ($\mu g/m^3$)	61	64	53	70	74	33
Fine/Total (%)	68	66	65	63	64	73
No. Samples	28	23	33	27	24	45
Total (Dichotomous)* / Hi-Vol (Whatman-41)	.76	.67	.69	.74	.78	.67

*The data base which was used in this ratio was comprised of dichotomous sampler runs which spanned 23-24 hour elapsed time to be consistent with the hi-vol data.

Assuming the effects of (a) and (b) to be relatively constant and equal for all six samplers, changes in the weight ratio (fine/total, F/T) will indicate changes in the particle size distribution of the measured air mass.

Plots of this ratio with respect to the time of year are shown in Figure 8 (Site 3) and Figure 9 (Site 6). The two plots are surprisingly similar even though they represent urban and rural stations. The fine/total particle percentage rises slowly and erratically until late February at both sites, after which it drops sharply. The slopes of the least squares straight line through each set of data (until mid-March) differ by less than 10% and the day-to-day variations are fairly similar. Because these sites are located far from each other (approximately 16 miles) and in vastly different environments (urban versus rural), it becomes obvious that a major component of the fine/total particle percentage affects both the urban and background sites with similar intensity. The minima which occur in March appear to be associated with decreases in sulfate and ammonium concentrations. This decrease in F/T in March also coincides with the spring thaw. A decrease in the production of fine particles resulting from less combustion of heating fuels may begin to be realized at this time of year. This effect may begin to be coupled with higher winds and an increased entrainment of larger particles to dramatically change the F/T ratio. Site-to-site variations (Table 5) in F/T are small at the urban sites; and the urban site values are significantly lower than background (Site 6). Since the coarse particle components arising from vehicular reentrainment and industrial activities are much lower at Site 6 relative to the urban sites, the F/T ratio at Site 6 is larger.

The ratios of total dichotomous to Whatman-41 suspended particulates are shown on the sixth line of Table 5. There are no distinct site-to-site variations. The data do indicate, however, that one-quarter to one-third of

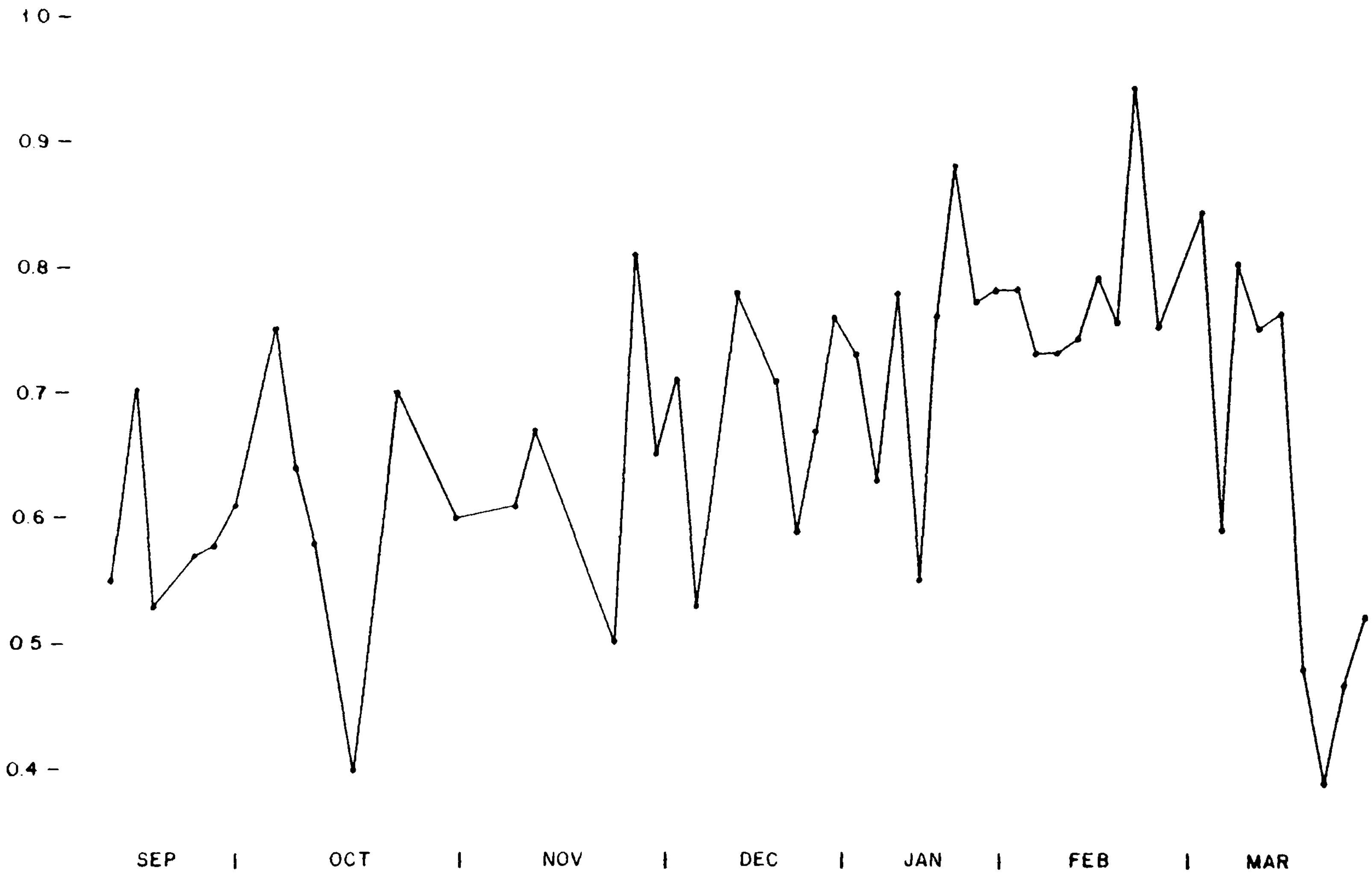


FIGURE 8. SITE 3 RATIOS OF PARTICULATE WEIGHTS (FINE/TOTAL)

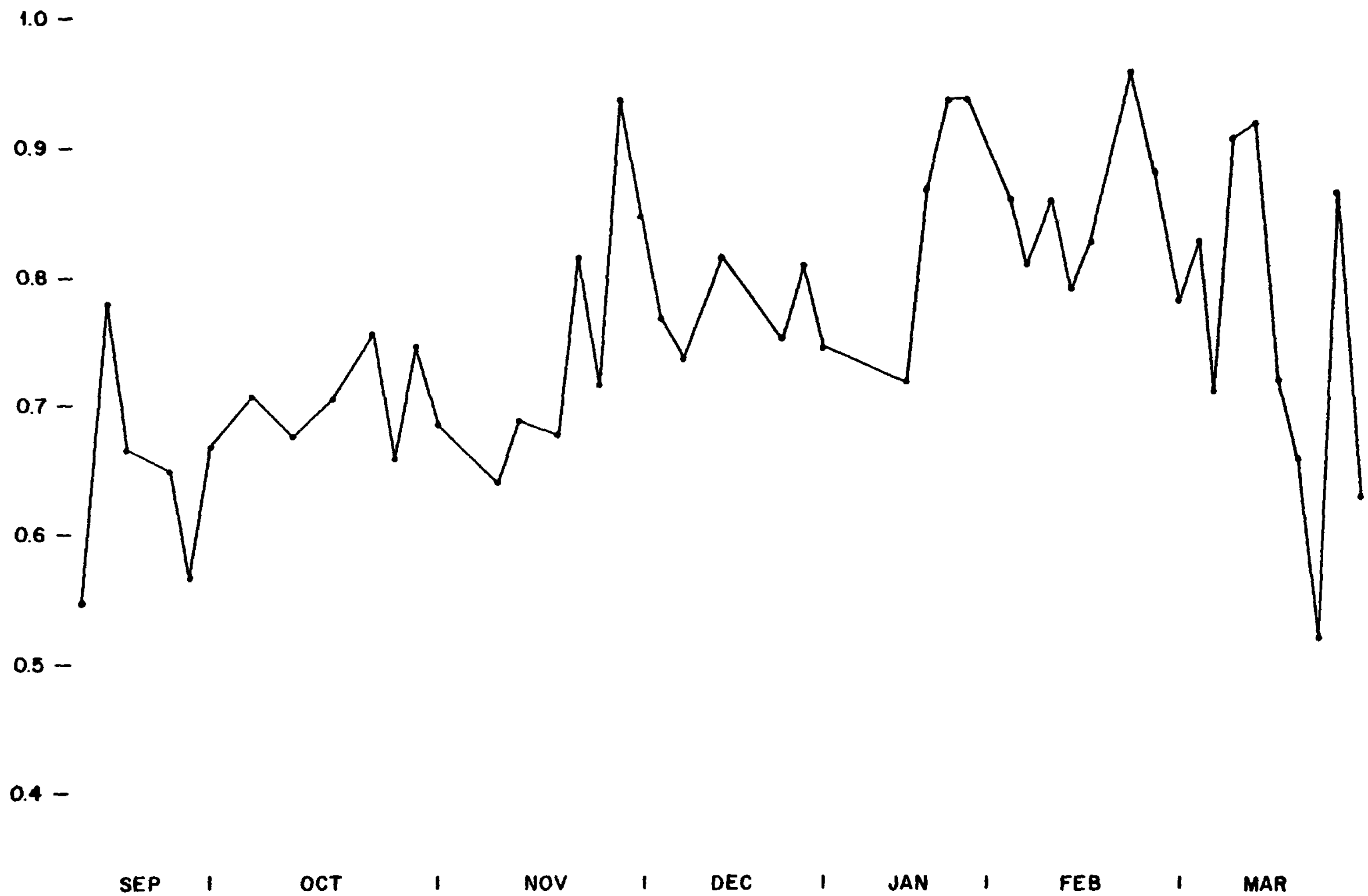


FIGURE 9. SITE 6 RATIOS OF PARTICULATE WEIGHTS (FINE/TOTAL)

the suspended particulates collected by the hi-vols is not collected by the dichotomous samplers. The particulates which are not collected by dichotomous samplers most likely represent that fraction of the coarse particulates with particle diameters above the exclusion limit of the dichotomous sampler but below that of the hi-vols. Thus, only 40-60% of the total coarse particulate fraction is actually collected by the dichotomous samplers. Therefore, the contribution of coarse particles to the hi-vol SP or TSP could be considerably greater than is indicated by the dichotomous sampler data.

A high percentage of fine particles observed at all six sites appear to be transported into the Erie County area, predominantly from the southwest from across Lake Erie. The pollution roses for FSP concentrations at each site are presented in Figure 10. The solid lines show the average FSP values together with their standard deviations. The dotted lines represent dosage roses, which are actually frequency plots of pollution rose data which was normalized to 100%. For all sites the fine particles predominantly arrive from the southwest quadrant, accounting for approximately three-quarters (68-77%) of all the observed FSP. This data was obtained from a wind sector analysis approach which was extended to each measured chemical variable in this study.

Further interpretation of Site 6 data shows that a summation of the project's average values of the sulfate, nitrate, and ammonium components from Appendix A accounts for almost one-half (45%) of the observed average FSP. It does not seem likely that much of these materials (sulfate, nitrate, and ammonium) could arise from the beach proper, which is located approximately one-quarter mile southwest of Site 6. Particulate material from the beach would be expected to contribute to the coarse particle fraction, as opposed to the fine particle fraction, and would not be expected to contain sulfate, nitrate, and ammonium at the levels observed in the FSP samples. It is more

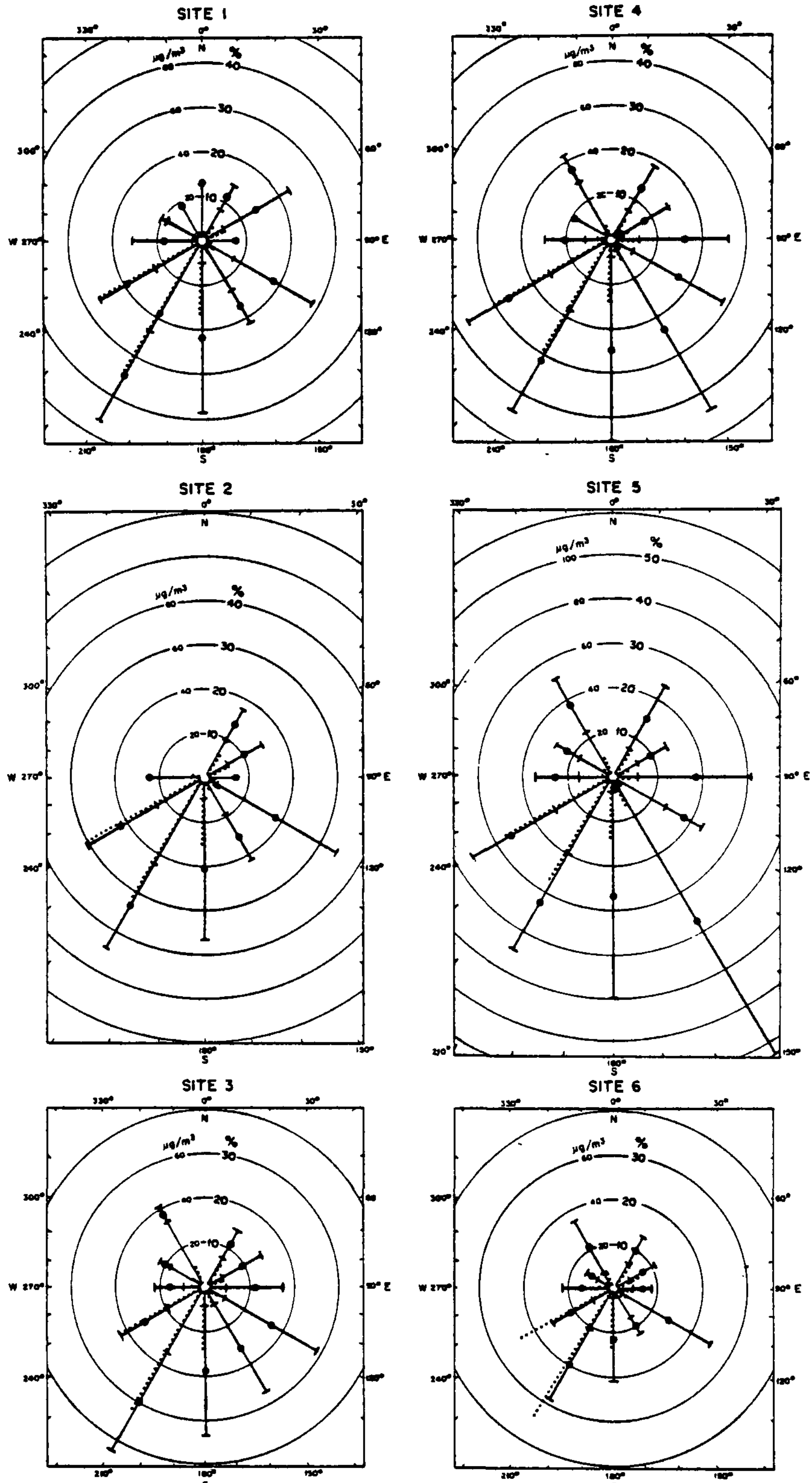


Figure 10. POLLUTION AND DOSAGE ROSES FOR FSP

reasonable to assume that the FSP component at Site 6 arrives from the west of New York State. Since the average FSP at Site 6 in Table 5 is about one-half that observed at the urban sites, then one could expect that 25% of the observed urban FSP is comprised of sulfates, ammonium, and nitrate components necessarily produced outside of New York State.

With such an interpretation it must be remembered that the background or incoming FSP, its absolute value and chemical composition, must be expected to overlay that FSP which is produced locally in the Erie County area. However, such an extrapolation to the CSP fraction (Figure 11) is not so readily made since transport over short distances may not be as uniform as for fine particles. In other words, the CSP fraction observed at Site 6 may bear little relation to that observed at the urban sites in regard to the CSP absolute value or its chemical composition.

GCA AMBIENT PARTICULATE MONITOR (APM) DATA

The APM was programmed to measure suspended particulates in one hour intervals to permit the measurement of diurnal variations. The data in Figure 12 presents the wind rose for the APM data which was collected during an eighteen day period during July-August, 1978. Such data was only available from Site 5 since use of the instrument was limited.

The compass has been divided into 18 sectors of 20° each; the average suspended particulate concentrations for those hours in which the wind was from that sector is plotted radially. Although Figure 12 shows that the southwest quadrant possesses the strongest input of particulates, it is the dosage rose in Figure 13 which more effectively displays the vector strengths when combined with frequency of occurrence. The dosage rose data is obtained by multiplying the average suspended particulate concentration (pollution

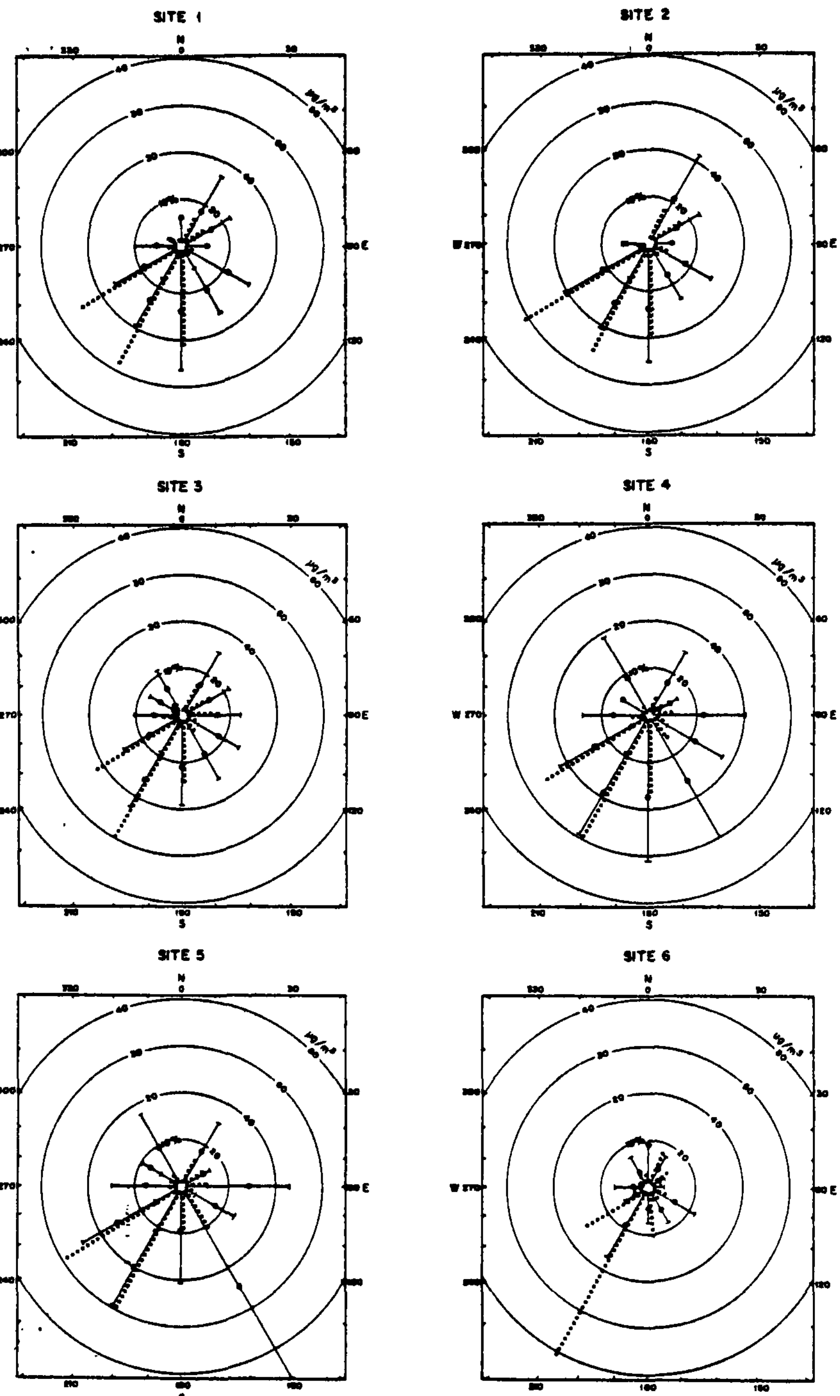


FIGURE 11. POLLUTION AND DOSAGE ROSES FOR CSP

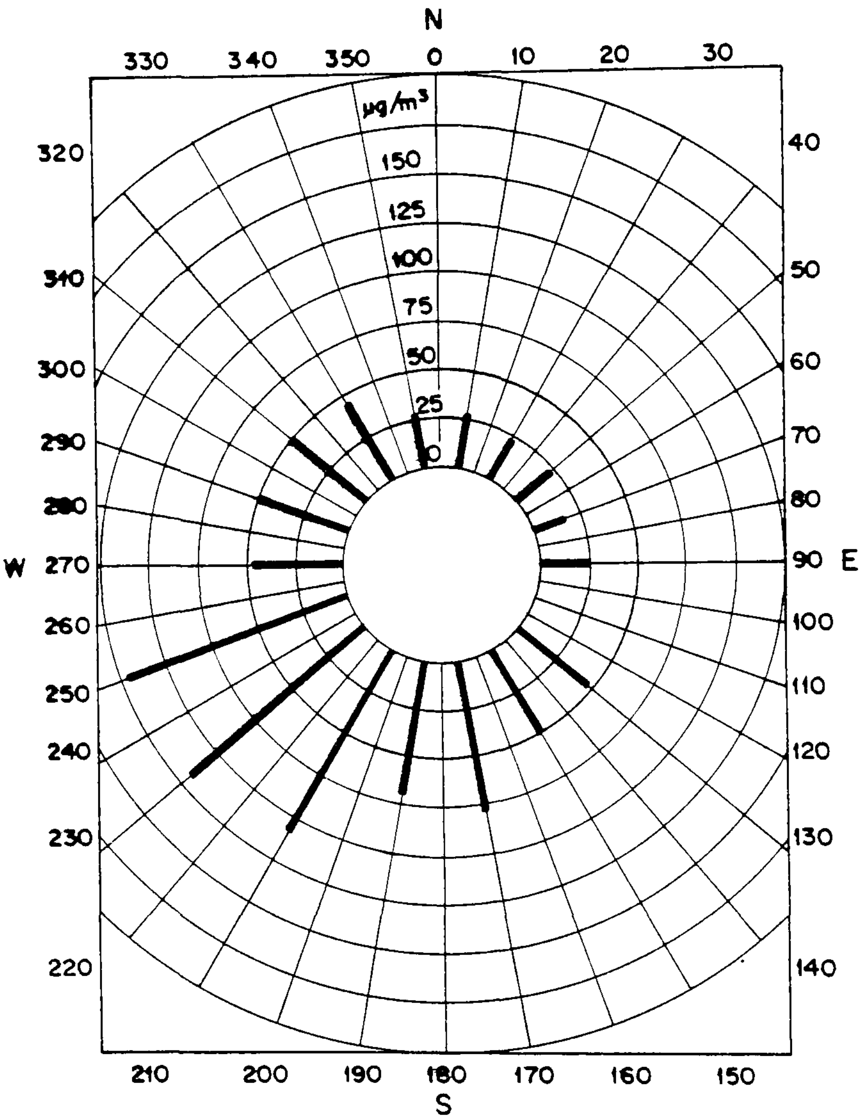


FIGURE 12. WIND ROSE FOR APM SUSPENDED PARTICULATES AT SITE 5

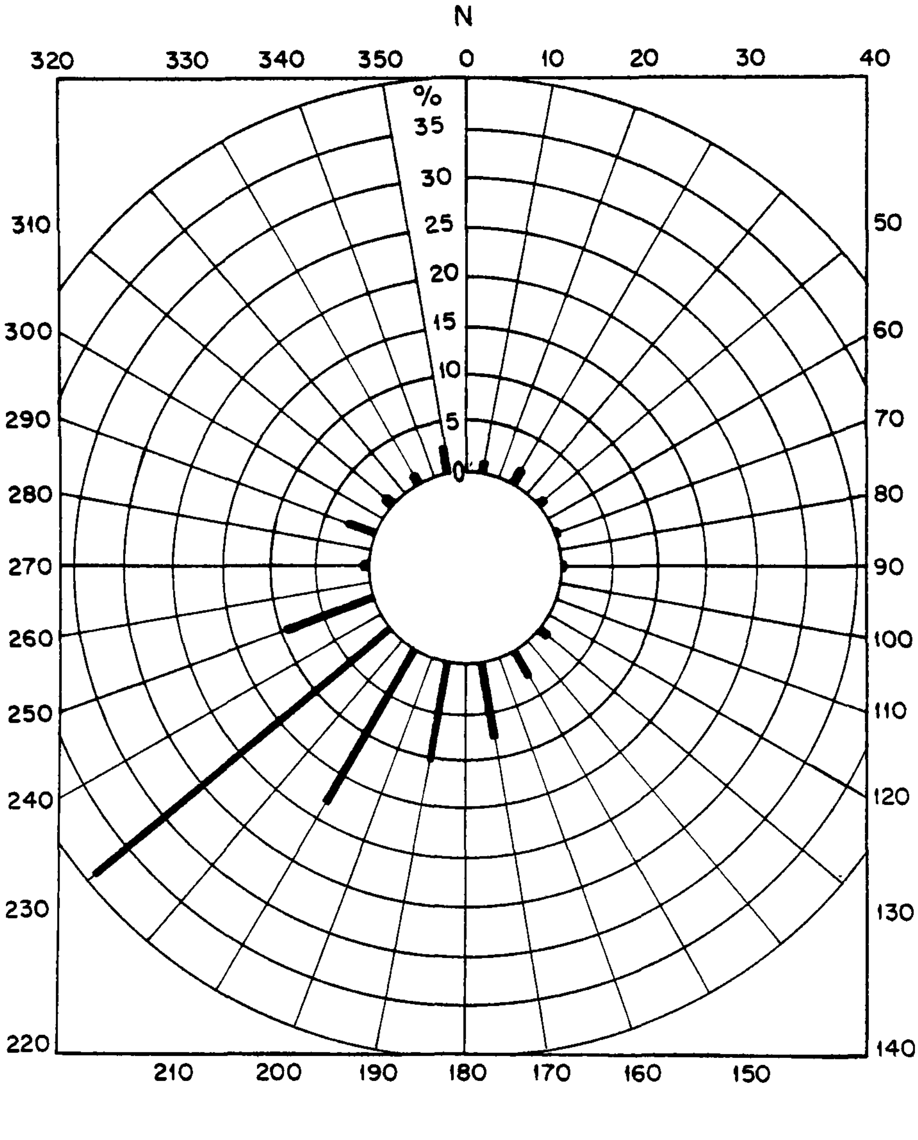


FIGURE 13. DOSAGE ROSE FOR APM SUSPENDED PARTICULATES AT SITE 5

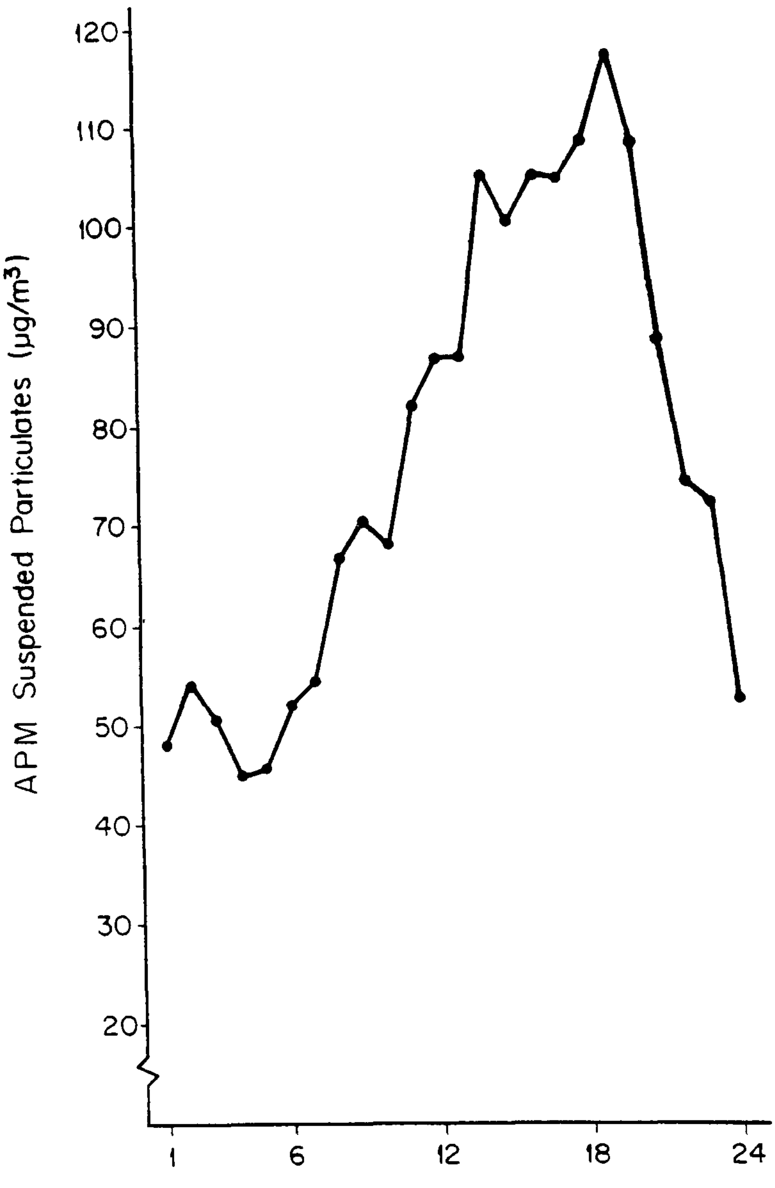


FIGURE 14. DIURNAL VARIATION OF SUSPENDED PARTICULATES

rose data) for each wind sector by the number of occurrences of wind arising from that sector and dividing this value by the sum of all values from all the sectors.

The diurnal variation of suspended particulates is presented in Figure 14. From 0500 hours to 1900 hours, the suspended particulate concentration rises sharply and steadily and then drops precipitately until 2400 hours. A subsequent rise occurs until the daily low is registered between 0400 and 0500 hours. This data would at first suggest an increase in local particulate production throughout the day. However, in view of the data presented in Figure 15, the previous fact would not be the major reason for the observed diurnal variation. In fact, it appears that the "lake effect" strongly influences the observed profile (Figure 15). Late at night and early in the morning, land breezes tend to proceed toward the lake where warmer air is rising. Throughout the day the land heats up and reaches a peak in the late afternoon. The air rising above the land is now met by cooler breezes approaching more from the west from Lake Erie. The hourly wind direction has been observed to rotate clockwise through 360° and results in a more complex picture for the interpretation of suspended particulate sources. The strong resemblance of Figures 14 and 15 suggests that most of the diurnal variation of suspended particulates can be explained by changes in wind direction and the unique source-sampler geometry present at Site 5. Since most of this APM data was obtained in July 1978, it is normal at this time of year for wind to arrive predominantly from the southwest. Such patterns may shift during other portions of the year.

Since the APM sampler is sufficiently different from hi-vol sampler operation, the following information is intended to briefly describe the

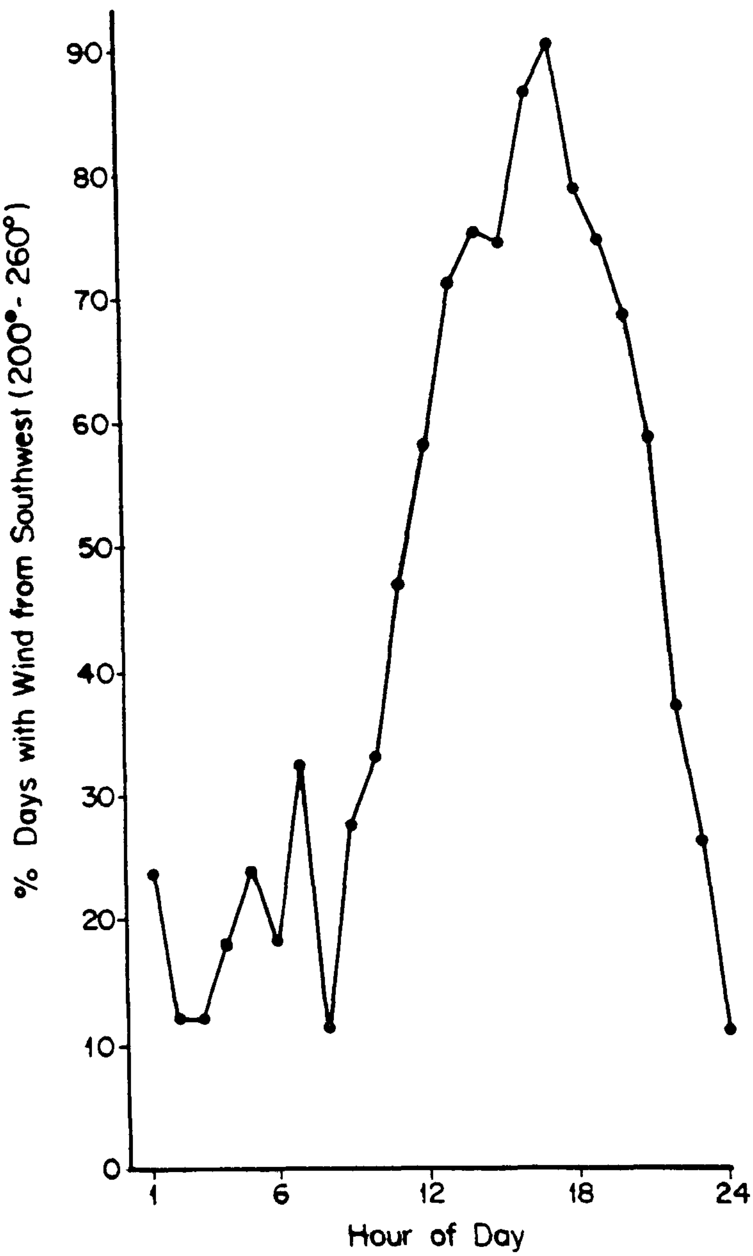


FIGURE 15. SOUTHWEST WINDS VS. TIME OF DAY

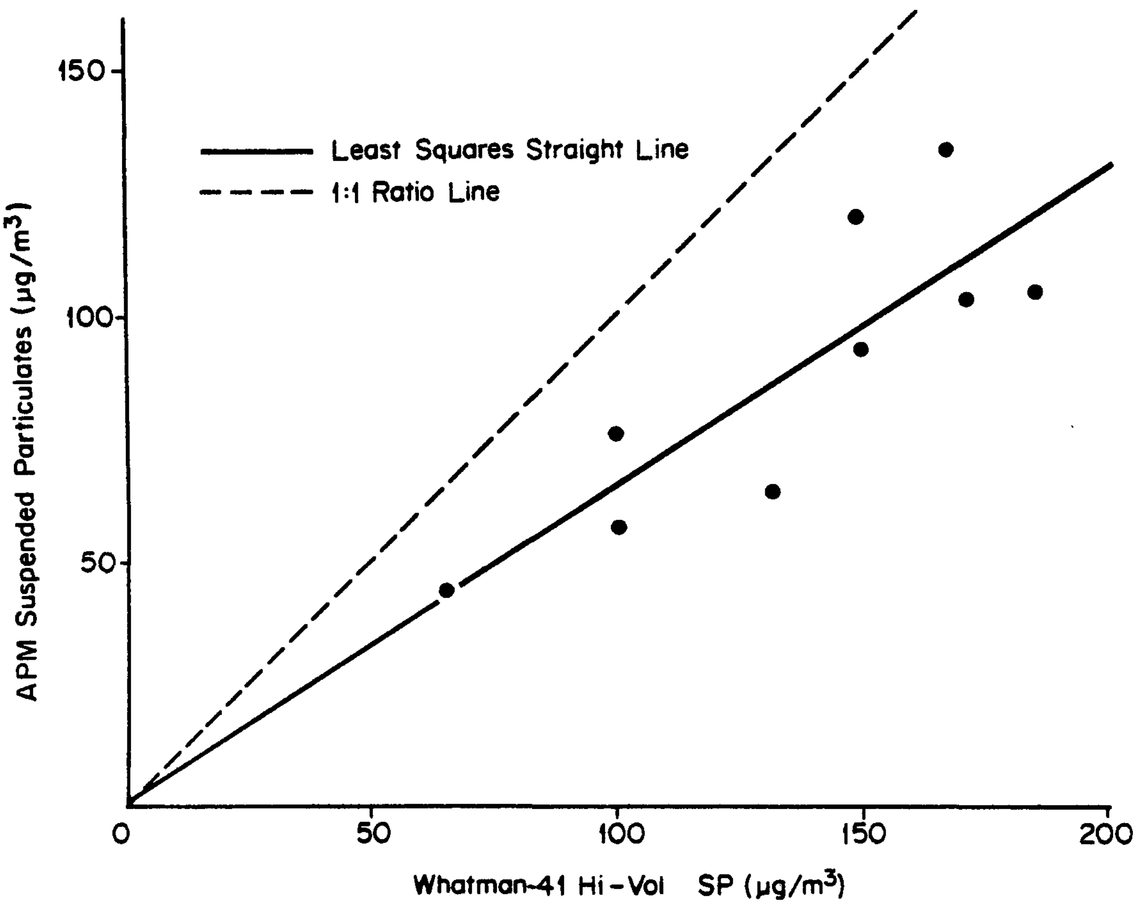


FIGURE 16. COMPARISON OF APM SP TO HI-VOL SP

relationship of their resultant data. It would not be expected that each instrument would measure the particulate air mass in precisely the same manner. The data in Figure 16 permits a comparison to be made between hi-vol (Whatman-41) and APM data. The APM hourly values of suspended particulate concentrations are summed and plotted against the hi-vol SP value for the same 24-hour period. In every case the APM values are lower than the hi-vol values (dotted line represents one-to-one correspondence). The solid line is the least-squares straight line fit to the data. Although the correlation coefficient for fit (R^2) is only 0.70, the intercept of the line is very good. The low R^2 value could be due to the small data set and the compounding of errors in both measurements.

SECTION 7

PARTICULATE SULFUR AND SULFATE

Early project data had indicated that sulfur-containing particulates form a significant percentage of the total particulate aerosol in the Niagara Frontier Air Quality Control Region. The following dichotomous sampler data is presented to define these site-to-site concentrations and variations.

The data in Figure 17 was obtained from the analysis of approximately 720 air filter samples which were collected over an eight month period. Total sulfate from the combination of fine and coarse particulate fractions is expressed as monthly averages. Although annual data is lacking here, the sulfate pattern appears consistent with the general contention that sulfate concentrations are higher during the summer period and lowest during the winter months. The data for total sulfate in Table 6 presents the maxima, minima, and arithmetic averages which were found for each site throughout the course of this investigation.

TABLE 6. TOTAL SULFATE FROM DICHOTOMOUS SAMPLERS ($\mu g/m^3$)

August 1978 through March 1979

	Site No.					
	1	2	3	4	5	6
Maximum	51.0	33.8	57.1*	71.4	68.5	44.3
Minimum	1.0	0.8	0.8	0.8	1.0	1.1
Arith. Avg.	12.1	11.8	10.2	12.2	12.1	7.9

*Represents Fine Particle Fraction Only.

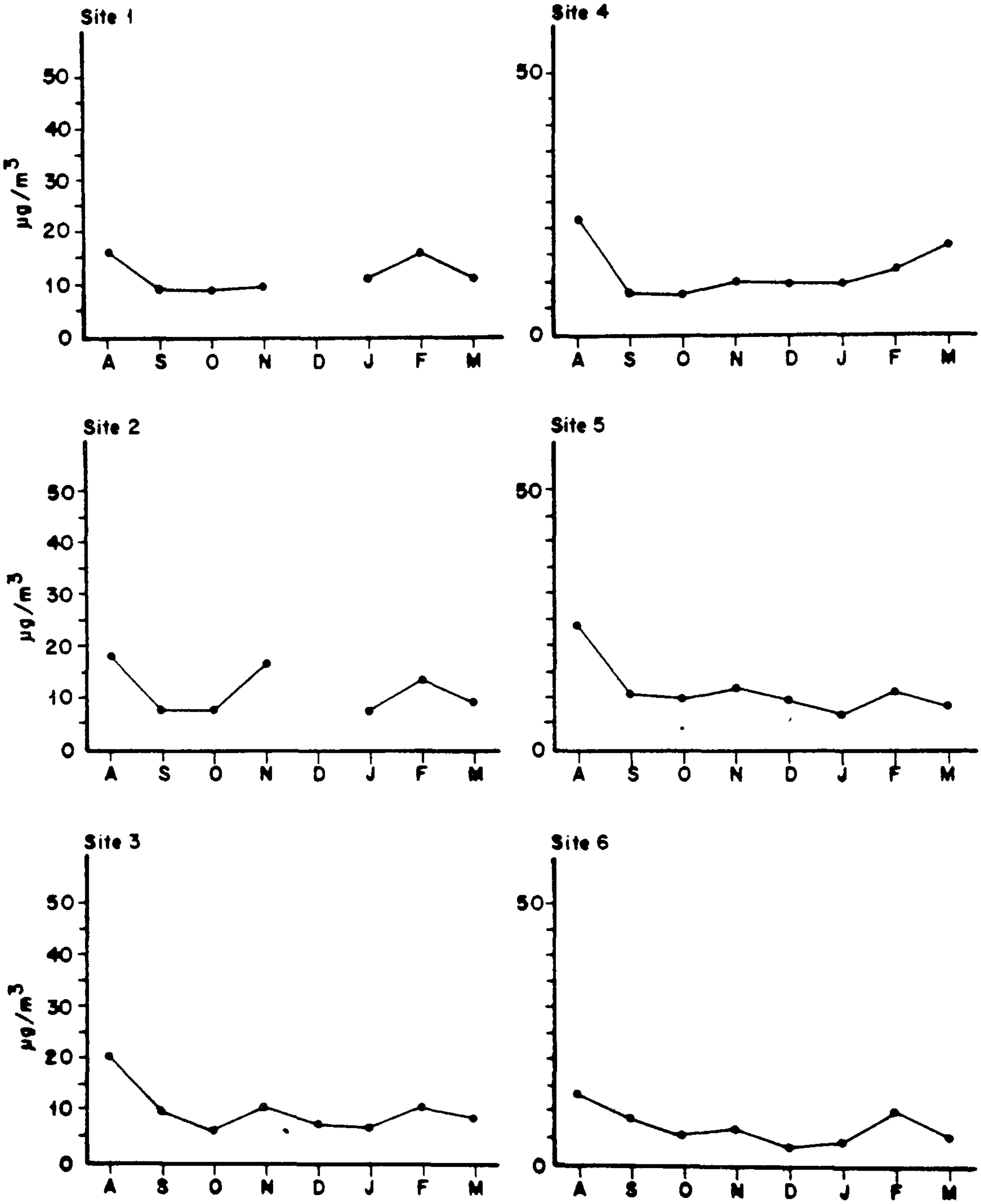


FIGURE 17. TOTAL SULFATE - MONTHLY AVERAGES PER SITE ($\mu g/m^3$)

The minimum sulfate concentrations at each site are fairly constant at 1 $\mu g/m^3$ while the mean of the urban arithmetic averages is 11.7 $\mu g/m^3$. However, the mean sulfate concentration at Site 6 exhibits a slightly lower value of 7.9 $\mu g/m^3$. The singular high sulfate values observed in Table 6 may be associated with particular weather patterns and/or higher than normal particulate loadings and are presented to simply illustrate the high concentrations which were obtained under actual field conditions.

The monthly averages per site for suspended particulates are presented in Figure 18. Trends are displayed for the fine, coarse, and inhalable particulate (fine plus coarse) fractions. A comparison of the sulfate data in Figure 17 with the FSP data in Figure 18 exhibits very good correlation. Upon consideration of the findings in Section 6, it is concluded that a significant percentage of fine particulates arrives from the west from outside of New York State. It is similarly concluded that most (> 75%) of the sulfate material which enters New York State arises from the west beyond Lake Erie. Although the data in Table 6 for Site 6 indicates an annual mean of 7.9 $\mu g/m^3$ for sulfate, this value is 3.8 $\mu g/m^3$ lower than the mean value observed for the urban sites. It is possible that this enhancement of observed sulfate levels at the urban sites may arise from local emission sources within the Buffalo-Lackawanna area. This increase in sulfate represents almost 33% of the observed total sulfate concentrations. It is difficult to explain this sulfate increase with regard to the industrial processes which are located between Lake Erie and the line of field stations.

Additional data in Figure 19 supports the conclusion that much (50-99%) of the sulfur in the particulate aerosol exists in the form of sulfate. In general, all sites exhibit a decline in the sulfate/sulfur percentage during the colder months. The decline in this ratio may be associated with the increased usage

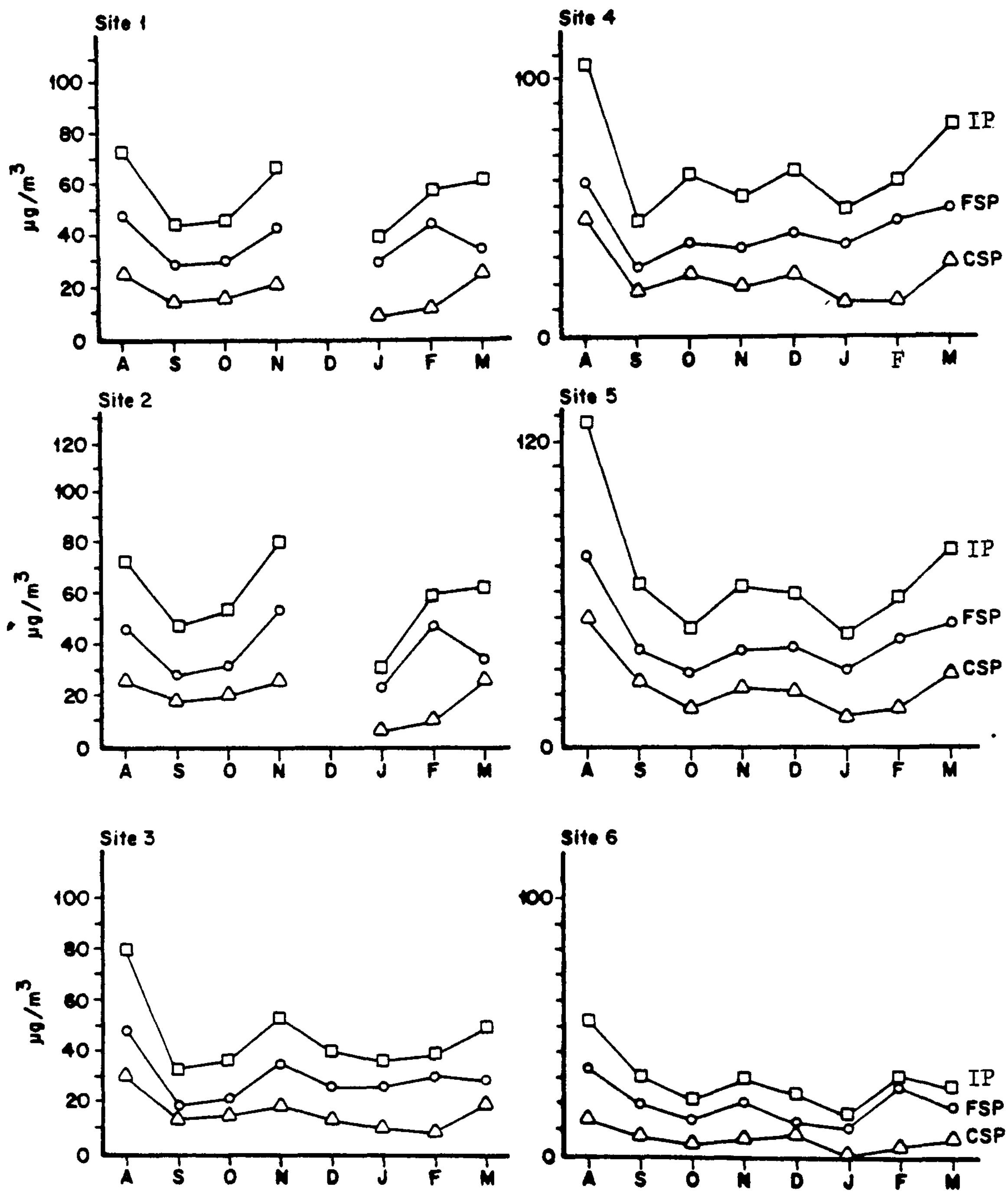


FIGURE 18. DICHOTOMOUS SAMPLER SUSPENDED PARTICULATES - MONTHLY AVERAGES PER SITE (μg/m3)

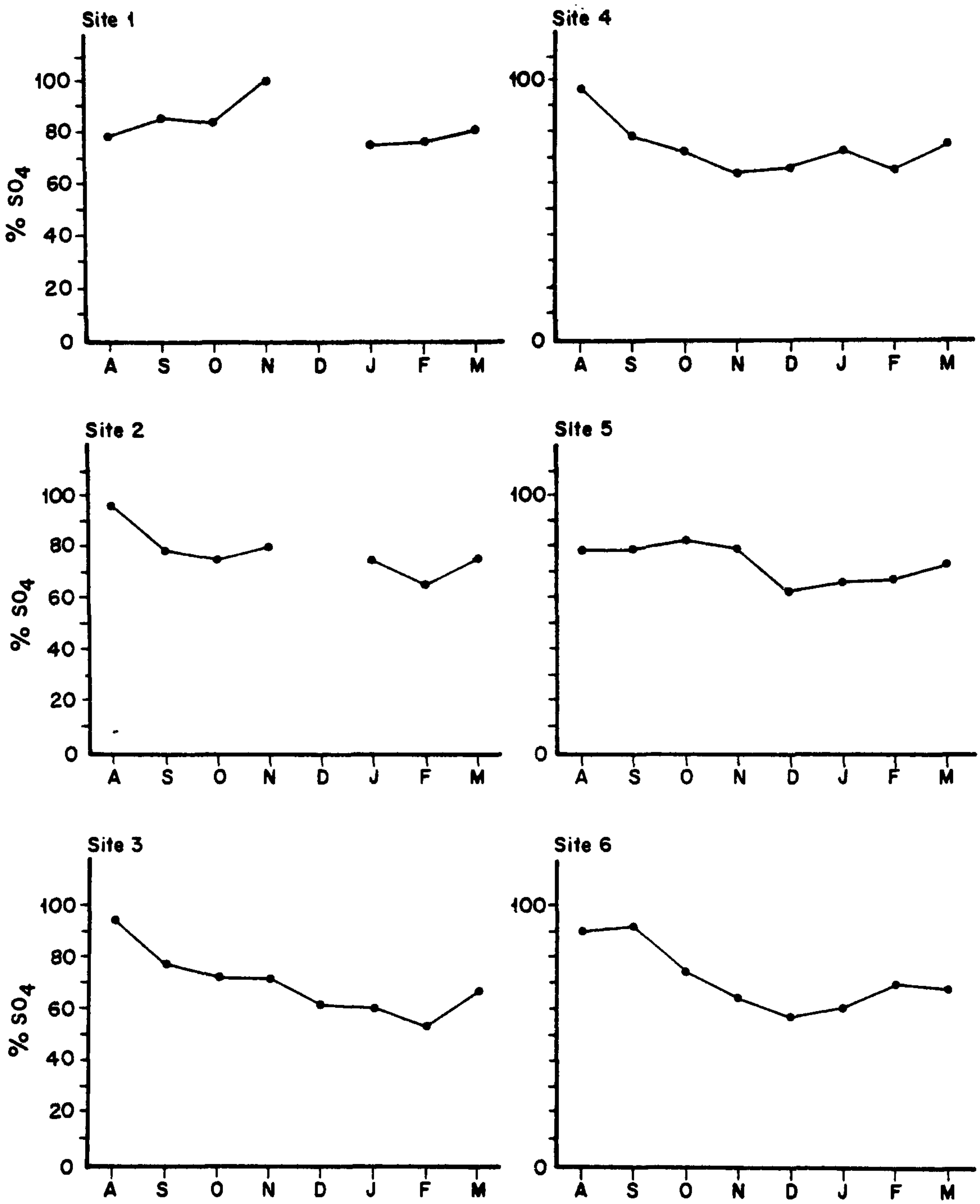


FIGURE 19. SULFATE AS A PERCENT OF TOTAL SULFUR -- MONTHLY AVERAGES PER SITE

of heating fuels and the increased generation of particulates which contain forms of sulfur other than sulfate. The data which is presented in Figure 20 represents fine particulate sulfate which is expressed as a percentage of IP. Fine particulate sulfate is considered here since less than 3% of the total sulfate was ever found to reside in the coarse particulate fraction. The general trends exhibited in Figure 20 show the sulfate percentages to be fairly constant at all six sites throughout the specified eight months. The mean overall sulfate percentage is approximately 18%. From this data it appears that the sulfate component of IP (or TSP) is not significantly affected among the urban sites by heavy industrial operations or heavy vehicular activities. Even the background Site 6 curve is very similar to the urban site data. Such behavior for the sulfate component is more consistent with the long range transport of sulfates into New York State from the predominantly southwesterly winds.

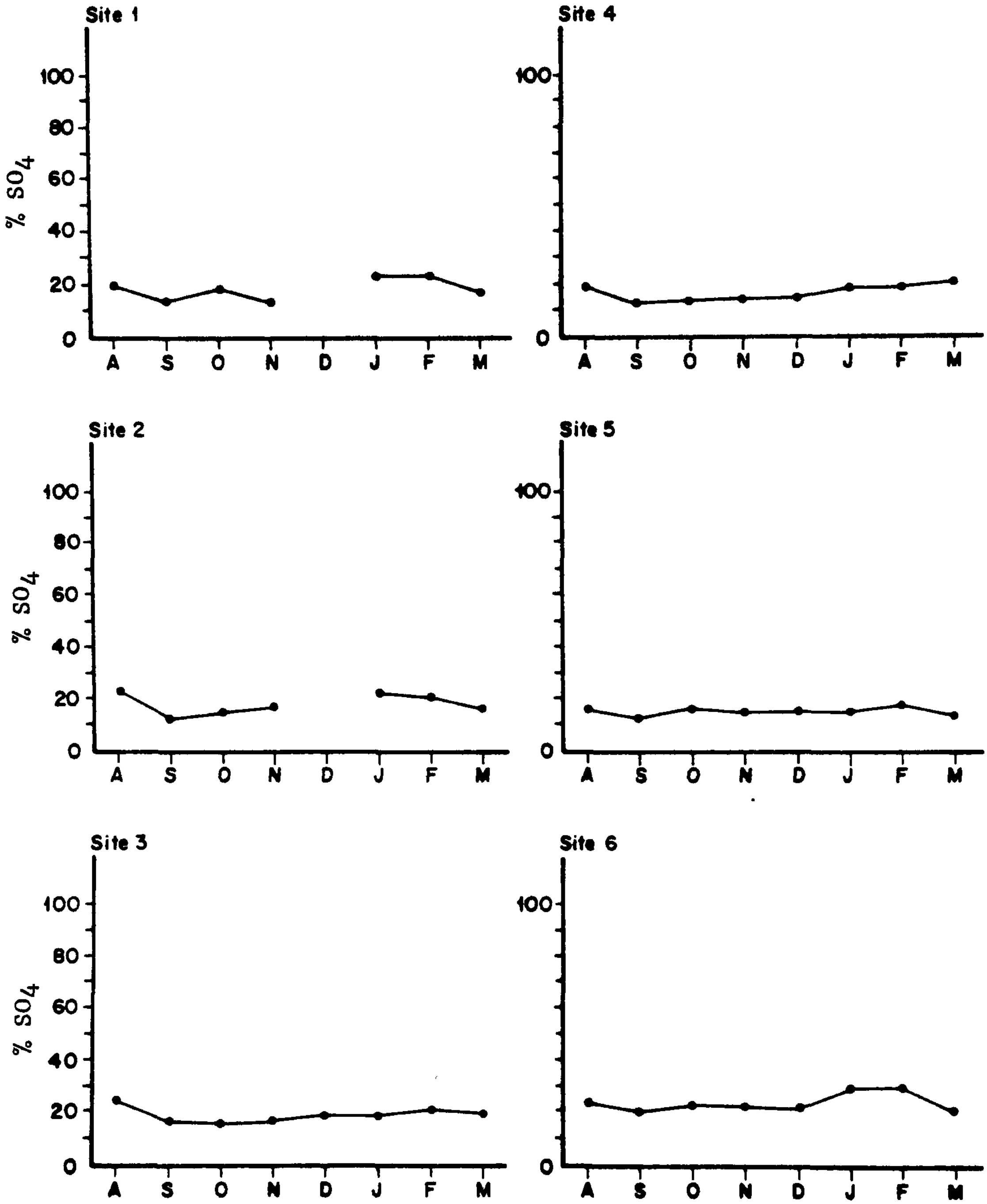


FIGURE 20. FINE PARTICLE SULFATE AS A PERCENT OF IP

SECTION 8

CHEMICAL COMPONENTS - GENERAL OBSERVATIONS

INTRODUCTION

Data in this section will be presented for the various chemical components which were found to occur in the particulate samples as determined by xrf and ion chromatographic methods. The discussion of all components will be limited to overall observations and generalizations. However, more detailed information concerning suspended particulates and sulfates can be found in Sections 6 and 7, respectively.

Average concentrations of the chemical components which were observed from the overall project are shown in Table 7. These values represent the averages for total dichotomous suspended particulates, where initially the individual fine and coarse measurements for each component were summed. Additional information contained in Table 8 represents for each component the percentages of their mean total concentrations which are found in the fine particulate fraction. For example, 81% of the lead at Site 1 was observed in the fine particle fraction. In fact, at all six sites lead is found predominantly in the fine fraction, urban and rural sites being similar. In contrast to lead, only 15-20% of calcium is represented by fine particles at each of the six sites. The large differences which are observed for the various chemical components in their degree of distribution between the two size fractions (fine and coarse) permits one to distinguish among the sources of such materials. The lead particles are mainly fine material and are consistent with automotive-type particle emissions.

TABLE 7. AVERAGE VALUES OF CHEMICAL SPECIES FOR TOTAL DICHOTOMOUS SUSPENDED PARTICULATES

SPECIE	DICHOTOMOUS TOTAL (ng/m^3) Site No. 1	2	3	4	5	6
Pb	844	821	472	860	943	235
Br	1130	988	813	829	845	272
Zn	191	67	58	138	146	22
Ni	12	11	9	11	12	7
Fe	1848	2453	1815	4057	4824	446
Mn	57	89	49	115	104	15
Cr	3	3	2	4	3	1
V	19	13	11	12	15	7
Ca	2170	2521	2153	4032	4089	466
S	5794	5577	5013	5992	5653	3590
Si	7017	7307	6128	6515	6063	4601
Al	1566	1523	1274	1448	1505	1039
F^-	46	52	61	88	123	59
Cl^-	287	315	295	603	745	102
Br^-	58	96	52	79	58	21
NO_2^-	276	374	213	237	320	185
NO_3^-	2162	2273	1195	1732	1603	600
$SO_4^=$	12968	11940	11240	12758	12126	8306
Na^+	474	323	382	712	571	248
K^+	376	403	356	915	1315	194
NH_4^+	5315	5015	3637	3987	3603	2759

TABLE 8. CHEMICAL SPECIES - PERCENTAGE FOUND IN FINE PARTICULATE FRACTION

ELEMENT	SITE NO. 1	2	3	4	5	6
Pb	81	83	75	86	87	82
Br	82	81	78	77	76	69
Zn	90	88	86	89	85	86
Ni	58	45	56	55	58	57
Fe	37	40	35	45	39	36
Mn	53	51	47	61	51	60
Cr	38	47	50	44	47	62
V	82	62	64	58	67	57
Ca	14	14	14	19	15	16
S	88	89	89	88	87	92
Si	26	26	23	24	21	27
Al	36	37	35	40	36	36
F^-	72	73	64	49	37	71
Cl^-	26	48	18	46	59	39
Br^-	88	69	88	57	86	62
NO_2^-	92	94	92	75	87	81
NO_3^-	78	75	54	68	63	38
$SO_4^=$	90	92	92	90	90	93
Na^+	41	51	52	56	63	54
K^+	82	83	88	93	93	87
NH_4^+	95	97	97	98	99	98

The lower value (Table 7) which is observed for lead at Site 6 as compared to the urban sites may be reflective of the differences in vehicular traffic densities. The fact that the Site 3 value is one-half that of all other urban sites is more difficult to explain. The Site 3 station is the tallest (15m) above ground level and sampler height would certainly be expected to have an effect on particulate measurements. However, Sites 1 (10m) and 2 (12m) do not appear to be sufficiently different in height in order to account for the large changes in the observed measurements. The contention here is that height is not an important factor in explaining the lower lead level at Site 3. Further support for this conclusion can be obtained from Table 10 where the percentage of lead in the fine fraction is found to be relatively equal at all urban sites. Certainly industrial lead emissions are possible within this region. However, overall site averages in the urban sector do not indicate a major impact from an industrial point source.

The calcium component appears mainly as large particles (3-15 micrometers diameter). This size classification allows one to conclude that the calcium sources are most likely soil and/or slagging operations. The physical crushing and grinding of slag material associated with steel production is a mechanical process which cannot produce fine particles below 3 microns diameter. Thus, the calcium-containing coarse particulates most likely represent a combination of these two principal sources and it remains for the CEB method and refined chemical profiles to distinguish the actual contributions from either source category.

At all sites the predominant components are silicon, sulfur, calcium, aluminum, and iron, while the corresponding major water soluble materials are sulfate, nitrate, and ammonium ions. This statement is made aside from the fact that carbon, hydrogen, oxygen, and nitrogen were not determined but which certainly form significant percentages of the suspended particulates. Figures 21-26 show site-to-site variations for all measured chemical components as represented by overall project averages of the combined fractions. This data is presented in a different form in terms of "enrichment factors" in Table 9. The site-to-site "enrichment factor" here is obtained as the ratio of the average of the three Buffalo sites to the average for the rural site. Similar treatment was afforded the data from the two Lackawanna stations. These "enrichment factors" help to indicate which of the chemical components result mainly from the urban/industrial environment and which components more likely comprise the general background particulates.

Fluoride at Sites 1 and 2 (Table 7) was the only component which was not enriched above background. The following components in Table 9 showed only moderate enrichments (1.2 - 1.9) --

vanadium	nitrite
nickel	sulfate
sulfur	fluoride (in Lackawanna)
silicon	sodium (in Buffalo)
aluminum	ammonium

On the other hand, the following components exhibited significant enrichments (2.0 - 4.9) --

lead	calcium (in Buffalo)
bromine	chloride (in Buffalo)
zinc (in Buffalo)	bromide
iron (in Buffalo)	nitrate
manganese (in Buffalo)	potassium (in Buffalo)
chromium	

TABLE 9. ENRICHMENT FACTORS FOR CHEMICAL COMPONENTS

SPECIES	Buffalo	Lackawanna
Pb	3.3	4.1
Br	4.1	3.4
Zn	4.9	6.5
Ni	1.5	1.6
Fe	4.7	11.6
Mn	3.7	6.9
Cr	2.4	2.8
V	1.9	1.8
Ca	4.3	9.2
S	1.5	1.5
Si	1.4	1.2
Al	1.4	1.5
F^-	0.9	1.8
Cl^-	2.9	6.6
Br^-	3.3	3.3
NO_2^-	1.6	1.5
NO_3^-	3.1	2.8
$SO_4^=$	1.4	1.5
Na^+	1.6	2.6
K^+	2.0	5.7
NH_4^+	1.7	1.4

TABLE 10. CHEMICAL SPECIES - PERCENTAGE COMPOSITION OF FINE AND COARSE PARTICLE FRACTIONS

	FINE						COARSE					
	1	2	3	4	5	6	1	2	3	4	5	6
Pb	1.68	1.63	1.62	1.69	1.77	0.81	0.81	0.64	0.63	0.45	0.45	0.46
Br	2.27	1.92	1.87	1.47	1.38	0.79	1.04	0.86	0.94	0.70	0.75	0.90
Zn	0.42	0.14	0.15	0.28	0.27	0.08	0.10	0.04	0.04	0.06	0.08	0.03
Ni	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03
Fe	1.69	2.34	1.89	4.21	4.08	0.69	5.79	6.61	6.20	8.40	10.94	3.02
Mn	0.07	0.11	0.07	0.16	0.11	0.04	0.13	0.20	0.14	0.17	0.19	0.06
Cr	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01
V	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Ca	0.76	0.83	0.86	1.72	1.32	0.31	9.26	9.72	9.85	12.42	13.01	4.17
S	12.60	11.95	13.10	12.01	10.58	13.99	3.43	2.72	2.88	2.82	2.71	3.09
Si	4.51	4.60	4.15	3.63	2.73	5.26	25.83	24.10	24.95	18.67	17.95	35.73
Al	1.38	1.36	1.32	1.33	1.15	1.60	5.01	4.28	4.37	3.28	3.62	7.04
F^-	0.08	0.09	0.11	0.10	0.10	0.18	0.06	0.06	0.12	0.17	0.29	0.18
Cl^-	0.18	0.36	0.16	0.64	0.95	0.17	1.06	0.74	1.28	1.22	1.13	0.66
Br^-	0.13	0.16	0.13	0.10	0.11	0.06	0.03	0.13	0.03	0.13	0.03	0.09
NO_2^-	0.62	0.84	0.58	0.41	0.59	0.64	0.11	0.11	0.08	0.23	0.16	0.37
NO_3^-	4.15	4.10	1.90	2.69	2.17	0.95	2.40	2.55	2.90	2.11	2.21	3.99
$SO_4^=$	28.83	26.43	30.28	26.27	23.35	32.86	6.43	4.33	4.85	4.84	4.67	5.86
Na^+	0.47	0.40	0.59	0.92	0.77	0.57	1.40	0.71	0.96	1.18	0.79	1.21
K^+	0.76	0.81	0.91	1.94	2.62	0.72	0.34	0.30	0.23	0.26	0.34	0.27
NH_4^+	12.51	11.76	10.36	8.97	7.62	11.42	1.23	0.60	0.55	0.26	0.19	0.69

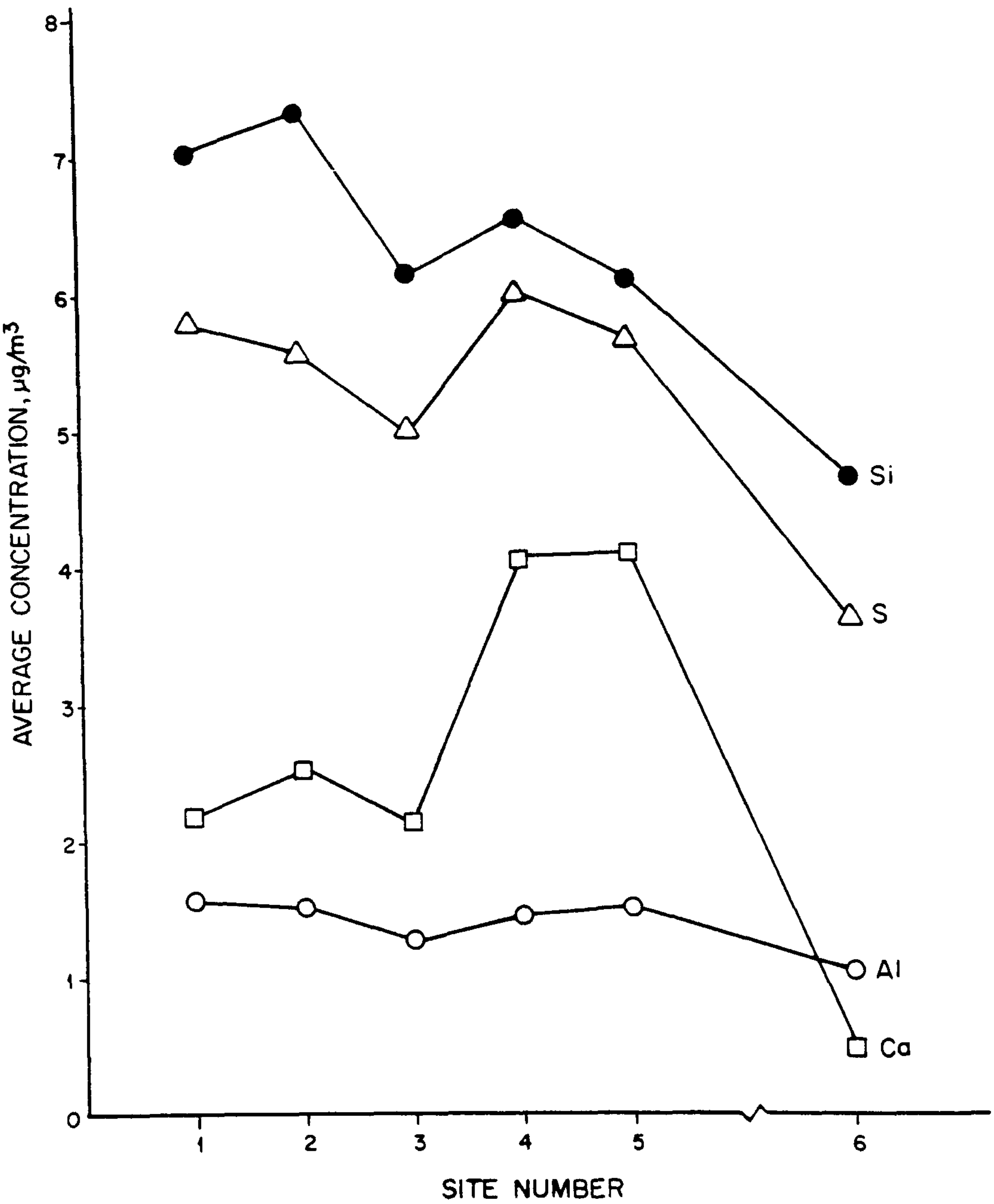


FIGURE 21. SITE VARIATIONS FOR SILICON, SULFUR, ALUMINUM, AND CALCIUM.

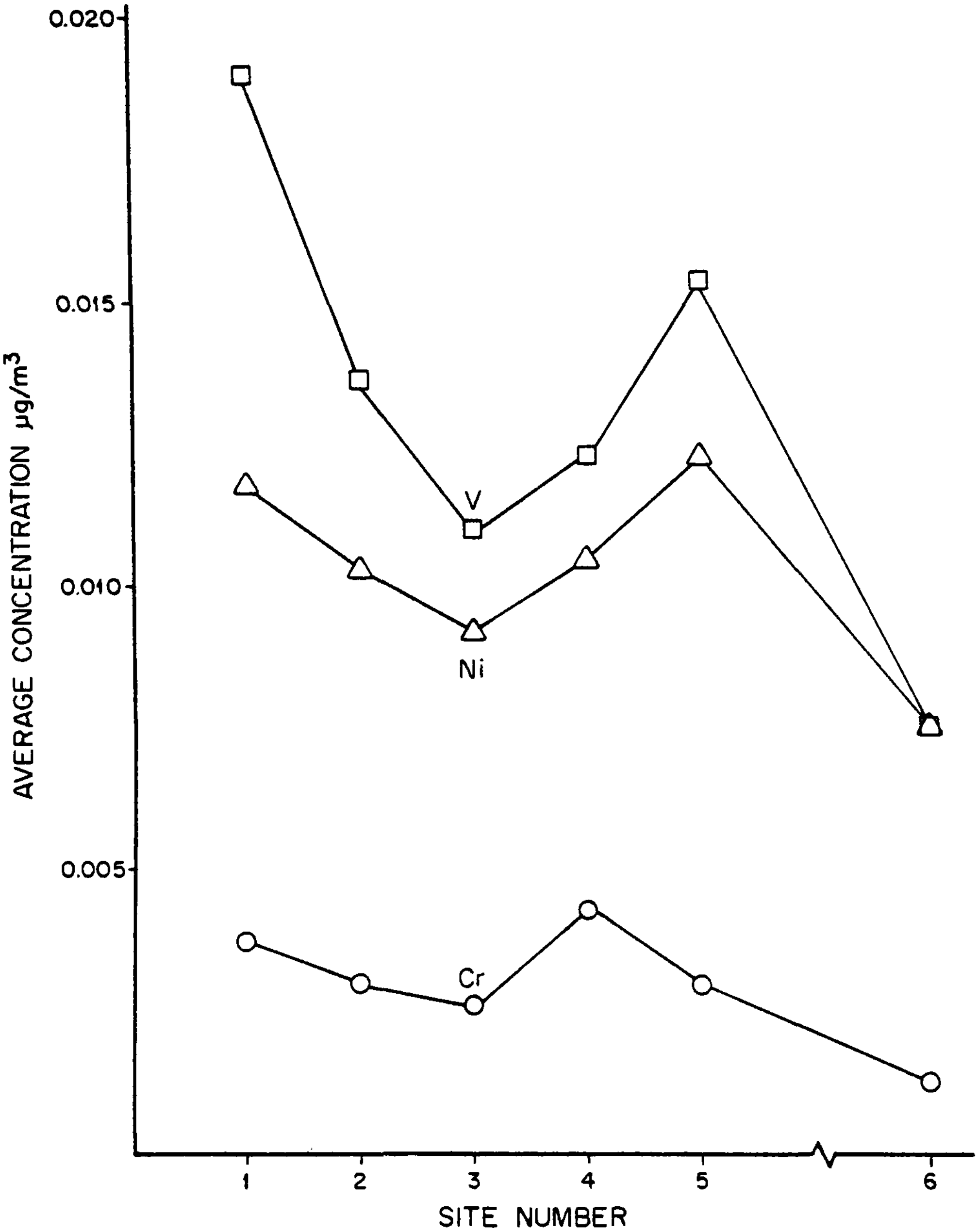


FIGURE 22. SITE VARIATIONS FOR CHROMIUM, VANADIUM, AND NICKEL.

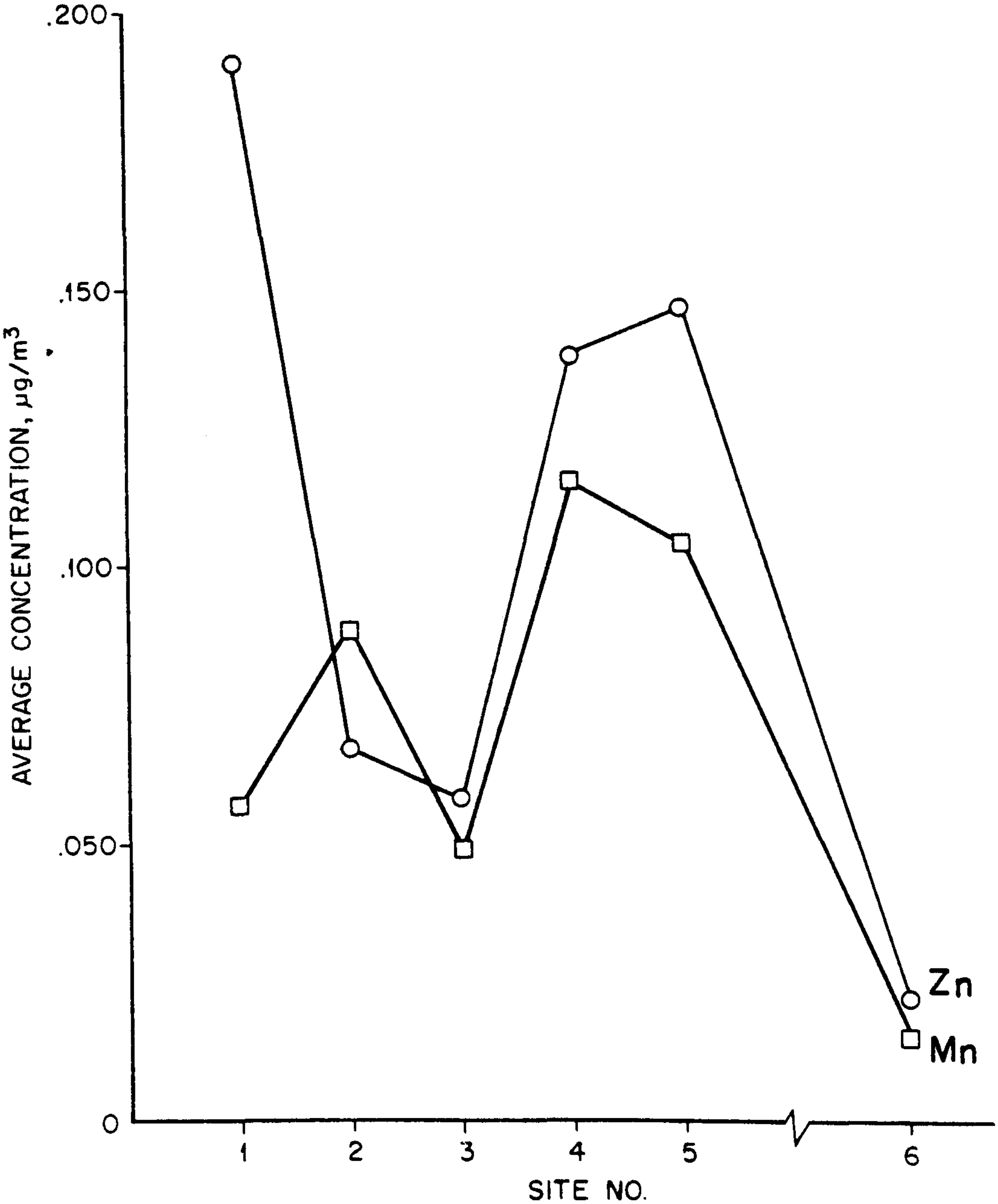


FIGURE 23. SITE VARIATIONS FOR ZINC AND MANGANESE.

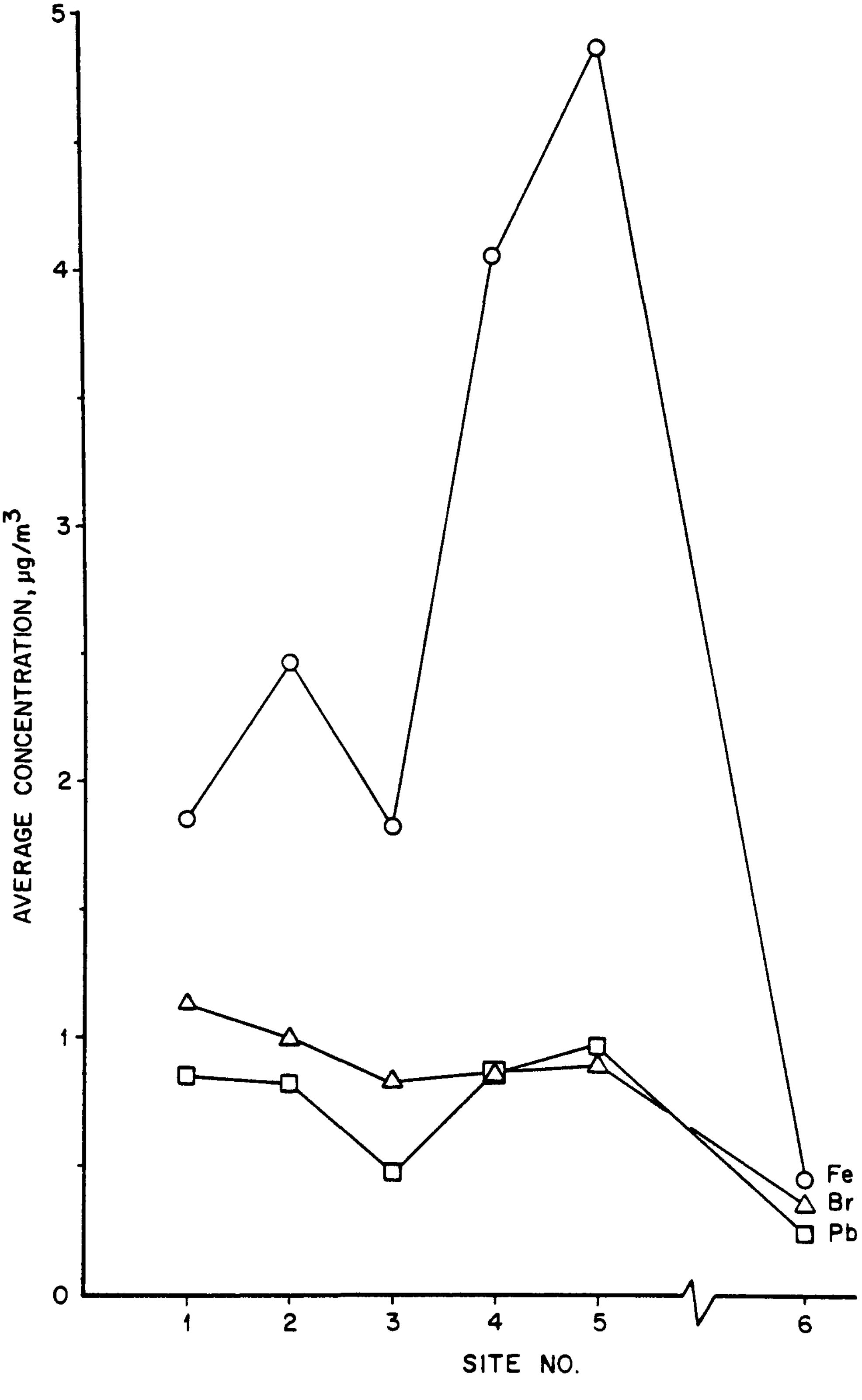


FIGURE 24. SITE VARIATIONS FOR IRON, LEAD, AND BROMINE.

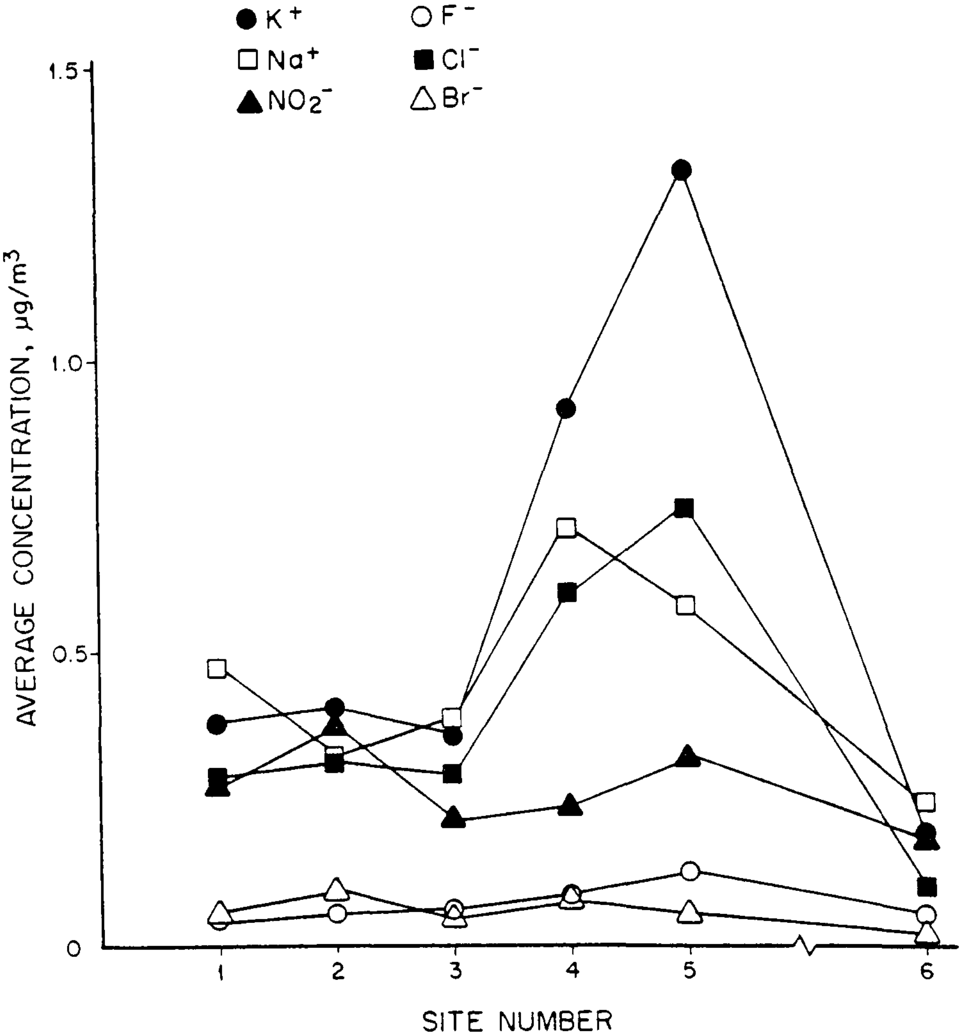


FIGURE 25. SITE VARIATIONS FOR SODIUM, POTASSIUM, NITRITE, AND HALIDES.

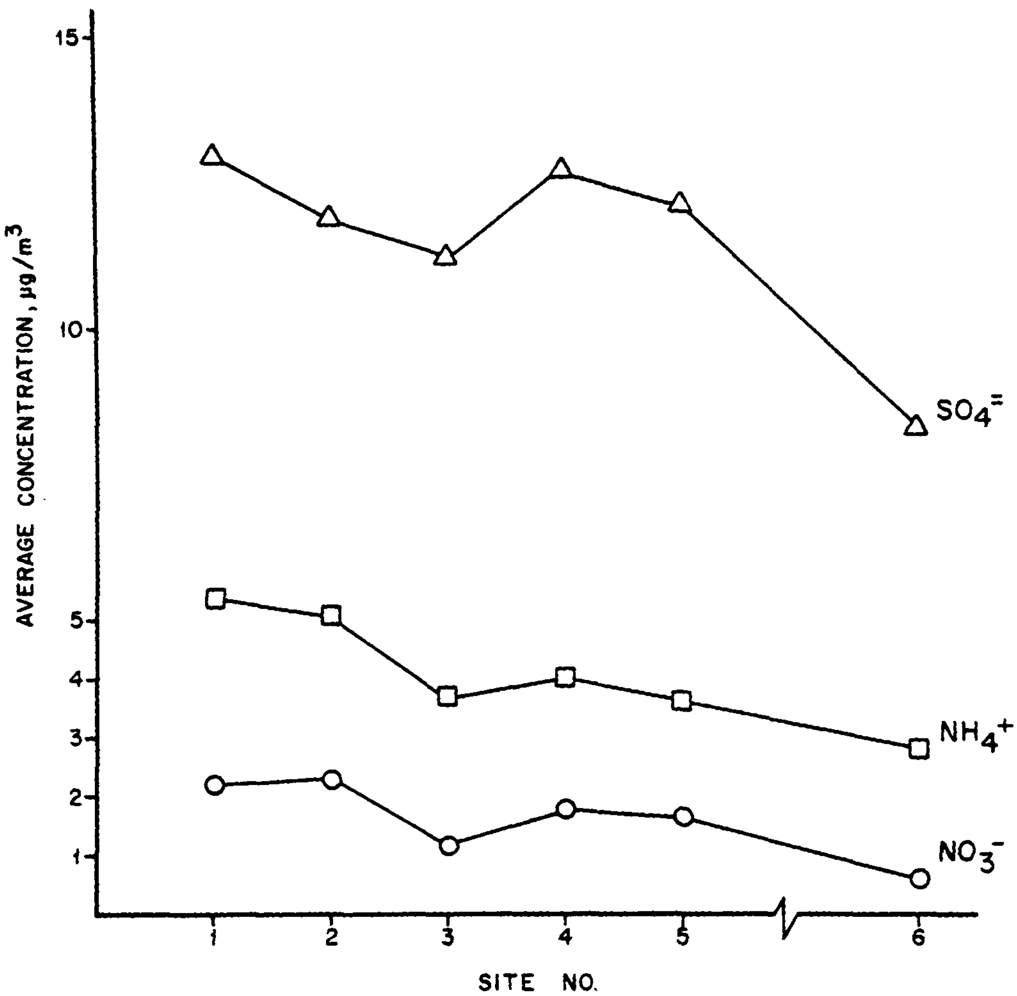


FIGURE 26. SITE VARIATIONS FOR SULFATE, AMMONIUM, AND NITRATE.

Very high "enrichment factors" were observed in Lackawanna for iron (11.6), calcium (9.2), manganese (6.9), chloride (6.6), zinc (6.5), and potassium (5.7). It appears that all six of these components can be related to the production of steel. In the interpretation of this data, one should be aware that high "enrichment factors" are not necessarily indicative of high contributions to the overall observed TSP from emissions from a single source. However, the chemical species with the largest "enrichment factors" will serve as chemical indicators of the source categories which contribute to the TSP levels observed at the downwind sites.

Additional information is presented in Table 10 to show the percentage contribution for each species to the suspended particulate concentration for both fine and coarse fractions. It should be kept in mind that most of the chemical components are not found in pure form but rather as compounds such as oxides, sulfides, carbonates, etc. When such anions are considered with their cation counterparts, the overall percentage contributions to observed TSP are much greater than the data in Table 10. As an example, if silicon is present as common sand (SiO_2), the values in Table 10 must be multiplied by 2.14. If calcium were present as the simple oxide (CaO), the calcium values in Table 10 would be multiplied by 1.4.

LIGHT ELEMENTS (Al, Si, S, Ca)

These four elements constitute individually and collectively the major proportion of the coarse particulate fraction; and individually (for sulfur and silicon) and collectively they comprise the major proportion of fine particulates Their distributions vary considerably between the fine and coarse fractions as shown in Tables 8 and 10.

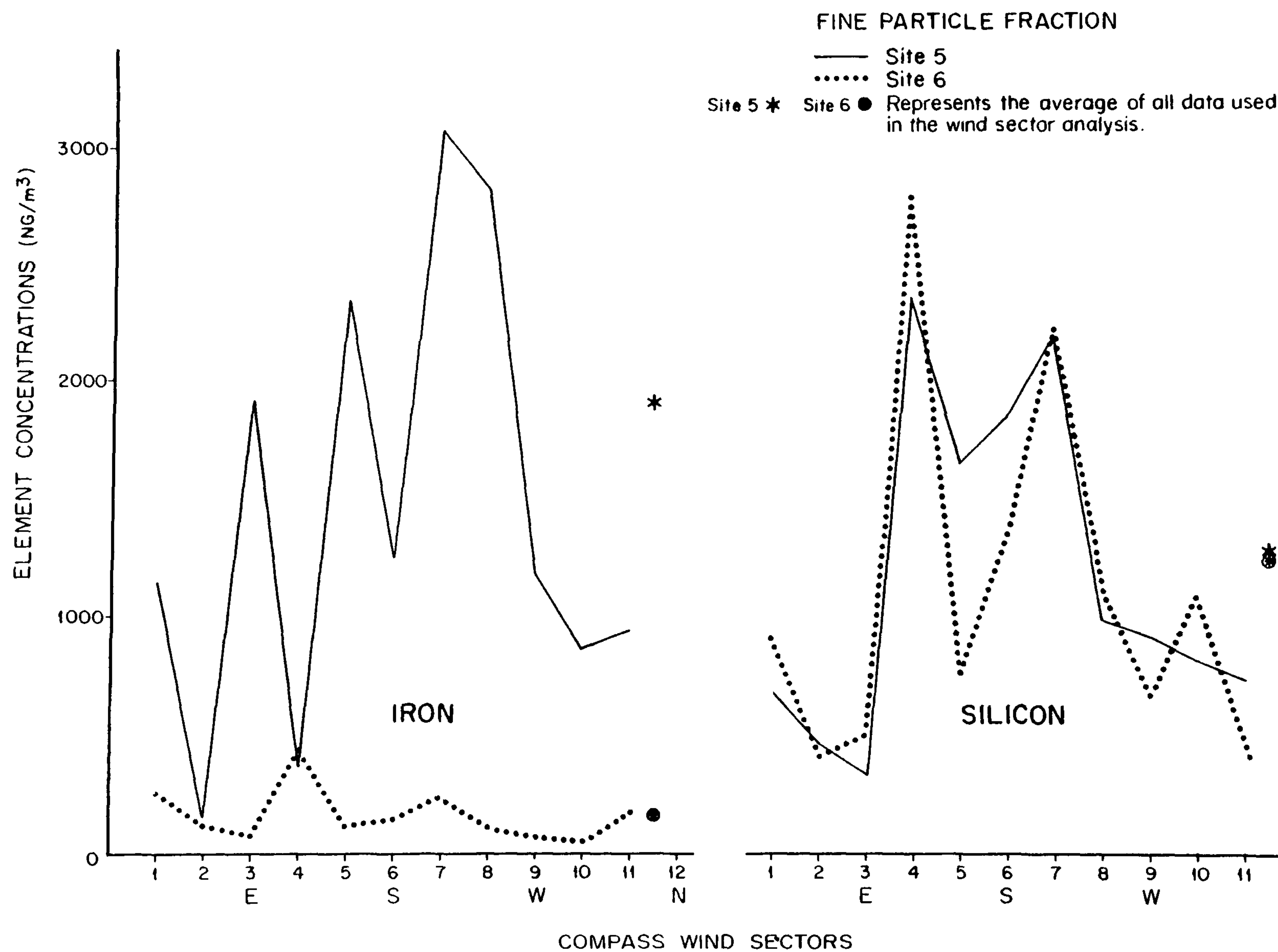
Aluminum

Aluminum varies little among all six sites (Figure 21). Although aluminum exhibits a lower concentration at Site 6 (Table 7), it constitutes a larger percentage of the TSP (Table 10) than at the urban sites, especially evident in the coarse fraction. The reasonably constant concentration of aluminum at the urban sites and its low "enrichment factor" over background suggest that its source is predominantly soil.

Silicon

Silicon is the only chemical component except bromine which is more abundant at Sites 1 and 2 than at Sites 4 and 5 (Figure 21). This observed trend is difficult to explain as anything more than an increased soil contribution to the TSP since a projected source such as cement or slag would also have elevated the calcium levels. The enrichment of silicon above background for the urban sites is only 1.4, far lower than for most other components.

By sorting the silicon data for Sites 5 and 6 into twelve wind sectors (each 30^{o} in width) and plotting each sector average concentration, one can overlay the results for both sites as in Figure 27. The information gathered throughout the entire project shows a striking similarity (Figure 27) between actual silicon concentrations for the urban station (Site 5) receiving the greatest TSP loading and the rural station (Site 6) receiving the least. The asterisks in Figure 27 represent the project's average concentration for that site. The silicon trends at Sites 5 and 6 overlap to such a degree that it is difficult to visualize any significant contribution to silicon at Site 5 from industrial operations. This data suggests that the single major source of silicon is soil. This fact is extended to all sites since the average silicon values found in Table 7 appear to increase in the direction of increasing traffic density. It is possible that the increased levels of silicon as one proceeds from Site 6 to Site 1 may result from reentrainment due to the increase in vehicular activity. While it is certain that the steel industry contributes


FINE PARTICLE FRACTION
Site 5
Site 6
Site 5 * Site 6 ● Represents the average of all data used in the wind sector analysis.
ELEMENT CONCENTRATIONS (NG/m3)
3000
2000
1000
0
IRON
SILICON
1 2 3 4 5 6 7 8 9 10 11 12
E S W N
COMPASS WIND SECTORS

to silicon emissions, any major impact among the urban sites is not evident. All of the preceeding analysis is in contrast with the iron data which is presented in similar fashion in Figure 27. The site average data (asterisks) for Sites 5 and 6 differ by a factor of 12 for iron and a factor of unity for silicon. The iron concentrations at Site 5 bear little resemblance to that for Site 6 and are indicative of sources of iron other than soil.

Sulfur

Sulfur is by far the largest single contributor to the fine particle fraction if one does not consider the light elements (carbon, hydrogen, oxygen, and nitrogen). Approximately 88% of the total observed sulfur is found in the fine fraction were it constitutes about 12% (Table 10) of the FSP fraction at the urban sites and 14% at the rural station. In the coarse particle fraction, sulfur comprises 3% of the CSP at all sites. Site-to-site variations (Figure 21) for sulfur within the urban area are relatively minor and the enrichment factor is only 1.5. These observations suggest that sulfur is not strongly associated with a point source and that most of it is not generated locally.

Furthermore, most of the sulfur at all six sites is present as sulfate. The percentage ranges from 71% at Site 4 to 77% at Site 6, with an urban average of 73%. The lower urban percentage could be affected by non-sulfate sulfur arising from coking or other sources.

Calcium

Calcium possesses the second highest enrichment factor after iron and surpasses iron in its percentage contribution to the IP concentration. The site-to-site calcium variations (Figure 21) are found to be very similar to that for iron (Figure 24). Because of the high enrichment of calcium, especially at Lackawanna (9.2), and its large mass contribution to the TSP, analysis was extended to determine the nature of its source(s).

Calcium is found to comprise approximately 85% of the CSP fraction. The observed concentrations of calcium at the two Lackawanna sites are about nine times greater than those at the rural site and twice those measured at the three Buffalo sites. For Sites 4 and 5, a subset of the entire data base was produced which included sixteen individual field runs containing the ten greatest calcium concentrations in the CSP fraction. This data subset simultaneously included 80% of the ten highest concentrations which were observed at the three Buffalo sites. While Sites 4 and 5 essentially had equal calcium levels (project average), usually large differences were observed between the sites on a single day. The correlation coefficient for calcium from this data was only 0.14 between the two sites. This result was unexpected since the two sites are only about one kilometer apart and possess similar overall levels for most of the chemical components.

This data suggests for calcium that (1) a single major source is so close to the sites that small variations in wind direction have enormous effects on observed downwind concentrations, or (2) there are several major sources nearby. When the concentration of calcium at Site 4 is significantly higher (>200%) than at Site 5 in this data subset, the observed ratios of Ca/Fe and Ca/Mn are greater at Site 4 than at Site 5. When the reverse occurs where calcium at Site 5 is about 200% greater than at Site 4, the observed Ca/Fe and Ca/Mn ratios become larger at Site 5. In general, calcium was not found to correlate well with iron, manganese, or silicon at Sites 4 and 5. However, subsets of the data can be found which exhibit high calcium-iron and calcium-manganese correlations, suggesting that such calcium may originate from slag. It appears that the highest calcium concentrations which were observed at Sites 4 and 5 may include emissions from the lime plant (steel production) which would account for the selective enrichment of calcium.

A summary of this data suggests that there are at least two major calcium sources contributing to the TSP which are located in close proximity to the two Lackawanna sites. The two most probable sources for coarse-particle calcium are operations which involve the production of lime and the processing of slag. Fine-particle calcium may arise from coking and furnace (steel) dust emissions.

TRANSITION METALS (V, Cr, Mn, Ni, Zn, Fe)

Of the measured transition metals, only iron is a significant contributor to TSP. Manganese and zinc offer minor contributions while the remaining transition metal components are negligible in terms of absolute ambient concentrations. However, each of these metals is regarded as important indicators of emission source categories. Manganese, iron, and zinc were found to be substantially enhanced at all urban sites while chromium, vanadium, and nickel exhibited only slight increases in concentration.

Vanadium

Vanadium (Figure 22) appeared rather irregularly at all sites but seldom at levels above 0.02 $\mu g/m^3$, except at Sites 1 and 5. Site averages from the overall project lie in the range 0.01 - 0.02 $\mu g/m^3$ with Site 6 being much lower. Vanadium constitutes approximately 2.5% by weight of particulates arising from the combustion of fuel oil. Thus, fuel oil is believed to be the single major source for this metal based on the current understanding of industrial processes and emissions in the Niagara Frontier. While very low in absolute concentration, vanadium later serves as an excellent marker or "tracer" in the CEB resolution of the major source categories.

Chromium

Concentrations of chromium (Figure 22) were usually less than 0.001 $\mu g/m^3$ at all sites and there is little net contribution to TSP. While chromium would appear to be associated with the production of steel, such data is currently lacking. For the moment chromium appears to provide little usable information in distinguishing among contributing source categories.

Manganese

Manganese and iron display similar site-to-site variations (Figures 23 and 24) and a high linear correlation exists among the urban sites. Although manganese peaks at Site 4, iron is found to peak at Site 5. The concentrations for both metals at the Lackawanna sites are about double those observed at the Buffalo sites. The high levels of both manganese and iron are presently associated with the production of steel. Any contribution of automotive manganese from gasoline additives would be expected to provide higher observed levels in areas of higher traffic densities (Sites 1-3). Since this effect was not evident, it is felt that automotive manganese offers a negligible contribution to observed concentrations of the metal.

Nickel

Nickel is found at very low levels at all sites (Figure 22). Although the urban site concentrations are 50% above background, the urban site levels do not vary much among themselves. The source of most of the observed nickel is believed to be particulates from the combustion of fuel oil.

Zinc

Zinc levels are unusual in that site-to-site variations (Figure 23) are very similar to trends which are characteristic of iron, calcium, and manganese, except that a second peak exists at Site 1. Zinc is the only metal* for which the highest average value appears at Site 1. Ninety percent of the zinc observed at Site 1 appears in the fine particle fraction and with elevated bromine, could indicate that automotive exhaust is the main source. However, further examination of the data on a day-to-day basis indicates little correlation between bromine

*Non-metals such as bromine, sulfate, and ammonium also show peak values at Site 1 (Figures 24 and 26).

and zinc. Wind direction data also indicates that the source of zinc differs from that for bromine. Combined wind direction data for Sites 1 and 2 suggest that the zinc source lies in a region which is currently used for coke and steel production in Buffalo.

Iron

Because steel production is the predominant industrial activity in the study area, iron has become one of the most interesting elements in this investigation. Iron has been found to exhibit the largest site-to-site enrichment factor of all chemical components. Both Lackawanna sites show an average enrichment factor of 11.6 above background and total iron concentrations (project average) of 4.4 $\mu g/m^3$. The data in Figure 24 presents the average project concentrations which were observed for each site and clearly indicates that strong local sources affect the urban sites, especially Sites 4 and 5. The average enrichment factor observed at Sites 1, 2, and 3 in Buffalo, although subdued when compared to Lackawanna, is still high at 4.7.

The effects of 24-hr resultant wind direction upon observed concentrations of iron were studied to gain information on the geographic locations of potential source contributors. For the moment this analysis is confined to the fine iron particulates since it is this fraction which most likely will be transported throughout the study area. Information is presented in Figure 27 for Site 5 which shows average iron concentrations observed for each 30° wind sector. Site 6 data is similarly displayed for reference. Such data is summarized in Table 11 where the actual compass directions pointing to the steel facilities are tabulated for each site to permit comparisons with the observed data. The wind directions, which were observed during periods when iron concentrations were high, are represented very well by those wind sectors

TABLE 11. WIND DIRECTION OBSERVED FOR HIGH IRON CONCENTRATIONS

SITE NO.	WIND DIRECTIONS* FOR IRON CONCENTRATIONS		COMPASS DIRECTION* TO STEEL FACILITIES	
	$>2 \mu g/m^3$	10 highest	Bethlehem	Republic
1	208-234 (4)**	208-234	180-210	205-230
2	208-277 (7)	208-277***	185-225	265-300
3	223-230 (2) 320 (1)	217-230 (9) 320 (1)	190-235	305-320
4	192-247 (16)†	192-235†	170-290	355-10
5	193-274 (25)††	193-274	180-310	355-5

* In degrees, north = 0°, east = 90°, etc.

** Values in ( ) indicate number of observations.

*** Also one reading at 18°.

† Also one reading at 37°.

†† Also one reading each at 37°, 75°, 103°, 150°.

that traverse the steel facilities with respect to each station. The data for Sites 1, 2, and 3 are particularly interesting since there are two potential iron sources which can impact within this area. For Site 1, the ten highest iron concentrations all occurred within a narrow wind sector (208° - 234°). These observations appear to indicate emissions emanating from Republic Steel. Only one or two of these readings possess a reasonable probability of involving emissions which originate from Bethlehem Steel. Because of its location, Site 2 presents a more dramatic distinction in the emissions arising from the two steel complexes. Two separate wind sectors are observed for high iron levels - 208°-223° and 230°-277° which represent the general locations of Bethlehem Steel and Republic Steel, respectively.

At Site 3, nine of the ten highest iron concentrations lay in the 217°-234° sector where Bethlehem Steel is upwind. However, the tenth observation, representing the third highest concentration, possessed a wind direction of 320° and arose from the general direction of Republic Steel.

When the analysis of iron concentrations is now limited to values greater than 2 $\mu g/m^3$, fifteen of sixteen observations (Table 11) for Site 4 fall into the 192°-247° sector and point toward Bethlehem Steel. The sixteenth value (37°) may involve emissions from Republic Steel, the nearby slag operation, or from the rail yards. A similar analysis at Site 5 shows that 21 of 25 observations lay in the compass sector 193°-274° when iron exceeded 2 $\mu g/m^3$. Bethlehem Steel is found upwind of this sector. Similarly, high readings (Table 11) were obtained for directions represented by 37°, 75°, 103°, and 150°. These data fall into the first five wind sectors displayed in Figure 27 and represent the first three peaks, each with an easterly component. This data points to the nearby rail yards and may involve the scrap iron plant which borders the southern edge of Site 5. One should not totally rule out a reentrainment component of iron particulates arising from steel emissions which are constantly transported into this area by the predominant southwesterly winds.

Further evidence in support of iron emissions which originate from the steel industry is provided from a comparison of iron and manganese in the fine particle fraction at Site 5. To avoid the uncertainties associated with low levels of manganese, only those days in which iron concentrations exceeded 1 $\mu g/m^3$ (38 out of 66 total observations) are considered. The least squares regression line for iron and manganese revealed a 0.81 correlation coefficient. For iron levels below 3 $\mu g/m^3$, the Mn/Fe ratio is consistently lower than when iron exceeds 3 $\mu g/m^3$. This information may describe the situation where a portion of the iron that is contributed by non-steel emission sources is depleted in manganese relative to the iron from steel. Iron is certainly prevalent in soil and such a general source is expected to impact on the sites throughout this region. Hopefully a more advanced analysis involving the CEB approach may better utilize such subtle differences in the chemistry of particulates to distinguish the relative contribution from major emission sources.

<u>Lead and Bromine</u>

Lead and bromine are two elements which are normally associated with automotive emissions. Both of these elements are consistently present at all sites (Figure 24) and found mainly in the fine particulate fraction (Pb, 82%; Br, 77%). Site-to-site variations were generally small among the urban stations with Site 3 having the lowest averages. Enrichment factors for both components ranged three to four.

The ratios of bromine/lead were examined but found to be far too high when compared to literature values (.15-.40) for automotive exhaust. It appears that the bromine values, not lead, have been overestimated during sample analysis.

This condition may have been caused by a deterioration of the bromine xrf standards. While the absolute bromine values reported here may be incorrect, the relative values are still indicative of meaningful trends. Fine particulate bromine is enhanced a factor of 5 at Site 1 which is adjacent to the New York State Thruway. Meteorological data help to show that both bromine and lead concentrations are elevated when Site 1 is downwind from the New York State Thruway.

Fine particulate lead peaks at Site 1 and is believed to originate mainly from automotive traffic. However, lead similarly peaks at Site 5 while there is no corresponding increase in bromine. A similar trend is witnessed for Site 4. Sites 4 and 5 together could indicate lead emissions arising from the steel industry where the metal is added at times to reduce brittleness.

ION CHROMATOGRAPHIC DATA

Introduction

Ion chromatographic data appears in Tables 7, 8, 9, and 10, and represent only those portions of each component which are water soluble. The general procedures involved in the measurement of the ten ionic components has been previously described in Section 5.

Sodium

Sodium generally constitutes less than 1% of the total dichotomous suspended particulate weight (Table 10) with 53% residing in the fine particle fraction. The enrichment factors are 1.6 for Buffalo and 2.6 for Lackawanna. Sodium levels peak at Site 4 (Figure 25) and are essentially constant at the Buffalo sites. For the moment sodium has no readily identifiable source other than as a roadway deicing agent.

Potassium

Potassium displays a behavior which is quite different from that for sodium.

The enrichment factor for potassium is 2.0 for Buffalo, reasonably similar to the 1.6 observed for sodium. However, for Lackawanna the potassium enrichment jumps to 5.7. Potassium exists primarily as small particulates at all sites where 82-93% (Table 8) is found in the fine particle fraction. Levels of potassium rise sharply at Sites 4 and 5 (Figure 25) where it represents approximately 2% of the dichotomous IP. The Buffalo sites exhibit small variations at much lower levels. Although limestone is known to contain small amounts of potassium, the exact source for most of this metal is currently unknown. It should be noted that variations in chloride concentrations (Table 7 and Figure 25) are similar to the trend observed for potassium. It is not known from this data whether potassium and chloride exist as a single compound, potassium chloride, but the individual components do possess similar enrichment factors (Table 9) at identical sites. Potassium chloride can be used as a flux in some high temperature operations but its possible use in steel production is unknown at this time.

Ammonium

Ammonium ion comprises about 10% of the fine particulate weight at all sites and is the second largest contributor to the measured water-soluble components. Modest enrichment factors are observed for Buffalo (1.7) and Lackawanna (1.4). Average ammonium concentrations display an increasing trend toward the more northern sites (Figure 26). An analysis of ammonium concentrations versus wind direction reveals that the greatest mass of ammonium arrives on southwesterly winds. However, northern winds exhibit significant ammonium concentrations at Site 3 and result in the highest observed concentrations at Sites 4 and 5. This pattern may reflect ammonia emissions from coke ovens which are located north of Sites 1 and 2. Obviously this source of ammonia would be superimposed on material carried into the region from long range transport. Therefore, it is not unexpected that a regression analysis of 30 sampling dates at Site 5 showed little correlation of ammonium ion to either sulfate or nitrate (other gas-to-particle conversion products).

Halides (F, Cl, Br)

As a group the halides generally represent 1% of the dichotomous IP for most sites, approximately 1.1% at Site 4 and 1.4% at Site 5. Chloride is by far the predominant halide component and shows the greatest enrichment (6.6) at Lackawanna. Potential sources of chloride are automotive exhaust, combustion, road salt, and steel manufacturing. The bromide analyzed here is soluble (BrS) and necessarily represents only a portion of total bromine as determined by xrf procedures. All forms of bromide in this project are mainly attributed to automotive exhaust. Fluoride is similarly found to occur at low levels but does exhibit a maxima at Site 5. Although it is known that fluorspar (calcium fluoride) is sometimes used in fluidizing slag during steel production, this source has not yet been verified. If fluorspar is used continuously, then it may help to serve as a marker element to distinguish between the various emission sources arising within the steel industry.

Nitrate and Nitrite

Both ions are found to be enriched above background (Table 9). However, nitrate appears to be the more interesting component and constitutes about 2-3.5% of the dichotomous IP. Nitrate at the urban sites is found mainly in the fine particle fraction (54-78%) but drops to only 38% at the rural station (Site 6). Sites 1 and 2 in Table 7 are considerably enriched in fine particle nitrate as compared to the remaining sites. This trend may reflect the presence of nearby coke ovens which are known to emit nitrogen oxides. Little correlation was found in a comparison of nitrite or nitrate to either ammonium or sulfate concentrations.

SECTION 9

SCANNING ELECTRON MICROSCOPY

Analysis was conducted on special samples of suspended particulates collected at two field stations in an effort to characterize the major types of particles present. The objective of this effort was to provide source category information for the CEB program from the classification of the physical and chemical characteristics of the predominant types of particles. Since this analysis was designed as a small effort, filter analysis was restricted to Sites 5 and 6 which represent urban and rural background stations, respectively. It was expected that major differences in types of particles would be evident between these two sites.

From the observation of many particles from the fine and coarse particulate filters of both sites, silicon appeared as the predominant element. Most particles contained silicon but no reasonable correlation could be made between silicon content and particle size or shape. The varying sizes and shapes of particles containing silicon sometimes contained additional metals, making it difficult to distinguish between sand, clay, or other sources.

Sulfur was found to be present in most of the fine and coarse particles from Site 5 but only in the fine particles from Site 6. These facts support other project data which indicate that the majority of sulfur in the particulate samples exists as sulfate which is confined to the fine particle fraction ($< 4\ \mu$ diameter). However, at Site 5 some sulfur was evident in the coarse particles in which calcium was simultaneously present. It is possible that such particles originate from blast furnace slag or limestone in the steelmaking process. However, much more SEM data would be required to substantiate any such claim. In general, sulfur was most often associated with fine particles which contained very low levels of other elements. Calcium was found at Site 6 to exist mainly in the fine particles with levels significantly lower than at the urban sites. The much higher calcium concentrations found at Site 5 were usually associated with high silicon and/or sulfur and/or aluminum levels. Such associated metals are suggestive of blast furnace slag particulates. In contrast to Site 5, the lower concentrations of calcium observed in the particulates at Site 6 were not associated with similar levels of silicon, sulfur, and aluminum. This fact suggests that the calcium component at the rural site may be comprised mainly of soil limestone and/or roadway deicing agents as opposed to the type of calcium-containing material which is evident at the urban sites. Although calcium chloride as the deicing agent is considered here, its actual impact appears to be negligible at Sites 5 and 6 since the measured chloride in each case accounts for a maximum of only 10% of the total observed calcium.

The highest iron concentrations were observed at Site 5 in particles which were low in other elements. Such iron particles most probably exist as the oxide, Fe_2O_3, since a rouge color was often evident on filter particulate samples. The single most important source for such a component would involve the steelmaking furnaces, most probably the basic oxygen furnace since these iron particles were fairly small ($< 2\ \mu$ diameter). Such small particles are more indicative of industrial process emissions associated with condensable particle streams. Iron particles arising from soil and ores are either considerably larger in size or, from combustion sources, are associated with other metals. The iron particles observed at Site 6 usually contained silicon, sulfur, and aluminum components. In addition, the presence at Site 5 of relatively high manganese concentrations appeared in particles which were simultaneously rich in iron or zinc-nickel-chromium. Manganese in this region is apparently related mainly with steel production processes rather than from automotive or fuel combustion sources.

Aluminum was the second most frequently appearing element, associated usually in round particles with similar concentrations of silicon. The fact that aluminum appeared mainly in round particles is again suggestive of condensable particle emission sources such as coal and/or oil combustion or steelmaking/slagging operations. Aluminum from soil components would tend to be associated with irregularly shaped particulates.

Lead and bromine at Site 5 appeared most frequently in the coarse particulate fraction as opposed to its presence mainly in the fine particles at Site 6. While it was expected beforehand that lead and bromine would present information regarding the impact of an automotive source throughout the study region, the situation has become more complicated. Lead is occasionally used in the production of steel where it is added directly to molten iron. This procedure would most certainly give rise to lead-containing particulate emissions. Therefore, difficulties will arise in distinguishing automotive and industrial process contributions to the measured concentrations of lead.

It was further observed that overall zinc concentrations at all sites were much lower than for many of the other analyzed metals. From SEM analysis, some zinc-containing particles were unusually depleted in most other metals. Such particles are believed to originate from the wear of rubber tires since rubber usually contains zinc compounds for curing. However, other zinc particles were enriched in other heavy metals. Although galvanizing operations are associated with steel production, the present information regarding such particles is insufficient to establish possible source(s).

Although the SEM analysis begins to show important differences in the particle characteristics associated with Sites 5 and 6, a greater in-depth particle analysis will be required in the future in order to obtain representative results which are applicable to studies of this type. This SEM data which is summarized in this section represents the interpretation of samples collected on only one day of the project and is necessarily limited.

SECTION 10

CHEMICAL ELEMENT BALANCE

INTRODUCTION

The dispersion modeling of various pollutants has traditionally involved the development of rather sophisticated computer programs. Such atmospheric dispersion models attempt to simulate observed parameters which describe the meteorological profile within the study area. By employing the emission factor for a single source, the model then predicts the downwind TSP concentrations which are contributed by that source. The treatment for multiple sources is similar and the downwind concentrations are obtained from the principle of superposition of each individual source. In this approach, some difficulties arise from an attempt to accurately model complex meteorology, which at best can only be approximated.

Before one can devise optimum control strategies for TSP, the source strengths of various sources must be defined. Estimates of source strengths from dispersion modeling are necessarily based upon emission factors which are obtained from source emissions inventories where data is often inaccurate or incomplete. Some of the errors in the subsequently predicted source strengths are associated with the incorrect assumption that contributions to the TSP from individual sources are directly proportional to the overall masses of material which are emitted. However, the different residence times, dilution factors, and transport properties of particles are based on their different size distributions and points of release. The various chemical species arising from a single point source and eventually observed at a downwind site do not necessarily possess the same proportionality to the composite emissions factor.

A different approach in determining the strengths of the various sources within an area is the chemical element balance (CEB) method. The major emission source categories for the region are defined. Subsequently, the respective samples from the categories are analyzed for many chemical species in order to establish a "chemical fingerprint" for each category. Samples of ambient suspended particulates are then collected at the various field stations and each is analyzed for the same components which are specified in the "chemical fingerprint". The assumption is made, similar to that used in dispersion modeling, that the concentration of trace elements found in the aerosol is a linear combination of the emission from all types of sources in the area. The CEB method then attempts to resolve the aerosol into its component sources.

From the CEB approach, the measured concentration of element i, C_i, in a particulate sample can be represented as:

(10-1) $$C_i = \sum_j m_j x_{ij}$$

where m_j is the fractional mass contribution to suspended particulates from source j, and x_{ij} is the concentration of the chemical component i in the particulate matter from source j. Using iron as an example and three source categories, one would have:

(10-2) $$C_{Fe} = m_1 x_{1_{Fe}} + m_2 x_{2_{Fe}} + m_3 x_{3_{Fe}}$$

where C_{Fe} is the concentration of iron as represented by the filter particulate sample. Additional equations can be written for other chemical species which have been measured in the investigation. If the matrix elements x_{ij} in equation 10-1 are known for all the major source categories contributing to the field sample, then equation 10-1 can be solved to obtain the source strength coefficients, m_j. From this method, one should be able to indicate the contribution of each type of source category to the TSP as well as the contribution of each source category to the concentration of each chemical component.

SOURCE CATEGORY COEFFICIENTS

In order to apply the resolution of the source category components to the field data gathered in this study, it is first necessary to identify the major source categories and to establish the "chemical fingerprint", x_{ij}, for each. Since the field data represents two size fractions of particulates, the power of the CEB model is only fully realized if one provides a "chemical fingerprint" for each of the particle size fractions.

No attempt was made within the course of this investigation to obtain physical samples of materials representing the individual source categories. Analysis of such materials would be useful in order to establish directly the necessary coefficients. However, such an effort is beyond the scope of the current project.

The CEB approach received major notice in 1973 in a publication by Friedlander (2). Although the CEB concept has been advanced considerably since that time, it is to be considered still in its infancy.

In order to operate the CEB model for the Niagara Frontier data, the only source for the x_{ij} coefficients is the literature. The data in Tables 12 and 13 represent the values which were used to perform the source resolution. All values appear in standard scientific notation in double precision format, i.e. 25.D-2 is equal to 0.25; all values within a category are normalized with respect to a "tracer" element. The seven source categories which were chosen for this analysis are soil, steel, coal, oil, refuse, auto, and lime. Much of the subsequent resolution of the Niagara Frontier data makes use of the CEB

TABLE 12. NORMALIZED ELEMENTAL CONCENTRATIONS FOR EACH SOURCE CATEGORY (FINE)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIME
PB	49.D-6		29.D-4	16.D-3	67.D-2	1.D0	30.D-6
BR	31.D-6	.D0	56.D-5	.D0	14.D-3	35.D-2	20.D-6
ZN	36.D-5	465.D-4	56.D-4	67.D-3	1.D0	22.D-3	66.D-6
NI	14.D-5			50.D-2	13.D-4	61.D-5	66.D-6
FE	16.D-2	1.D0	25.D-2	11.D-2	24.D-3	14.D-3	2.D-2
MN	20.D-4	310.D-4	32.D-4	28.D-4	49.D-4	20.D-4	2.D-2
CR	25.D-5		20.D-4	31.D-4	31.D-4		36.D-6
V	33.D-5		31.D-4	1.D0	14.D-5		66.D-6
CA	21.D-3	1395.D-4	75.D-3	15.D-2	30.D-3	14.D-3	1.D0
S	10.D-4	1.D-4					30.D-3
SI	1.D0	1.D-2			468.D-3	.D0	23.D-2
AL	25.D-2	5.D-3	1.D0	61.D-2	5.D-2		4.D-2
CA	85.D-5	.D0	16.D-4	.D0	6.D-2	78.D-3	50.D-5
NA	14.D-3		16.D-3	65.D-2	60.D-2		13.D-4
K	49.D-3		99.D-3	.D0	.D0	2.D-2	89.D-4

TABLE 13. NORMALIZED ELEMENTAL CONCENTRATIONS FOR EACH SOURCE CATEGORY (COARSE)

LEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIME
PB	49.D-6		12.D-4	2.D-2	42.D-2	1.D0	30.D-6
BR	31.D-6	.D0	16.D-5	.D0	17.D-3	69.D-2	20.D-6
ZN	36.D-5	465.D-4	52.D-4	77.D-3	1.D0	52.D-3	66.D-6
NI	14.D-5			50.D-2	13.D-4	61.D-5	66.D-6
FE	16.D-2	1.D0	11.D-1	15.D-2	41.D-2	37.D-2	2.D-2
MN	20.D-4	310.D-4	31.D-4	78.D-4	39.D-3	20.D-4	2.D-2
CR	25.D-5		16.D-4	14.D-4	26.D-3		36.D-6
V	33.D-5		35.D-4	1.D0	11.D-4		66.D-6
CA	21.D-3	1395.D-4	73.D-3	84.D-2	12.D-1	41.D-2	1.D0
S	10.D-4	1.D-4					30.D-3
SI	1.D0	1.D-2			468.D-3	.D0	23.D-2
AL	25.D-2	5.D-3	1.D0	46.D-3	93.D-2		4.D-2
CA	85.D-5	.D0	37.D-5	.D0	23.D-1	30.D-2	50.D-5
NA	14.D-3		16.D-3	25.D-2	13.D-1		13.D-4
K	49.D-3		11.D-2	.D0	.D0	2.D-2	89.D-4

model which was developed by Dr. Glen Gordon, et.al., (10, 11). With the exception of steel, all of the "chemical fingerprints" for the source categories were derived from the Washington, D.C. aerosol study. It is believed that this data represents the most complete category profiles which were available to us for application to the Niagara Frontier data. However, coefficients for a steel category were obtained from the Chicago aerosol study (4). Where possible, relative proportions of metals were updated from more current information.

An abundance of information exists in the literature for use by those employing the CEB approach. However, more often than not, the specific chemical parameters which describe the particulate emissions from a source category don't coincide with those parameters actually measured in a project. When this event occurs, the "chemical fingerprints" are incomplete and a highly detailed resolution of the data base cannot be achieved. This situation exists at the moment when attempts are made to resolve the Niagara Frontier data.

The information in Tables 12 and 13 for source categories for soil and lime do not represent two different size fractions, but rather the bulk overall sample. Similarly the values for a steel component represent bulk particle emissions and are not size classified. These three chemical profiles are simply not available at this time in the detail required by such studies employing dichotomous samplers. The available chemical profiles (Tables 12 and 13) were used under the constraints which are described. One should realize that this situation will not permit full interpretation of the data. Certainly such chemical profiles can be advanced in the future and the data can then be reanalyzed to permit a greater understanding of the relationship of source category contributions to TSP in the Buffalo-Lackawanna area.

SIX SOURCE RESOLUTION

A six-source CEB analysis of fine particles is presented in Appendix E. The source categories which are considered to account for approximately 95% of the observed TSP in the Buffalo-Lackawanna area are soil, steel, oil, refuse, auto, and liming. A marker element is designated within each source category but does not necessarily have to represent the respective chemical constituent with the highest concentration. The prime consideration here is whether or not a marker element is peculiar to a single source category. When this situation occurs, the distinguishing features of the chemical profile for that source category are enhanced above the remaining choices. Although it is felt that such marker elements aid in resolving the contributions from the various source categories, one is not always permitted the opportunity to select marker elements which occur in only a single source category.

In this study the soil category possesses a chemical profile which is based upon a silicon marker. This profile will account for soil particles observed in the TSP, regardless of the manner in which these particles become airborne. However, silicon is also found to occur in the steel category, particularly in slag material. On the other hand, the marker element for steel was chosen to be iron, which similarly forms an appreciable percentage in soil. Vanadium was selected as the marker for particulates originating from the combustion of fuel oil. Within this study, vanadium is the marker which comes closest to fulfilling the earlier requirement that a marker be found predominantly in the chemical profile for only one source category. Meanwhile, zinc was the marker element chosen for refuse since literature reports find refuse to be the chief source for this metal in the environment. However, the matter is certainly complicated by the presence of zinc in the abraded particles from rubber tires of vehicles and in emissions from galvanizing operations. It is felt that neither of the latter zinc sources has yet been adequately characterized for studies of this type. The marker selected for the auto (vehicular) source is lead. Certainly the reduction of lead in gasoline in the future may eventually force one to reconsider this choice. Although the use of unleaded fuel is constantly on the rise, vehicular traffic is still considered to be the major source of lead which is emitted into the environment. The sixth category, liming (10), was found to be necessary to account for a source of calcium. In this study, liming will represent a chemical profile of particulate emissions which result chiefly from the abrasion of concrete surfaces and from slag operations. Other sources of calcium, i.e., cement, would also be included in this category.

From the data which is presented in Appendix E for Site 1, one observes the predicted distribution of the chemical components among the six source categories. The input, C_i, for Site 1 for the chemical components is labelled "Observed" in Appendix E and does not represent the measurements made on individual filter samples. The "Observed" data represents the respective project average values for fine particles. Although the input to the CEB program could have been the chemical component concentrations which are descriptive of a single filter sample, the current number of source categories and/or the present quality of each chemical profile occasionally results in the prediction of large negative concentrations for entire source categories. The project's average site values effectively remove large variations within a given chemical measurement and results in a computer source resolution which is considered here to be more meaningful in its interpretation. Certainly a great deal of information is lost by not utilizing individual filter samples.

However, it is judged more important for the moment to present the average findings in view of the project's overall goals to broadly define the nature of TSP in the Niagara Frontier region.

From Site 1 data in Appendix E, lead is distributed chiefly in auto, then refuse, and is negligible in all other remaining categories. The total predicted concentration for lead is 711 $\mu g/m^3$ as compared to the average observed value of 682 $\mu g/m^3$. The resulting ratio large/small (L/S) is 1.04 and reveals very good agreement overall. The L/S ratio for bromine is 4.33 where the observed value is considerably in excess of the predicted value. It is felt that the observed bromine values are in error as discussed in Section 8. Despite a poor chemical analysis for bromine, one observes a decrease in the bromine L/S ratio from 4.3 at Site 1 to 2.8 at Site 6. This decrease toward unity in the ratio suggests an improving fit. However, the xrf data appears to overestimate the concentrations of bromine by approximately a factor of 2.5.

Zinc is found to be distributed between the auto and refuse categories, similar to lead but in the reverse order of predominance. Iron and manganese are chiefly found in the steel category, where chromium, lead, nickel, and other components are reported to be zero simply because the analyses for these metals relative to iron in the chemical profile was not readily available to the project. If chromium was present in steel emissions, presumably the CEB program would predict a chromium component for steel. Thus, the L/S ratio of 1.34 may eventually move toward unity, indicating a better correlation between predicted and observed values.

The bulk of calcium containing particulates is found in the liming category, although appreciable quantities are also distributed in soil and steel emissions. Much of the calcium may arise from the degradation of concrete and from slagging operations, both sources of which are figured into the liming profile. Once sufficient confidence is achieved in the chemical profiles, it is possible that slag contributions to TSP could be resolved directly by establishing a chemical profile specifically for such a material.

The concentration of vanadium is distributed chiefly in the oil category. Although there is a wide variety of heavy industries and chemical processes to be considered in the Buffalo-Lackawanna area, present information suggests that fuel oil combustion is the prime contributor to the observed levels of vanadium. In contrast to the reasonable fit for vanadium, the resolution of sulfur appears, at first, to be extremely poor with regard to resolution and distribution among the specified source categories. The L/S factor exceeds 500. However, one should realize that background particulates arising from some combination of distant sources cannot be adequately characterized in a chemical profile as a single source. The end result is that the CEB approach simply must ignore the background aspect of TSP. The CEB method must ignore those components which arise from gas-to-particle conversion processes and which enter the study region through long range transport, i.e., sulfate, nitrate, ammonium, etc. The inability of the CEB method to cope with this aspect of the TSP problem should not be considered as a deficiency in the model. Data from Section 7 has presented a detailed discussion of sulfur-containing particulates and has shown that much of the sulfur exists as sulfate. Except for minor variations, the bulk of the observed sulfate, nitrate, and ammonium particulates appears to be well dispersed among the sites and to be largely independent of industrial activities throughout the entire region. From a study of the chemical profiles of the source categories presented in Table 12, one realizes that sulfur is an element which exists at very low levels when normalized to the marker element. Thus, correspondingly low levels of sulfur are predicted and distributed among the sources. One could argue that the sulfur data should not have been included in the resolution analysis. In any case, the CEB results should be interpreted as simply reflecting the absence of any major sulfur species in the source categories considered.

Upon examining the results for silicon, one finds that the CEB model has predicted that approximately 80% of this element arises from a soil component. An order of magnitude lower concentrations are received from refuse and liming categories. Similar trends are observed for aluminum and potassium in the discussion of data at Site 1. At this stage in the interpretation of the data, one should recall that the liming category was included in an attempt to explain additional sources of calcium. The liming chemical profile was modified in an attempt to include a slag component based mainly on silicon and calcium. It is probable that errors exist here since good data was not available. Therefore, a future reanalysis is expected to decrease the predicted soil component in an effort to account for slag particulates which are included in the liming category.

The high predicted distribution of chloride in the automotive category appears reasonable since chlorinated scavengers are still in use in leaded gasoline. Chloride is also expected to be produced from the incineration of refuse containing appreciable amounts of chlorinated plastic films, i.e., PVC (polyvinyl chloride), etc.

The CEB analysis of potassium does not account very well for its presence among source categories as is evident in the L/S ratio of 3.02. The zero values predicted for steel, oil, and refuse sources simply arise from the lack of information for potassium in the respective chemical profiles. As discussed in Section 8 of this report, potassium levels rise near the steel industry. The verification of a potassium emission from steel production could be expected to improve the resulting mass balance distribution and the subsequent L/S ratio for this metal.

Additional information may be found toward the bottom of page E-2 (Appendix E) which describes three variables. The "COEFF" variable is simply the m_j value resulting from the CEB analysis. The "TSP" variable is computed from knowledge of the weight percent of the marker element in a sample from the respective source category. The percentage weight values which were used in this analysis appear under the heading "EST. % WEIGHT" found on page E-8. For example, at Site 1 the predicted value of silicon is divided by .250 and results in a predicted TSP value of 7189 ng/m^3 arising from the soil. The "% TSP" variable simply represents the predicted source category contribution to FSP as a percentage of the sum of all the predicted contributions.

Similar information is presented for the remaining Sites 2-6 (pages E3-E7) and one can now draw comparisons from the results on a site-to-site basis. For instance, the predicted soil contributions (% FSP) can be seen in Table 14 to vary among the sites. A maximum soil component (72%) is observed at Site 6.

TABLE 14. SIX SOURCE CATEGORY DISTRIBUTION SUMMARY (% FSP)

Site #	Soil	Steel	Oil	Refuse	Auto	Liming
1	42.8	5.8	1.2	11.1	35.8	3.4
2	47.5	8.8	0.6	1.4	38.5	3.1
3	44.3	7.5	0.7	2.0	41.5	4.0
4	31.2	20.6	0.4	2.9	37.9	6.9
5	25.5	22.6	0.7	2.8	43.5	4.9
6	72.0	-2.1	0.7	2.7	24.9	1.8

While this absolute value may be argued, the source-by-source distribution at Site 6 seems entirely reasonable. The soil category percentage is lowest at Sites 4 and 5 but this trend is in agreement with the observed facts. For Sites 4 and 5 the overall TSP values, and therefore FSP, are the highest observed throughout the project. The chemistry of the particulates at Sites 4 and 5 differ considerably from the other sites and the CEB model predicts a much larger percentage of steel emissions contributing to the observed TSP. Thus, while one could conceive that the soil component could be relatively constant among the sites from the discussions in Section 8, the soil percentage decreases at Sites 4 and 5 due to the increased percentage of contributions from the steel category. The CEB model predicts that percentages of particulates derived from steel emissions in Lackawanna are 3-4 times greater than similar percentages which are projected for the Buffalo sites. The negative value which is predicted for steel emissions at Site 6 reflects the inability of the model to match the chemical profile with the observed data. A refinement in the CEB parameters and modeling routines should eventually lead to positive values. However, the conclusion to be drawn here is that Site 6 does not receive any steel particulate emissions when project-average data is used. Certainly on a single day basis, project information exists which strongly suggests that steel emissions from Lackawanna can impact fifteen miles south at Site 6. This ocurrence is infrequent because winds arriving from the north are infrequent. Hence the project average distribution summarized in Table 14 does not reflect this possibility.

The impact of percent FSP from oil particulates is relatively constant for all sites. An exception is noted at Site 1 where the percentage is doubled. The generally low overall values suggest that little attention need be devoted to this category in the development of SIP control strategies. A similar trend is observed for refuse contributions among the sites. Percentages for each site are fairly constant. The overall low values are consistent with the knowledge that major incineration facilities do not exist within the study area. Furthermore, any such facilities outside of the study area make little impact within this area. The five-fold increase which is observed for Site 1 is difficult to explain. At the moment it is believed that the chemical profile for refuse may not realistically represent the situation in NFAQCR. The refuse marker element is zinc and Site 1 has been shown to exhibit high zinc levels. More general knowledge suggests that zinc at Site 1 may originate from rubber tire particles from nearby heavy traffic. If the latter fact proves true, then the CEB results are in error simply because the authors have failed to include rubber tire wear in the automotive chemical profile. An accounting of this zinc source is easier said than done since appropriate data does not exist. In any event the refuse component using zinc at Site 1 may be overestimated. Conversely the automotive component at Site 1 may be underestimated. While the "auto" percentages at the urban sites are uniform, an interpretation of data from individual days can indicate a much greater impact at Site 1 from an automotive source than at Site 2. However, project-averaged data does not support this theory under the present conditions of analysis. The last category (liming) in Table 14 can best be described as helping the CEB model in achieving a balance of distribution. Sources of calcium occur in the environment other than from the categories represented by soil, steel, oil, refuse, auto, or coal. Cement operations do exist in the study area and may represent a contribution to observed TSP. More importantly, calcium particulates from the abrasion of concrete roadways is expected to provide a larger contribution to TSP than cement. Relatively small sources such as these are not easily represented by singular chemical profiles. In CEB modeling it is easier to combine such non-related sources into one overall category. Although the liming category in Table 14 ranges only 2-7%, important information is contained within this source and represents some of the finer details of the overall TSP picture.

While the data from all six sites have been individually analyzed (pp. E2-E5), a composite average is provided by the CEB program and results appear on page E-8. It is recognized that the particulate aerosol at the rural site is much different from the urban sites, so that perhaps the average fit here is somewhat confusing. We recognize now that more meaningful data would have resulted from an average fit of all urban sites, which then could have been compared directly to the Site 6 data on page E-7. Nevertheless, one finds that the CEB model considers soil and automotive sources to represent 40% each, or 80% combined, of the total predicted TSP. The average steel contribution to TSP at all sites is 12.5% but would increase slightly if the rural site was deleted from this analysis. An additional data summary is presented on page E-9 where data from the product of the source strength coefficients, mj, and the marker element concentrations are tabulated in ng/m^3. This data allows one to readily compare the predicted concentrations within the respective source categories for the marker elements only.

Now that results from the fine particulate fraction have been interpreted, a similar analysis is extended to the coarse particulate fraction. The CEB analysis of the coarse particle data is identical to the fine particle case except that ideally all of the six source chemical profiles are replaced. In actuality, chemical profiles were not available to us to describe the soil, steel, and liming categories for the coarse fraction. In these instances, we could only use the profiles which represent bulk samples.

The six-source CEB analysis is found in Appendix F and is summarized in Table 15. The coarse particulates are mainly attributed to a soil component which comprises approximately 80% of the overall predicted CSP concentration. This percentage drops at Sites 4 and 5 because a steel component becomes evident

TABLE 15. SIX SOURCE CATEGORY DISTRIBUTION SUMMARY (% CSP)

Site #	Soil	Steel	Oil	Refuse	Auto	Liming
1	79.5	-.7	.1	.5	6.0	14.7
2	79.0	.1	.1	-.1	5.0	16.0
3	79.5	-.4	.1	.0	4.9	15.9
4	67.3	4.3	.1	-.7	4.4	24.6
5	66.6	3.8	.1	-.3	4.3	25.5
6	96.4	-6.0	.2	1.2	2.7	5.5

and the liming category increases significantly. At Site 6 the soil component reaches its maximum of 96.4%. It is to be expected that much of the coarse particle fraction consists of soil particulates. The separation of large and small particles was taken into account in the design of the operation of the dichotomous samplers. Because the conduct of this study is new to us and to New York State and necessary literature data is still incomplete, the absolute values of the numbers resulting from this investigation may not be entirely correct. However, the type of distribution which is noted for Site 6 in Table 15 seems reasonable when one considers the nature of the surroundings for this rural station. The negative values associated with the predicted steel and refuse components indicate that the CEB program and/or chemical profiles need further refinement. The automotive contribution is found to increase continuously as one proceeds northward from Site 6 to Site 1, consistent with the direction of increasing traffic density. The liming category exhibits an increase in % CSP at sites 4 and 5 which is above that observed for the Buffalo urban sites. This increase in % CSP in Lackawanna is believed to represent input from slag/limestone operations which are associated with emissions from the steel industry. This increment in %CSP should probably be added to the

4% figure which is evident in the steel category column (Table 15). In effect, the actual total steel emissions have been split between the steel and liming categories because of the manner in which data was available for the respective chemical profiles. This problem is minor and may be rectified in future work by the development of a chemical profile which is characteristic of the composite plume representing all possible steel emissions.

The average data for all six sites which represents the coarse particulate fraction can be found on page F-8. The "EST. % WEIGHT" factors are deficient here since information regarding fine and coarse fractions of the respective categories was not available. We had no recourse at this time but to use the same factor for either size fraction. The resultant situation is obviously incorrect since the marker elements are certainly not expected to be equally dispersed by weight between the fine and coarse fractions for a given source category. Aside from these shortcomings, coarse particulates are predicted to be comprised mainly of soil and liming components to the combined extent of 94%. In comparison to the average results for the fine fraction (page E-8), one finds that the soil component constitutes about twice its share in the coarse fraction as it does in the fine fraction. Steel emissions (furnace-type particulates) are predominantly found in the fine fraction as are automotive particulates. Refuse does not appear to represent an impact on coarse particulates, and only a minor impact in the fine fraction. Calcium-containing materials are chiefly found as larger particles in the coarse fraction.

SEVEN SOURCE RESOLUTION

In an effort to define the major source categories which ultimately contribute to the total observed TSP, one should include those categories which account for at least 90% of the resultant TSP. The previous sub-section presents a CEB resolution which was conducted in this manner. One could argue that the list of the six source categories should have been altered to exchange one or more items for other categories. However, such freedom does not really exist.

We have attempted to include in our final analysis another category which has been an important consideration in other studies of this type. The six source categories are expanded here to seven to include particulates arising from the combustion of coal. The % FSP and % CSP resulting from the resolution of the data appear in Appendices G and H and are summarized in Tables 16 and 17. The values which are reported in Table 16 for the fine fraction for a seven-source resolution are not really much different than the six-source data in Table 14. As a result of the inclusion of a coal category, contributions from soil have been reduced 2-4 percentage units at each site. Residual contributions to the observed coal values in Table 16 have been redistributed by the CEB program from the steel and auto categories. The oil and liming distributions remain essentially unchanged for either 6 or 7 source analysis. However, the soil component is affected at all sites and one should be aware of possible category interactions. The chemical profiles of soil and coal are the most similar of all other categories.

TABLE 16. SEVEN SOURCE CATEGORY DISTRIBUTION SUMMARY (% FSP)

Site #	Soil	Steel	Coal	Oil	Refuse	Auto	Liming
1	40.9	5.3	4.2	1.1	10.7	34.6	3.2
2	45.6	8.7	2.4	.6	1.4	38.2	3.0
3	41.9	7.0	4.6	.7	2.0	40.2	3.8
4	29.1	19.0	6.6	.4	2.8	35.7	6.4
5	23.4	20.4	8.0	.6	2.6	40.4	4.4
6	68.1	-2.3	5.0	.7	2.6	24.1	1.7

TABLE 17. SEVEN SOURCE CATEGORY DISTRIBUTION SUMMARY (% CSP)

Site #	Soil	Steel	Coal	Oil	Refuse	Auto	Liming
1	77.0	6.3	-8.4	.2	-.9	7.9	17.9
2	75.0	9.9	-10.0	.3	-2.1	7.0	20.0
3	76.7	8.9	-10.9	.2	-1.8	6.9	20.0
4	59.5	16.6	-7.4	.2	-3.2	6.0	28.3
5	53.0	20.7	-3.2	.2	-3.8	5.8	27.3
6	103.0	-.3	-13.7	.3	.1	3.9	6.7

It should be realized that a resolution analysis which makes use of these two categories results in a certain amount of internal competition for the same chemical components during the distribution scheme. It becomes increasingly difficult to interpret such results and to simultaneously comprehend the subtle interrelationships in the source categories. For instance, data for coal in Table 16 indicates an increase at Sites 4 and 5 and may represent the heavy use of coal/coke from the nearby steel industry. On the other hand, when one attempts to over-define the resolution analysis of a data system by employing too many source categories, the CEB model simply proceeds in a mechanical fashion to develop the best fit to the data. The additional source categories may create an unnecessary readjustment of the distribution of the observed chemical component concentrations. It is believed that at some point human judgment must be used to maintain the data analysis as simple as possible without seriously degrading the final results. Such results are aimed at eventual use in the development of SIP control strategies, where an over-resolved analysis may not be needed and may serve to unnecessarily complicate the problem of interpretation.

The preceding discussion may be reflected in a comparison of the coarse fraction data found in Tables 15 and 17. During the fitting routine, the additional category (coal) in Table 17 has provided more constraints which now result in both larger and more frequent negative values for both coal and refuse. Such results may indicate an attempt to overload the resolution program. It may also be argued that the chemical profiles for all categories are not entirely correct. The fit to the observed data begins to deteriorate as evidenced in the data for Site 6 (Table 17) where the soil component now emerges as 103% of the CSP. In an effort to accommodate the coal category, coal and refuse results are forced negative while steel is significantly increased in the positive direction to maintain balance. Oil, auto, and liming results are hardly affected at all. It is too early at this time to conclude that the chemical profiles contain large errors. Certainly the profiles can always be improved. Similarly one cannot claim that a seven-source resolution is solely responsible for the deterioration in the results. The chemical profile for coal is representative of particulates derived from coal-fired power plants. Particulates arising from large stockpiles of coal, coking operations, and other industrial processes using coal in the Buffalo area may not result in a coarse particulate fraction which is adequately addressed by the chemical profile used in this study.

In the application of the CEB model to air pollution data within the study region, judgments must be made which consider the realistic emissions and characteristics of the aerosol within the urban-rural community so as not to unnecessarily complicate the number of source categories in the model. Some of the interpretations from this type of analysis are highly subjective and are strongly dependent upon the input parameters. It should be noted that many of these parameters are not well established because of their site dependent nature. It is hoped that the efforts of this study have defined the basic approach which we have attempted to apply to the TSP aspects of air pollution in Erie County.

While it is difficult to interpret how much of the observed TSP results from fugitive dust, reentrainment, etc., we are confident that such an approach will eventually lead to a greater understanding of this complex problem.

PARTICULATE MASS BALANCE

Despite all of the recognized shortcomings in this investigation and in the interpretation of the data, the following information is presented for review regarding a projected mass balance of suspended particulate (SP) concentrations. In order to compare the predicted SP resulting from the CEB model with the observed SP data, one must recall that background particulates are not currently treated in this model. Therefore, starting with the FSP fraction, the predicted FSP value is added to the respective concentrations for sulfate, ammonium, and nitrate ions to yield an estimated gross FSP concentration. It is felt that the background FSP levels are adequately represented by the sum of the concentrations of these three ionic particulates. The trace metal concentrations which are associated with these three ions as well as those which are associated with the remainder of the observed FSP are all included in the CEB-predicted FSP levels. This data is presented in Table 18 for each site and includes similar calculations for the CSP fraction. The data from this analysis is presented in Figure 28 for ease of interpretation.

It is surprising to find such good agreement overall between the predicted and observed SP concentrations. In general, the CEB model has slightly underpredicted the FSP contributions to the fine fraction at all sites, even after attempts are made to include background components. The amount of underprediction ranges 14-23%. This comparison is easily seen in Figure 28. In a reverse fashion, it appears that the CEB model has overestimated the predicted CSP concentrations which range 32-90% above the observed values. Upon summing FSP and CSP data to

TABLE 18.* MASS BALANCE OF SUSPENDED PARTICULATE CONCENTRATIONS

Site No.	FSP						CSP						IP	
	$SO_4^=$	NH_4^+	NO_3^-	Predicted	Sum††	Observed	$SO_4^=$	NH_4^+	NO_3^-	Predicted	Sum††	Observed	Total Pred.**	Total Observed***
1	11.7	5.0	1.7	16.8	35.2	41	1.3	.25	.48	30.8	32.8	20	68	61
2	11.0	4.88	1.7	17.9	35.48	42	.97	.13	.57	33.7	35.37	22	70.8	64
3	10.3	3.53	.65	13.5	27.98	34	.92	.10	.55	28.9	30.47	19	58.5	53
4	11.5	3.92	1.17	19.6	36.19	44	1.28	.07	.56	33.5	35.4	26	71.6	70
5	10.9	3.55	1.01	19.1	34.56	47	1.25	.05	.6	33.9	35.8	27	70.4	74
6	7.75	2.69	.23	7.6	18.3	24	.55	.06	.37	16.1	17.1	9	35.4	33

* All units are ng/m^3

** Total Predicted IP = FSP-Sum + CSP-Sum

*** Total Observed IP = FSP-Observed + CSP-Observed

††Sum = Total of $SO_4^=$ + NH_4^+ + NO_3^- + Predicted SP

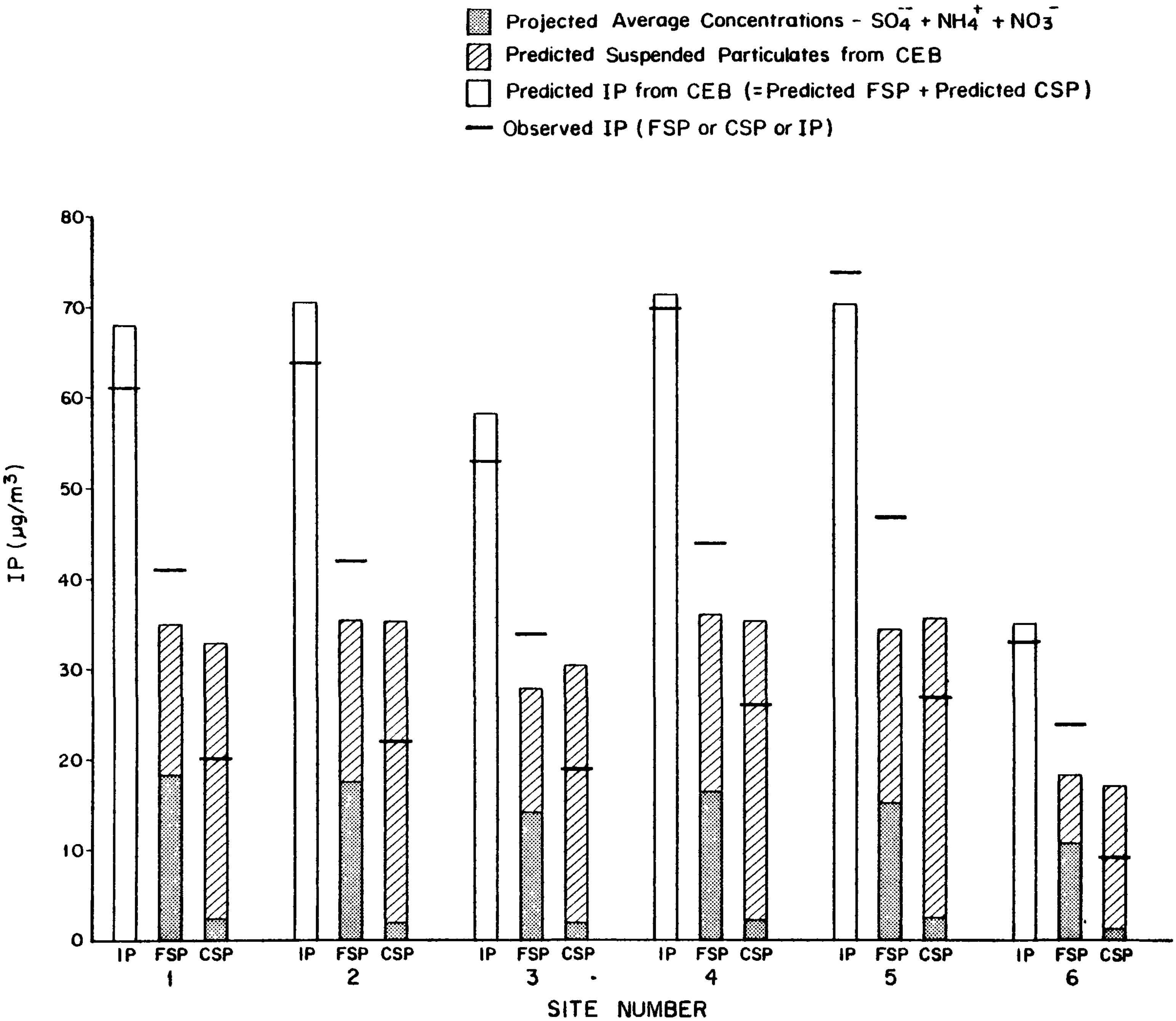


FIGURE 28. HISTOGRAM OF PREDICTED AND OBSERVED SUSPENDED PARTICULATE CONCENTRATIONS

obtain total concentrations, the resulting IP concentration data for observed and predicted values are found to agree exceptionally well with each other (worst case is 11%). This analysis implies that it may be possible to advance the model to improve its resulting predictions with respect to CSP and FSP observed data.

This comparison between predicted and observed data neglects two other obvious constituents of suspended particulates - carbonaceous materials and moisture. Carbon-containing particulates are visually identifiable on a majority of the fine particulate filter samples. However, fine carbon possesses a very large unit surface area. A small amount of this element can effectively cover large areas and yet represent only a very small percentage of the entire mass. Similarly, moisture is believed to represent only a small portion of the total SP mass.

From the overall project, it is very encouraging to realize that reasonable mass balances of suspended particulates may be within the grasp of investigators in the future. A source category apportionment when combined with a particulate mass balance offers considerably more information toward the development of particulate control strategies than can otherwise be obtained from the traditional approach of dispersion modeling.

The application of chemical element balance procedures to the study of suspended particulates in New York State is new to us. The resulting data are expected to be controversial and to have far-reaching implications in the design of control methods. One can envision use of the CEB approach to serve as a more effective monitor of air quality in an attempt to define net gains and losses resulting from the field installation of various phases of a master particulate control plan. The future monitoring of the chemistry of air particulates is essential to the interpretation and enforcement of regulations. This fact is especially true now as major changes are implemented in our production of energy; i.e., use of higher sulfur oil, coal, and synthetic fuels. Significant changes in the percentage use of these raw materials for the generation of energy will possibly change observed TSP concentrations but will certainly change the chemical profile of air particulates. These chemical changes must be defined and monitored in an effort to maintain an air quality which is consistent with our health requirements and the protection of the environment.

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APPENDIX A

The following data is tabulated for the fine and coarse particulate fractions resulting from the dichotomous samplers. The various chemical species which were measured throughout the study are presented here as project averages for each site in ng/m^3.

FINE SUSPENDED PARTICULATES

	Site #					
	1	2	3	4	5	6
FSP*	41	42	34	44	47	24
Pb	682	678	552	740	823	192
Br	921	796	636	641	645	187
Zn	171	59	50	123	124	19
Ni	7	5	5	6	7	4
Fe	684	972	644	1840	1900	162
Mn	30	45	23	70	53	9
Cr	1	1	1	2	1	1
V	14	8	7	7	10	4
Ca	309	343	292	753	613	74
S	5110	4970	4470	5250	4930	3300
Si	1830	1910	1410	1590	1270	1240
Al	558	564	449	581	538	377
F	33	38	39	43	45	42
Cl	74	150	54	280	443	40
NO_2	253	350	197	177	277	150
PO_4	6	7	23	11	7	9
BrS	51	66	46	45	50	13
NO_3	1680	1700	647	1170	1010	225
SO_4	11700	11000	10300	11500	10900	7750
Na	192	164	200	401	361	134
NH_4	5070	4880	3530	3920	3550	2690
K	308	336	312	847	1220	169
# of Samples	54	46	70	64	66	68

*The units for FSP are $\mu g/m^3$.

COARSE SUSPENDED PARTICULATES

	Site #					
	1	2	3	4	5	6
CSP*	20	22	19	26	27	9
Pb	161	143	120	120	120	43
Br	209	192	177	184	200	85
Zn	20	9	8	15	22	3
Ni	5	6	4	5	5	3
Fe	1160	1480	1170	2220	2920	284
Mn	27	44	26	45	51	6
Cr	2	2	1	2	2	0
V	5	5	4	5	5	3
Ca	1860	2180	1860	3280	3470	392
S	689	609	545	745	724	290
Si	5190	5400	4710	4930	4790	3360
Al	1010	959	825	867	967	662
F	13	14	22	45	78	17
Cl	213	165	241	323	302	62
NO_2	23	24	16	60	43	35
PO_4	24	9	0	2	4	5
BrS	7	30	5	34	8	8
NO_3	482	571	548	558	590	375
SO_4	1290	970	916	1280	1250	551
Na	282	159	182	311	210	114
NH_4	248	134	104	68	52	65
K	68	67	44	68	92	25
# of Samples	54	46	68	64	66	68

*The units for CSP are $\mu g/m^3$.

APPENDIX B

The data base for the entire project is listed here and represents all of the dichotomous particulate filters which were collected for the fine particle fraction. Each filter is printed along with information describing the date (month and day), elapsed time, sampled air volume (flow), meteorological data, and concentrations of particulate weight and various chemical components. A series-20000 filter reflects the use of 0.5μ pore diameter filters while the series-40000 reflects the change to 1.0μ pore diameter filters. The series-20000 filter data for fine particulates corresponds to the series-30000 filter data for coarse particulates which is presented in Appendix C. Similarly, the series-40000 filter data for fine particulates corresponds to the series-50000 data for coarse particulates in Appendix C.

FILTER SERIES DESIGNATION

	PARTICULATES	
FILTER PORE DIAMETER	FINE	COARSE
0.5μ	20,000	30,000
1.0μ	40,000	50,000

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 1   FINE PARTICULATE DATA   (PART - 1)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
20001	41	6	27	5.8	12.2	212	5	73	577	181	1426	11	1551	45	11	11	1245	5560
20021	49	7	19	7.3	15.7	193	6	122	1382	783	246	8	3337	52	0	17	1435	26863
20028	50	7	21	6.6	15.1	205	5	116	771	743	165	9	1120	27	0	18	422	20086
20036	51	7	25	7.5	15.2	209	5	52	1002	1376	1622	9	884	9	0	9	656	6820
20077	60	8	18	17.7	41.1	156	3	40	616	1526	60	3	882	23	6	3	272	2718
20080	61	8	22	17.7	39.0	238	4	36	568	1186	28	3	461	10	7	7	195	4879
20109	62	8	24	7.1	17.7	211	7	86	831	407	368	31	925	54	7	39	313	16830
20081	64	8	30	17.7	43.1	187	3	29	408	630	19	3	398	3	6	3	617	2627
20087	65	9	1	18.0	45.3	235	1	31	1418	2393	73	9	562	27	6	33	308	2983
20095	66	9	7	18.0	43.4	284	3	33	389	376	54	3	440	22	3	15	216	3171
20100	67	9	11	17.2	43.7	204	11	93	723	298	507	3	1750	63	3	6	288	13038
20073	68	9	13	23.6	56.1	47	9	12	392	491	22	2	330	83	2	12	175	372
40003	69	9	17	23.6	53.2	51	3	15	474	768	2	2	10	2	0	2	28	833
40007	70	9	19	23.6	54.0	32	4	19	451	589	20	2	179	43	0	23	223	1397
20201	72	9	23	23.9	50.0	92	2	15	1153	2215	2	2	108	2	5	2	127	640
40016	73	9	26	23.7	51.2	205	3	29	1274	1948	13	5	327	13	0	5	292	2335
40022	74	9	29	23.6	51.6	114	2	22	1608	3152	21	5	249	37	0	5	150	904
40034	76	10	5	23.7	54.1	163	8	28	1005	774	43	2	705	25	0	2	168	3360
40040	77	10	7	23.8	55.2	274	10	7	293	464	2	2	45	5	0	2	62	451
40028	78	10	11	23.8	54.4	168	3	38	1177	1905	20	17	568	22	0	12	458	4535
20094	79	10	13	23.6	42.8	15	2	26	675	1037	54	3	598	64	3	9	210	1396
20214	82	10	23	23.6	58.6	313	6	19	240	292	94	7	144	9	0	11	103	1756
40046	83	10	25	23.6	70.3	192	10	57	1178	859	431	3	3260	84	3	1	782	6000
40052	84	10	29	23.7	70.6	165	5	17	548	670	1	1	119	17	3	15	72	1621
40058	85	10	31	23.5	67.5	219	6	55	996	963	399	16	1872	65	0	22	477	6574
40064	87	11	4	6.9	19.7	209	5	67	3055	5920	21	14	484	28	0	7	196	4853
40070	88	11	7	23.0	66.3	254	3	17	263	484	45	4	108	10	0	4	2	499
40076	89	11	10	23.7	68.5	116	2	51	1631	2658	151	8	772	42	6	8	214	5940
40130	105	1	2	23.7	70.1	288	7	20	320	464	25	9	165	11	0	15	69	2707
40133	106	1	9	23.8	68.6	221	12	51	721	199	96	22	3817	125	2	10	300	7210
40139	107	1	11	14.8	42.9	190	1	39	791	1973	38	16	465	19	0	19	255	3314
40144	108	1	15	23.8	68.7	243	14	31	572	373	131	16	615	16	0	20	163	5764
40149	109	1	17	10.9	31.2	244	6	34	713	1015	26	8	186	8	0	4	93	4894
40158	110	1	21	23.8	71.6	336	4	18	330	380	11	9	40	1	0	23	30	1890
40163	112	1	27	23.9	70.9	237	6	42	306	509	247	9	44	1	0	11	124	7160

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 1 FINE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
40164	113	1	30	23.8	71.8	277	9	11	233	366	5	9	77	9	0	13	48	1325
40170	114	2	2	24.0	69.7	254	10	25	449	586	55	9	157	7	0	13	222	3770
40176	115	2	6	11.6	35.1	241	3	51	730	620	675	3	193	15	0	31	395	8046
40182	116	2	8	23.9	69.3	251	13	31	293	517	800	25	129	9	0	45	327	4900
40187	117	2	12	22.0	63.7	43	3	27	436	719	21	2	69	6	0	2	102	1410
40193	118	2	14	12.0	34.7	68	4	48	323	555	327	3	207	15	0	39	918	7134
40199	119	2	20	6.7	19.4	220	6	82	932	113	242	7	3097	149	0	7	484	13600
40205	120	2	22	14.1	41.7	247	6	71	481	670	53	3	139	3	0	39	311	8390
40211	121	2	26	23.8	67.9	43	11	15	142	32	34	2	93	6	0	12	79	1659
40217	122	2	28	9.5	28.1	220	4	66	597	538	172	4	1515	133	0	4	488	7739
40223	123	3	4	23.8	52.9	171	15	23	180	285	2	2	107	5	0	5	81	4032
40228	124	3	7	20.6	46.4	61	4	36	444	426	35	2	319	56	0	14	190	4662
40234	125	3	10	23.9	52.7	235	13	49	270	307	60	10	552	13	0	18	212	6503
40240	126	3	14	23.9	54.2	243	15	33	311	398	28	7	457	25	0	15	235	3578
40246	127	3	16	23.8	53.8	232	12	54	278	525	100	2	574	20	0	12	198	5909
40252	128	3	20	19.3	43.2	247	1	53	631	1099	64	3	772	41	0	38	689	4091
40258	129	3	22	23.8	52.0	28	2	29	588	802	13	2	293	18	0	13	309	1924
40264	130	3	26	23.9	52.7	253	13	20	215	357	2	7	144	0	0	26	186	2907
40270	131	3	28	23.8	53.0	177	7	25	409	830	67	2	537	15	0	7	472	2114

S T A T I S T I C S

	FSP	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
AVERAGE	40.5	682.5	921.2	171.1	7.0	684.3	29.9	1.4	14.0	309.0	5105.1
STANDARD DEVIATION	25.4	501.9	964.3	318.5	6.4	886.0	33.5	2.5	11.2	283.9	4975.8

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 1 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
20001	41	6	27	5.8	12.2	212	5	5424	838	163	4292	81	14390	0	588	0	4946	0	858
20021	49	7	19	7.3	15.7	193	6	7933	651	0	445	19	12949	305	1061	0	19275	0	2733
20028	50	7	21	6.6	15.1	205	5	3581	679	179	145	159	54446	318	663	0	17241	0	464
20036	51	7	25	7.5	15.2	209	5	2407	674	157	427	111	10849	263	197	0	3949	184	329
20077	60	8	18	17.7	41.1	156	3	1529	249	72	97	24	7297	0	145	0	2529	243	145
20080	61	8	22	17.7	39.0	238	4	1399	262	51	128	76	11666	0	102	0	4538	179	25
20109	62	8	24	7.1	17.7	211	7	5231	580	169	396	0	37960	0	453	0	13533	0	0
20081	64	8	30	17.7	43.1	187	3	1238	238	46	255	69	5318	0	139	0	1463	116	185
20087	65	9	1	18.0	45.3	235	1	2252	1357	66	66	0	6885	88	154	66	2383	308	44
20095	66	9	7	18.0	43.4	284	3	2613	692	69	115	0	6680	46	69	69	2741	0	184
20100	67	9	11	17.2	43.7	204	11	3117	888	45	183	45	46977	0	572	0	9594	0	366
20073	68	9	13	23.6	56.1	47	9	3878	479	0	53	53	784	0	178	0	71	71	17
40003	69	9	17	23.6	53.2	51	3	398	192	0	263	56	2144	338	0	0	940	112	0
40007	70	9	19	23.6	54.0	32	4	1646	848	37	185	55	3555	0	0	0	1259	92	0
20201	72	9	23	23.9	50.0	92	2	704	709	0	100	20	1701	0	120	0	460	280	20
40016	73	9	26	23.7	51.2	205	3	1580	977	0	254	117	6331	0	58	0	2051	0	0
40022	74	9	29	23.6	51.6	114	2	2071	1169	58	0	0	2034	0	58	0	290	426	0
40034	76	10	5	23.7	54.1	163	8	1480	452	0	0	18	7996	0	92	0.	2991	0	166
40040	77	10	7	23.8	55.2	274	10	188	185	0	36	72	797	416	0	0	326	90	144
40028	78	10	11	23.8	54.4	168	3	3141	1090	55	36	0	10540	0	73	0	4102	257	0
20094	79	10	13	23.6	42.8	15	2	3371	1018	70	1517	0	3618	280	140	70	1657	0	233
20214	82	10	23	23.6	58.6	313	6	1294	174	0	272	68	5285	0	238	0	2796	0	0
40046	83	10	25	23.6	70.3	192	10	2600	747	0	996	455	17805	1095	441	0	4312	0	1323
40052	84	10	29	23.7	70.6	165	5	854	145	0	368	99	3510	608	184	0	1642	0	0
40058	85	10	31	23.5	67.5	219	6	2795	492	29	3168	103	17559	533	222	0	7254	0	222
40064	87	11	4	6.9	19.7	209	5	1074	2156	50	4513	50	11054	405	304	0	8164	0	0
40070	88	11	7	23.0	66.3	254	3	156	154	30	844	0	2066	678	105	0	754	0	120
40076	89	11	10	23.7	68.5	116	2	3867	774	0	978	0	14905	0	175	0	3927	379	291
40136	105	1	2	23.7	70.1	288	7	1094	474	14	1369	99	5821	684	42	0	4437	0	71
40133	106	1	9	23.8	68.6	221	12	1139	149	29	1327	58	17558	787	58	0	7714	0	131
40139	107	1	11	14.8	42.9	190	1	894	239	0	2659	23	6111	0	233	0	6018	0	209
40144	108	1	15	23.8	68.7	243	14	544	149	43	1092	0	11649	0	43	0	7936	0	72
40149	109	1	17	10.9	31.2	244	6	3169	1285	96	480	0	8578	0	96	0	5985	0	0
40158	110	1	21	23.8	71.6	336	4	144	289	0	1409	27	4633	2456	111	0	3433	0	0
40163	112	1	27	23.9	70.9	237	6	296	374	0	3284	0	22839	1099	0	0	13788	0	0

NIAGARA FRONTIER STUDY

***** SITE # 1 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
40164	113	1	30	23.8	71.8	277	9	472	142	0	654	0	2395	459	55	97	2423	0	69
40170	114	2	2	24.0	69.7	254	10	451	445	0	1205	258	9471	846	172	0	2683	0	0
40176	115	2	6	11.6	35.1	241	3	778	292	0	4107	0	18311	1340	85	0	15744	0	256
40182	116	2	8	23.9	69.3	251	13	806	147	14	2581	0	10757	0	43	0	8161	0	201
40187	117	2	12	22.0	63.7	43	3	726	160	47	1569	15	2699	0	204	0	2574	0	0
40193	118	2	14	12.0	34.7	68	4	1757	603	0	4066	57	13383	0	317	0	4182	0	288
40199	119	2	20	6.7	19.4	220	6	4293	1673	51	411	0	35116	0	565	0	16555	0	0
40205	120	2	22	14.1	41.7	247	6	979	245	0	3953	167	24083	0	167	0	7117	0	239
40211	121	2	26	23.8	67.9	43	11	538	350	0	529	0	2767	0	117	0	1015	0	176
40217	122	2	28	9.5	28.1	220	4	1574	365	35	4882	0	18674	0	641	0	6450	0	1888
40223	123	3	4	23.8	52.9	171	15	395	193	0	113	0	6772	0	227	0	2251	0	378
40228	124	3	7	20.6	46.4	61	4	2344	220	21	3144	0	10833	0	0	0	3833	0	581
40234	125	3	10	23.9	52.7	235	13	417	194	18	6775	0	19889	0	0	0	6054	0	835
40240	126	3	14	23.9	54.2	243	15	825	447	0	2362	258	10391	350	221	0	3525	0	461
40246	127	3	16	23.8	53.8	232	12	1576	556	18	10044	390	15941	0	130	0	6045	0	911
40252	128	3	20	19.3	43.2	247	1	2183	997	0	6251	416	8288	0	0	0	4144	0	717
40258	129	3	22	23.8	52.0	28	2	1630	197	38	3328	0	3963	0	0	0	2232	0	519
40264	130	3	26	23.9	52.7	253	13	512	194	18	1744	94	7224	0	0	0	2806	0	189
40270	131	3	28	23.8	53.0	177	7	1260	905	0	1262	395	5202	282	301	0	1319	0	584

STATISTICS

	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
AVERAGE	1826.2	558.4	33.1	1680.2	74.2	11675.0	253.3	191.8	5.6	5066.9	50.7	308.2
STANDARD DEVIATION	1547.2	429.6	45.9	2077.2	114.3	11023.5	453.6	211.7	20.3	4581.0	106.2	493.8

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 2 FINE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
20002	40	6	25	6.1	12.5	226	5	29	805	1247	11	11	342	11	11	11	99	2957
20008	41	6	27	6.1	12.5	212	5	82	1077	177	144	11	2843	144	0	11	488	8752
20022	49	7	19	8.8	18.3	193	6	109	680	120	392	7	2085	60	0	7	1216	24065
20029	51	7	25	13.5	27.1	209	5	52	357	331	61	5	755	25	5	10	418	8122
20071	60	8	18	18.1	43.8	156	3	39	509	1101	41	3	1025	31	3	6	322	4111
20066	61	8	22	10.3	20.4	238	4	48	271	108	6	6	665	13	6	6	380	6751
20110	62	8	24	18.1	38.0	211	7	74	710	965	65	3	459	21	0	3	331	8245
20082	64	8	30	18.1	38.8	187	3	28	1102	1880	107	3	628	21	3	10	321	2712
20088	65	9	1	15.3	32.2	235	1	50	1122	1458	81	4	675	34	4	21	649	4681
20112	67	9	11	6.8	14.6	204	11	85	956	151	94	9	4206	142	9	18	947	13234
20231	68	9	13	23.4	50.3	47	9	7	294	415	2	2	30	0	0	5	57	368
40002	69	9	17	20.8	43.2	51	3	18	724	1250	3	6	19	3	0	3	32	907
40008	70	9	19	21.8	45.7	32	4	23	966	1202	3	3	109	9	0	6	308	1678
20202	72	9	23	24.0	47.3	92	2	14	1004	1696	2	5	102	2	2	2	114	694
40017	73	9	26	24.0	50.3	205	3	22	713	801	2	2	517	19	0	2	322	2122
40023	74	9	29	24.0	50.3	114	2	15	1063	1518	8	2	104	11	0	5	137	1038
40033	76	10	5	24.0	52.7	163	8	23	275	160	26	2	522	18	0	2	131	2909
40041	77	10	7	24.0	53.1	274	10	25	1388	203	117	7	3033	80	0	2	498	2764
40035	78	10	11	12.5	26.0	168	3	50	1506	2034	63	5	772	42	0	10	505	5447
20122	80	10	17	23.7	48.7	64	1	23	1776	3649	25	2	272	34	0	8	278	605
40047	83	10	25	24.0	52.8	192	10	41	595	359	123	10	2626	68	2	7	1338	4793
40053	84	10	29	24.1	53.2	165	4	20	653	952	2	13	179	15	2	26	143	2110
40059	85	10	31	24.1	49.8	219	6	48	653	514	63	8	1618	50	0	11	964	5569
40065	87	11	4	13.1	28.6	209	5	84	968	726	135	9	1248	62	4	4	745	12354
40071	88	11	7	20.1	42.2	254	3	22	1165	1569	16	3	157	9	0	3	164	1251
40077	89	11	10	22.7	50.0	116	2	59	2073	3628	144	22	928	110	5	13	371	6336
40143	112	1	27	24.2	53.0	237	6	25	127	127	2	5	88	5	0	2	10	3353
40165	113	1	30	24.2	52.8	277	9	25	653	238	110	2	1959	65	0	2	246	2538
40171	114	2	2	24.3	53.7	254	10	30	649	275	41	2	930	23	0	10	201	2809
40177	115	2	6	12.0	26.5	241	3	54	287	523	62	5	847	52	0	5	313	6399
40183	116	2	8	24.3	52.8	251	13	53	407	398	65	2	1285	52	0	2	215	6733
40188	117	2	12	22.7	50.0	43	3	34	778	1142	38	2	676	108	0	8	177	2381
40194	118	2	14	24.3	53.4	68	4	25	327	360	44	2	184	15	0	18	85	2743
40200	119	2	20	11.4	26.2	220	6	64	381	195	137	5	682	63	0	21	285	12870
40206	120	2	22	13.2	28.9	247	6	78	359	633	14	4	503	19	0	9	62	11273

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 2 FINE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
40212	121	2	26	24.3	52.0	43	11	18	255	436	42	2	378	213	0	15	98	1846
40218	122	2	28	16.3	35.4	220	4	88	363	465	121	3	1549	86	3	11	238	7106
40224	123	3	4	24.3	51.4	171	15	19	132	134	2	2	460	21	0	10	21	3207
40229	124	3	7	24.2	52.2	61	4	31	392	517	10	5	156	18	0	5	188	4535
40235	125	3	10	24.2	51.3	235	13	38	202	256	37	2	553	26	0	2	153	5234
40241	126	3	14	24.2	52.3	243	15	36	307	111	42	2	2381	79	2	5	203	4008
40247	127	3	16	24.3	52.0	232	12	32	207	215	31	2	191	13	0	2	130	2703
40253	128	3	20	16.6	35.4	247	1	76	739	825	39	3	1898	66	0	27	916	5057
40259	129	3	22	24.3	50.8	28	2	35	545	877	32	2	643	21	0	13	468	3085
40265	130	3	26	24.2	51.0	253	13	34	290	249	37	2	2961	81	2	2	303	3851
40271	131	3	28	24.3	51.4	177	7	22	206	409	53	2	487	16	0	10	196	2226

S T A T I S T I C S

	FSP	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
AVERAGE	41.5	678.1	795.6	58.6	4.8	972.4	45.1	1.4	8.5	343.2	4968.1
STANDARD DEVIATION	24.0	438.3	807.6	67.0	3.9	970.6	44.0	2.5	6.5	308.9	4338.0

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 2 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
20002	40	6	25	6.1	12.5	226	5	827	2229	119	382	0	6494	0	0	0	3513	0	637
20008	41	6	27	6.1	12.5	212	5	6019	1888	0	3969	0	20288	0	320	0	8299	0	1900
20022	49	7	19	8.8	18.3	193	6	7283	559	152	174	120	26050	0	654	0	11729	0	981
20029	51	7	25	13.5	27.1	209	5	2720	377	147	294	0	18577	147	221	0	6561	73	368
20071	60	8	18	18.1	43.8	156	3	2177	477	0	91	45	8957	0	182	0	3313	137	114
20066	61	8	22	10.3	20.4	238	4	1942	502	210	0	29	21731	156	490	0	8190	0	441
20110	62	8	24	18.1	38.0	211	7	2550	269	78	368	0	31570	0	105	0	9839	78	0
20082	64	8	30	18.1	38.8	187	3	1363	635	103	206	51	6261	103	180	103	2267	257	128
20088	65	9	1	15.3	32.2	235	1	3033	989	93	217	0	10935	124	217	124	3727	186	62
20112	67	9	11	6.8	14.6	204	11	2993	701	136	205	68	32147	0	547	0	11696	0	0
20231	68	9	13	23.4	50.3	47	9	825	203	0	79	79	794	0	158	0	0	79	0
40002	69	9	17	20.8	43.2	51	3	240	237	0	254	92	2198	323	0	0	833	161	0
40008	70	9	19	21.8	45.7	32	4	1366	1087	43	196	87	4243	0	0	0	1399	196	0
20202	72	9	23	24.0	47.3	92	2	219	624	21	126	42	1713	0	105	0	465	232	21
40017	73	9	26	24.0	50.3	205	3	1481	597	59	0	0	4771	39	39	0	1729	119	0
40023	74	9	29	24.0	50.3	114	2	206	203	0	0	79	2327	596	0	0	835	39	0
40033	76	10	5	24.0	52.7	163	8	624	194	0	0	0	7071	0	75	0	2843	0	113
40041	77	10	7	24.0	53.1	274	10	1177	193	0	113	75	5710	339	320	0	678	0	810
40035	78	10	11	12.5	26.0	168	3	3205	974	0	192	153	11418	1230	346	0	4959	230	307
20122	80	10	17	23.7	48.7	64	1	832	1281	20	307	143	1641	0	20	0	61	574	0
40047	83	10	25	24.0	52.8	192	10	4399	708	0	378	113	10380	454	397	0	2102	0	1193
40053	84	10	29	24.1	53.2	165	4	1717	192	0	545	37	4153	657	150	0	1935	0	0
40059	85	10	31	24.1	49.8	219	6	3367	433	60	1465	100	12788	0	260	0	5380	0	521
40065	87	11	4	13.1	28.6	209	5	4187	1520	69	1992	0	28241	1083	139	0	12443	0	244
40071	88	11	7	20.1	42.2	254	3	1027	568	71	663	0	2773	0	142	0	687	165	118
40077	89	11	10	22.7	50.0	116	2	6419	1834	0	600	0	16409	0	220	0	4562	520	400
40143	112	1	27	24.2	53.0	237	6	195	193	37	3432	0	7486	0	18	0	8259	0	94
40165	113	1	30	24.2	52.8	277	9	870	194	0	1382	227	5601	0	246	0	1742	0	454
40171	114	2	2	24.3	53.7	254	10	193	523	0	1637	372	5749	0	223	0	2177	0	0
40177	115	2	6	12.0	26.5	241	3	1977	387	0	5175	0	11220	1851	37	0	13298	0	340
40183	116	2	8	24.3	52.8	251	13	1264	194	18	3315	1117	15858	0	0	0	14437	0	170
40188	117	2	12	22.7	50.0	43	3	2212	479	60	2902	60	4243	0	260	0	4743	0	0
40194	118	2	14	24.3	53.4	68	4	194	192	0	2961	0	4460	0	206	112	2061	0	187
40200	119	2	20	11.4	26.2	220	6	2657	391	38	267	0	26834	0	229	0	18348	0	0
40206	120	2	22	13.2	28.9	247	6	1386	355	0	3844	484	28957	0	0	0	9594	0	450

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 2   FINE PARTICULATE DATA   (PART - 2)   *****

FILTER #	R U N	M O N	D A Y	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
40212	121	2	26	24.3	52.0	43	11	3407	197	0	327	0	2885	0	153	0	904	0	134
40218	122	2	28	16.3	35.4	220	4	1608	289	56	12602	254	15286	0	0	0	8166	0	0
40224	123	3	4	24.3	51.4	171	15	202	199	0	194	0	5720	8328	0	0	2101	0	428
40229	124	3	7	24.2	52.2	61	4	1242	703	0	1572	0	9950	0	0	0	3259	0	364
40235	125	3	10	24.2	51.3	235	13	456	199	19	3118	214	13060	0	0	0	4600	0	487
40241	126	3	14	24.2	52.3	243	15	198	196	0	1778	210	9353	688	229	0	3404	0	478
40247	127	3	16	24.3	52.0	232	12	812	197	57	6328	96	6443	0	.134	0	3750	0	673
40253	128	3	20	16.6	35.4	247	1	3323	696	0	8931	1.752	10712	0	0	0	6076	0	960
40259	129	3	22	24.3	50.8	28	2	1092	436	78	3522	78	5509	0	334	0	2558	0	590
40265	130	3	26	24.2	51.0	253	13	1099	200	0	1293	509	10248	0	0	0	3625	0	666
40271	131	3	28	24.3	51.4	177	7	1188	199	0	836	194	5331	0	194	0	1362	0	603
S T A T I S T I C S							AVERAGE	1908.1	564.0	37.9	1702.0	149.6	10969.7	350.4	164.1	7.4	4880.6	66.2	335.6
							STANDARD DEVIATION	1684.8	491.9	51.6	2520.1	309.5	8645.5	1261.2	157.9	28.3	4356.8	129.0	388.1

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 3 FINE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
20003	40	6	25	5.6	11.6	226	5	38	1380	2117	11	23	309	11	11	11	71	2534
20009	41	6	27	5.9	12.3	212	5	67	1904	664	67	11	4620	112	0	11	1228	6107
20024	49	7	19	12.5	25.8	193	6	88	653	85	91	5	1650	26	5	5	814	15859
20032	50	7	21	17.7	36.5	205	5	92	629	322	269	3	1570	26	0	3	660	12670
20038	51	7	25	18.2	37.4	209	5	38	540	521	25	44	614	14	0	3	470	6395
20055	54	8	2	16.4	31.0	197	6	48	366	71	35	17	599	13	0	17	187	7528
20053	55	8	6	17.2	35.1	330	2	35	591	489	31	3	244	7	0	3	43	4503
20060	56	8	8	10.8	21.1	219	13	69	334	531	45	6	1796	45	6	6	452	12459
20059	58	8	12	13.5	25.6	181	4	50	346	568	48	5	400	27	5	16	119	6388
20075	59	8	15	18.2	34.8	150	4	57	544	302	51	3	671	27	3	19	59	7437
20072	60	8	18	18.2	36.3	156	3	26	751	1285	26	3	476	19	3	3	87	2853
20064	61	8	22	18.1	35.4	238	4	42	446	426	23	3	587	19	7	3	207	5181
20107	62	8	24	12.5	23.8	211	7	93	769	571	635	11	1842	52	5	11	577	11943
20083	64	8	30	18.1	37.4	187	3	21	747	821	11	3	440	22	3	7	144	2115
20089	65	9	1	16.7	34.5	235	1	39	1364	1854	80	4	485	32	4	4	272	3876
20096	66	9	7	18.2	35.4	284	3	25	429	394	19	3	324	23	3	3	218	3191
20098	67	9	11	17.6	36.1	204	11	95	402	61	72	3	1504	46	7	7	376	16025
20211	68	9	13	24.1	49.6	47	9	6	226	343	2	2	11	2	0	5	47	332
40006	69	9	17	24.1	50.5	51	3	14	753	959	2	2	24	2	0	2	63	984
40009	70	9	19	24.1	50.2	32	4	16	556	722	2	2	46	5	0	5	187	1613
20203	72	9	23	23.6	45.2	92	2	13	1126	1938	3	3	76	9	3	6	73	725
40018	73	9	26	23.7	49.4	205	3	18	886	928	11	2	260	14	0	2	182	1632
40024	74	9	29	23.6	49.0	114	2	17	1447	2344	2	2	104	16	0	2	149	1165
40031	76	10	5	23.8	49.4	163	8	12	75	120	2	14	434	8	0	11	75	2087
40030	77	10	7	23.7	50.2	274	10	9	146	159	2	2	104	0	0	5	57	1433
40036	78	10	11	23.7	48.1	168	3	32	981	1217	34	5	371	14	0	8	198	4226
20127	80	10	17	23.6	48.7	64	1	19	1536	3526	2	2	210	25	0	2	224	654
20215	82	10	23	23.5	47.3	313	6	19	280	412	46	8	134	14	0	11	84	1968
40049	83	10	25	23.7	49.3	192	10	0	0	0	0	0	0	0	0	0	0	0
40054	84	10	29	23.7	49.5	165	5	75	637	716	0	0	0	0	0	0	114	2377
40060	85	10	31	23.7	49.1	219	6	42	538	363	67	14	1203	45	0	11	603	5249
40066	87	11	4	16.6	34.6	209	5	75	935	1191	103	3	1075	43	3	3	687	10891
40072	88	11	7	22.5	47.0	254	3	19	1105	1745	2	8	135	11	0	11	129	1376
40078	89	11	10	23.7	49.5	116	2	51	1645	2765	125	13	596	39	2	2	173	5959
40091	93	11	22	23.6	51.8	281	4	16	618	1292	2	2	61	0	0	2	155	1335

NIAGARA FRONTIER STUDY

***** SITE # 3 FINE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
40088	94	11	28	23.7	52.5	98	7	26	226	300	21	2	255	13	0	10	282	2648
40099	95	11	30	23.6	46.7	80	9	31	204	136	32	2	645	23	0	11	497	4209
40097	96	12	4	23.7	47.6	43	17	22	346	46	26	5	614	26	0	8	460	3980
40103	97	12	6	23.7	48.1	75	6	35	460	478	60	2	688	25	0	5	941	3427
40107	98	12	10	23.6	47.4	103	12	6	87	46	2	2	32	5	0	2	160	1882
40110	99	12	12	23.7	47.8	37	9	28	269	46	69	2	805	28	0	14	223	5174
40114	101	12	16	23.7	48.1	209	10	35	354	363	63	5	873	20	2	2	374	4105
40118	102	12	19	23.6	49.3	307	3	24	359	457	42	5	469	25	0	14	185	3193
40123	103	12	22	23.7	49.6	229	12	22	296	385	30	2	913	33	2	2	259	3109
40122	104	12	28	23.7	50.3	322	4	42	1112	1145	68	8	2465	60	2	13	275	4459
40135	105	1	2	23.7	50.5	288	7	19	186	216	8	2	304	13	0	10	71	2705
40134	106	1	9	23.7	48.3	221	12	33	450	292	71	5	1471	40	0	2	777	4415
40013	107	1	11	15.8	34.4	190	1	42	547	1184	40	4	435	20	0	4	817	3537
40145	108	1	15	23.7	47.6	243	14	22	352	171	96	2	762	20	2	2	448	2921
40150	109	1	17	20.6	41.8	244	6	26	397	222	19	3	291	9	0	3	86	5268
40157	110	1	21	15.3	31.4	336	4	36	312	308	4	13	22	0	0	48	30	2803
40162	112	1	27	23.8	52.1	237	6	23	111	146	2	2	77	7	0	2	162	3412
40166	113	1	30	24.0	52.5	277	9	14	57	200	2	2	221	10	0	5	173	2105
40172	114	2	2	24.0	52.4	254	10	14	290	454	31	2	100	7	0	2	163	826
40178	115	2	6	18.8	41.3	241	3	37	532	566	93	3	794	26	0	3	268	5996
40184	116	2	8	24.0	52.4	251	13	19	182	42	13	2	256	10	0	2	203	3402
40189	117	2	12	22.9	50.1	43	3	25	618	806	8	2	85	2	0	13	151	1950
40195	118	2	14	18.1	39.3	68	4	30	418	408	63	3	232	14	0	3	172	3274
40201	119	2	20	9.9	21.6	220	6	70	1020	468	346	6	3112	102	6	32	776	12951
40207	120	2	22	14.3	31.0	247	6	48	290	227	13	4	133	4	0	8	263	11174
40213	121	2	26	23.5	50.5	43	11	12	150	43	2	2	49	0	0	8	79	1886
40219	123	3	4	24.0	50.7	171	15	16	128	234	2	2	32	2	0	2	68	3308
40230	124	3	7	24.0	51.2	61	4	27	431	424	8	2	227	8	0	5	218	4898
40236	125	3	10	24.0	50.3	235	13	39	429	129	63	2	1163	41	0	2	294	6612
40242	126	3	14	24.0	51.5	243	15	30	276	164	16	2	1078	51	0	2	258	4342
40248	127	3	16	24.0	51.0	232	12	53	559	353	97	13	1491	97	0	5	366	6085
40254	128	3	20	19.2	40.5	247	1	46	683	718	47	3	1015	47	3	23	872	4818
40260	129	3	22	24.0	49.7	28	2	30	517	885	47	2	498	19	2	2	473	2981
40266	130	3	26	24.0	50.1	253	13	16	116	174	2	2	276	16	0	2	218	1868
40272	131	3	28	24.0	50.9	176	7	16	168	440	16	2	201	5	0	2	179	1976

STATISTICS		FSP	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
	AVERAGE	34.1	552.4	635.7	49.5	5.1	643.7	22.8	1.3	7.0	291.8	4468.1
	STANDARD DEVIATION	22.0	408.3	681.6	90.4	6.4	781.8	22.7	2.3	7.6	256.9	3593.5

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 3 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
20003	40	6	25	5.6	11.6	226	5	892	880	85	515	0	5283	0	85	0	2886	214	343
20009	41	6	27	5.9	12.3	212	5	2625	833	8	2091	699	14784	0	504	0	4442	0	2367
20024	49	7	19	12.5	25.8	193	6	5550	396	46	0	116	22978	0	669	0	7052	0	746
20032	50	7	21	17.7	36.5	205	5	3008	280	112	0	57	53643	265	383	0	8216	0	876
20038	51	7	25	18.2	37.4	209	5	2180	1080	120	66	16	13375	56	160	0	4329	0	320
20055	54	8	2	16.4	31.0	197	6	2177	330	0	0	0	20351	148	129	0	5455	0	387
20053	55	8	6	17.2	35.1	330	2	1786	914	108	76	113	11520	0	170	0	4897	99	199
20060	56	8	8	10.8	21.1	219	13	2603	485	151	307	156	18584	189	426	0	6676	85	994
20059	58	8	12	13.5	25.6	181	4	1804	400	0	109	0	15954	160	234	86	6259	39	273
20075	59	8	15	18.2	34.8	150	4	1741	667	86	0	28	31831	28	200	0	6773	28	86
20072	60	8	18	18.2	36.3	156	3	667	282	0	27	110	6031	0	247	0	2451	165	192
20064	61	8	22	18.1	35.4	238	4	1408	289	129	48	14	19138	203	169	0	6216	0	197
20107	62	8	24	12.5	23.8	211	7	3118	431	126	0	0	45034	168	294	0	10774	0	42
20083	64	8	30	18.1	37.4	187	3	1154	573	106	106	26	4300	106	186	160	1842	106	53
20089	65	9	1	16.7	34.5	235	1	2777	296	86	173	0	8229	173	173	0	3245	202	57
20096	66	9	7	18.2	35.4	284	3	1726	289	84	84	0	6544	84	112	0	2961	56	28
20098	67	9	11	17.6	36.1	204	11	3956	283	110	0	0	54281	0	304	0	8866	27	193
20211	68	9	13	24.1	49.6	47	9	209	206	0	0	80	806	0	100	0	0	0	0
40006	69	9	17	24.1	50.5	51	3	751	649	39	257	39	2375	0	0	0	1049	138	0
40009	70	9	19	24.1	50.2	32	4	852	419	19	39	79	3722	0	39	0	1393	79	0
20203	72	9	23	23.6	45.2	92	2	783	839	22	88	66	1724	0	176	0	265	265	44
40018	73	9	26	23.7	49.4	205	3	1099	650	60	0	0	3746	60	60	0	1275	141	0
40024	74	9	29	23.6	49.0	114	2	692	209	0	0	61	1735	0	0	0	489	0	0
40031	76	10	5	23.8	49.4	163	8	535	207	40	0	0	3984	0	80	0	1254	0	0
40030	77	10	7	23.7	50.2	274	10	206	504	19	0	19	2328	0	19	0	915	19	0
40036	78	10	11	23.7	48.1	168	3	2125	984	0	20	83	9189	436	270	0	3929	124	353
20127	80	10	17	23.6	48.7	64	1	603	876	0	82	123	1644	0	102	0	143	472	61
20215	82	10	23	23.5	47.3	313	6	1506	611	0	147	84	4858	0	147	0	2703	0	0
40049	83	10	25	23.7	49.3	192	10	0	0	0	0	0	0	0	0	0	0	0	0
40054	84	10	29	23.7	49.5	165	5	1264	416	0	262	20	4463	1454	242	0	1939	60	0
40060	85	10	31	23.7	49.1	219	6	3185	916	61	488	81	13515	162	305	0	6146	0	386
40066	87	11	4	16.6	34.6	209	5	4701	295	57	635	0	25230	1270	404	0	11258	0	317
40072	88	11	7	22.5	47.0	254	3	958	218	85	446	0	2809	0	148	0	659	191	106
40078	89	11	10	23.7	49.5	116	2	3554	850	0	444	0	15945	0	242	0	4607	262	363
40091	93	11	22	23.6	51.8	281	4	575	757	0	425	57	2067	0	154	0	598	251	154

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 3   FINE PARTICULATE DATA   (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
40088	94	11	28	23.7	52.5	98	7	1432	195	0	838	0	6419	0	114	0	2704	0	285
40099	95	11	30	23.6	46.7	80	9	847	219	42	1240	171	7871	0	213	0	3358	0	0
40097	96	12	4	23.7	47.6	43	17	218	215	42	252	42	6497	0	168	0	2186	0	525
40103	97	12	6	23.7	48.1	75	6	648	457	41	2703	103	5822	0	207	145	1954	0	561
40107	98	12	10	23.6	47.4	103	12	558	485	168	232	21	2890	0	147	42	1055	0	105
40110	99	12	12	23.7	47.8	37	9	1287	759	41	104	20	10150	0	188	0	3285	0	0
40114	101	12	16	23.7	48.1	209	10	1287	213	0	915	0	7073	582	208	0	4867	0	0
40118	102	12	19	23.6	49.3	307	3	1513	609	0	912	0	6124	709	141	0	4867	0	202
40123	103	12	22	23.7	49.6	229	12	1246	206	40	1291	40	5749	0	221	0	2138	0	0
40122	104	12	28	23.7	50.3	322	4	206	203	19	1531	357	9864	0	278	0	3739	0	0
40135	105	1	2	23.7	50.5	288	7	1026	620	0	1148	0	5130	851	59	0	4318	0	178
40134	106	1	9	23.7	48.3	221	12	1419	212	0	2091	0	7971	2132	414	0	3768	0	848
40013	107	1	11	15.8	34.4	190	1	302	298	87	1774	116	5875	1279	203	58	1657	0	232
40145	108	1	15	23.7	47.6	243	14	1612	215	63	630	0	4832	0	231	0	2122	0	294
40150	109	1	17	20.6	41.8	244	6	2065	503	71	95	0	9336	0	71	0	5937	0	0
40157	110	1	21	15.3	31.4	336	4	330	326	0	572	0	4487	572	254	0	1750	0	445
40162	112	1	27	23.8	52.1	237	6	467	196	0	537	0	6830	537	76	0	5986	0	0
40166	113	1	30	24.0	52.5	277	9	1093	195	0	932	114	4414	0	114	0	1655	0	209
40172	114	2	2	24.0	52.4	254	10	459	195	0	247	38	419	0	133	0	324	0	0
40178	115	2	6	18.8	41.3	241	3	1166	248	0	653	0	10721	169	411	0	7405	0	556
40184	116	2	8	24.0	52.4	251	13	1303	195	19	95	0	6222	0	171	0	5077	0	95
40189	117	2	12	22.9	50.1	43	3	207	204	19	1037	0	3391	0	259	0	2414	0	0
40195	118	2	14	18.1	39.3	68	4	1390	619	0	2592	0	5007	0	355	177	2211	50	254
40201	119	2	20	9.9	21.6	220	6	1790	1334	92	741	0	27988	0	787	0	10750	0	2363
40207	120	2	22	14.3	31.0	247	6	334	330	0	32	0	20993	0	386	0	5256	0	419
40213	121	2	26	23.5	50.5	43	11	205	202	0	39	0	2891	0	138	0	930	0	0
40219	123	3	4	24.0	50.7	171	15	204	202	0	39	0	5799	0	98	276	1953	98	138
40230	124	3	7	24.0	51.2	61	4	1057	565	19	97	0	9701	0	0	117	2791	58	566
40236	125	3	10	24.0	50.3	235	13	1537	203	0	774	0	15849	0	0	0	3872	0	714
40242	126	3	14	24.0	51.5	243	15	658	446	0	1009	58	8910	524	271	0	3203	0	582
40248	127	3	16	24.0	51.0	232	12	1559	201	58	4884	58	14044	0	176	0	4433	0	1059
40254	128	3	20	19.2	40.5	247	1	3252	895	49	5160	0	8518	0	0	0	3753	0	716
40260	129	3	22	24.0	49.7	28	2	1762	206	80	2231	100	5045	0	341	0	2010	0	603
40266	130	3	26	24.0	50.1	253	13	945	204	19	558	259	3712	1437	79	558	658	0	219
40272	131	3	28	24.0	50.9	176	7	845	744	0	392	157	4102	19	157	0	981	0	529
S T A T I S T I C S						AVERAGE		1414.3	449.0	39.0	647.3	54.0	10323.5	196.8	200.0	23.1	3533.3	46.1	311.9
						STANDARD DEVIATION		1106.5	278.4	45.1	1002.4	102.3	11001.4	421.2	148.2	81.1	2663.4	88.5	446.8

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 4 FINE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
20004	40	6	25	6.5	13.7	226	5	48	1165	1165	10	10	517	20	20	10	223	2615
20010	41	6	27	6.3	11.9	212	5	100	1366	712	151	11	7240	256	0	23	7287	7333
20025	49	7	19	7.8	16.1	193	6	119	891	394	128	8	3593	42	0	8	2238	22957
20039	51	7	25	12.3	24.8	209	5	32	708	379	150	5	2118	39	0	5	535	6233
20056	54	8	2	5.0	9.8	197	6	88	1171	818	14	14	1454	42	14	28	338	8908
20057	55	8	6	16.7	35.7	330	2	41	497	535	42	11	590	19	3	3	163	4597
20061	58	8	12	7.1	14.0	181	4	62	237	1137	39	9	1088	29	9	9	385	7221
20076	59	8	15	6.8	13.2	150	4	95	292	596	104	10	1516	31	20	10	397	11412
20044	60	8	18	23.9	49.3	156	3	22	736	744	168	2	649	28	2	2	339	1877
20117	61	8	22	16.2	34.1	238	4	45	674	556	73	4	1390	69	0	4	552	6406
20106	62	8	24	5.1	10.7	211	7	97	529	206	129	12	3627	103	0	12	1600	14960
20084	64	8	30	17.7	37.8	187	3	29	878	1065	54	3	812	32	3	7	1219	3046
20090	65	9	1	17.7	37.9	235	1	49	1426	1858	215	3	1082	76	3	7	526	4762
20097	66	9	7	17.7	35.8	284	3	29	313	347	42	3	498	23	3	3	595	3381
20101	67	9	11	11.1	24.9	204	11	75	705	88	238	5	3772	111	5	5	644	11888
20223	68	9	13	24.2	50.9	47	9	6	157	299	2	2	70	0	0	2	32	288
40001	69	9	17	24.1	51.9	51	3	16	447	679	2	2	69	2	0	2	34	938
40010	70	9	19	24.1	51.9	32	4	17	546	541	2	2	61	5	0	2	122	1589
20204	72	9	23	24.0	50.3	92	2	12	655	1142	2	2	88	5	0	2	74	751
40019	73	9	26	23.9	51.5	205	3	22	788	946	13	2	594	18	0	5	185	2159
40025	74	9	29	23.9	51.3	114	2	18	1061	1411	2	2	280	16	0	2	172	1325
40032	76	10	5	24.0	51.2	163	8	23	500	235	29	2	583	18	0	8	156	3378
40043	77	10	7	23.9	54.8	274	10	11	227	250	2	2	174	10	0	5	113	1426
20124	80	10	17	16.2	34.0	64	1	1	765	1522	4	4	130	12	0	4	97	590
40048	83	10	25	23.9	49.7	192	10	102	827	532	223	11	4499	125	0	5	1438	4521
40055	84	10	29	24.0	51.5	165	5	0	0	0	0	0	0	0	0	0	0	0
40061	85	10	31	17.3	36.7	219	6	53	1221	565	101	11	2986	90	0	18	1304	6632
40067	87	11	4	14.7	31.6	209	5	79	1060	972	197	13	1809	100	0	8	1029	12548
40073	88	11	7	22.3	48.3	254	3	19	751	1029	25	2	272	14	0	5	177	1193
40079	89	11	10	23.3	50.2	116	2	50	1309	2333	126	2	780	30	2	2	468	6307
40087	91	11	16	24.1	52.9	69	4	22	918	1682	18	5	232	13	0	2	177	1363
40090	92	11	20	24.1	54.2	210	6	31	265	112	38	2	761	46	0	2	651	3171
40089	93	11	22	24.2	54.3	281	4	16	497	925	7	2	84	0	0	10	124	1053
40092	94	11	28	24.0	54.8	98	7	26	202	209	32	2	242	22	0	5	171	3980
40100	97	12	6	13.9	30.5	75	6	59	468	681	186	13	1627	59	0	4	3400	4590

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 4 FINE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
40104	98	12	10	24.0	52.6	103	12	32	123	42	2	2	466	34	0	2	126	5430
40111	99	12	12	24.0	53.2	37	9	43	452	241	111	5	3277	104	2	5	658	5918
40115	101	12	16	20.8	46.3	209	10	40	520	643	131	2	1649	38	0	2	1329	4127
40119	102	12	19	24.0	53.2	307	3	19	346	304	28	10	500	20	0	5	231	2156
40124	103	12	22	24.0	54.1	229	12	43	696	330	128	10	2657	76	0	2	862	4899
40130	106	1	9	24.0	57.1	221	12	42	351	502	101	16	2621	65	0	4	1699	4339
40141	107	1	11	12.9	30.5	190	1	37	836	1486	4	4	522	27	0	4	522	2731
40146	108	1	15	24.0	56.4	243	14	44	292	272	329	4	1823	105	2	2	680	5937
40151	109	1	17	19.6	44.1	244	6	39	671	458	50	3	687	31	0	9	72	5916
40156	110	1	21	22.3	51.8	336	4	31	425	187	10	13	248	26	0	40	56	4113
40161	112	1	27	17.0	38.2	237	6	39	398	253	14	3	793	32	0	3	155	3271
40167	113	1	30	24.1	54.4	277	9	27	206	251	38	2	445	43	0	7	106	2746
40173	114	2	2	24.1	54.4	254	10	51	1226	564	119	2	1452	86	0	2	305	4875
40179	116	2	8	24.0	54.0	251	13	41	676	241	66	2	1936	125	0	2	266	6192
40190	117	2	12	21.2	47.7	43	3	28	502	828	2	2	72	2	0	2	95	1880
40196	118	2	14	16.5	37.1	68	4	30	398	499	52	3	425	18	0	14	201	3068
40202	119	2	20	9.8	22.9	220	6	78	1138	96	369	6	3688	96	6	6	2028	12148
40208	120	2	22	14.6	32.9	247	6	62	1228	218	21	4	1224	88	0	4	143	13025
40214	121	2	26	24.0	53.2	43	11	13	148	148	2	2	44	0	0	15	93	1972
40220	122	2	28	9.5	20.9	220	4	74	1223	806	595	6	3717	125	0	6	873	5635
40225	123	3	4	24.1	55.1	171	15	24	128	266	2	2	354	42	0	2	65	3699
40231	124	3	7	24.1	52.7	61	4	27	317	252	23	2	296	10	0	5	241	4498
40237	125	3	10	6.0	13.0	235	13	82	3353	1167	2663	42	32767	1178	10	10	5295	27869
40243	126	3	14	24.1	52.7	243	15	42	1071	288	73	2	2064	105	2	2	501	3824
40249	127	3	16	5.0	11.7	232	12	113	4372	1500	106	11	3828	118	11	11	2398	5105
40255	128	3	20	24.0	52.0	247	1	75	748	1072	87	2	2084	135	2	7	982	4611
40261	129	3	22	23.5	50.5	28	2	30	521	855	19	2	482	21	0	8	765	2710
40267	130	3	26	24.0	52.3	253	13	52	436	145	127	2	1677	206	0	2	248	4723
40273	131	3	28	24.0	52.9	177	7	22	285	428	28	13	698	15	2	10	230	2960

S T A T I S T I C S

	FSP	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
AVERAGE	43.7	739.7	640.7	122.9	5.8	1840.4	69.9	1.9	6.6	753.0	5246.5
STANDARD DEVIATION	28.2	675.7	493.9	338.9	6.2	4172.5	149.6	4.4	6.6	1214.6	4910.0

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 4 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
20004	40	6	25	6.5	13.7	226	5	2778	750	73	0	0	6054	0	0	0	3060	226	380
20010	41	6	27	6.3	11.9	212	5	2615	864	337	4258	801	17074	0	607	0	1559	0	2908
20025	49	7	19	7.8	16.1	193	6	10376	2692	111	315	154	27411	0	1145	0	10854	0	1021
20039	51	7	25	12.3	24.8	209	5	2163	412	181	128	120	18647	0	281	0	7487	0	281
20056	54	8	2	5.0	9.8	197	6	1058	1044	0	275	0	17380	489	407	0	6931	0	1223
20057	55	8	6	16.7	35.7	330	2	955	287	0	1152	0	11359	353	140	633	4121	381	336
20061	58	8	12	7.1	14.0	181	4	1899	732	257	150	150	44429	428	714	0	13571	0	1142
20076	59	8	15	6.8	13.2	150	4	5073	1841	226	75	75	31570	0	679	0	11480	151	528
20044	60	8	18	23.9	49.3	156	3	1500	207	20	101	20	4869	0	101	0	1176	101	385
20117	61	8	22	16.2	34.1	238	4	918	300	58	88	58	15556	0	146	0	5195	58	0
20106	62	8	24	5.1	10.7	211	7	4349	3949	93	93	0	35448	372	279	0	12208	0	838
20084	64	8	30	17.7	37.8	187	3	2296	1289	79	264	0	5764	52	158	79	951	105	423
20090	65	9	1	17.7	37.9	235	1	4327	1686	52	449	0	12229	105	422	0	3011	211	184
20097	66	9	7	17.7	35.8	284	3	3296	707	27	139	0	7198	111	195	0	2594	55	55
20101	67	9	11	11.1	24.9	204	11	2661	411	40	80	0	29281	120	280	0	9065	40	762
20223	68	9	13	24.2	50.9	47	9	925	623	0	0	78	785	0	117	0	0	0	0
40001	69	9	17	24.1	51.9	51	3	199	621	0	327	38	2310	0	0	0	1155	115	0
40010	70	9	19	24.1	51.9	32	4	794	197	96	57	0	3118	38	57	0	1270	77	0
20204	72	9	23	24.0	50.3	92	2	704	756	0	19	59	1788	0	59	0	397	158	0
40019	73	9	26	23.9	51.5	205	3	699	435	58	0	0	4971	58	116	0	1689	116	310
40025	74	9	29	23.9	51.3	114	2	1258	793	0	0	19	2163	0	19	0	584	0	58
40032	76	10	5	24.0	51.2	163	8	689	200	39	0	19	6967	0	78	0	2888	58	0
40043	77	10	7	23.9	54.8	274	10	189	187	0	36	73	2410	383	146	0	803	18	146
20124	80	10	17	16.2	34.0	64	1	863	301	0	235	88	1469	0	88	0	88	235	0
40048	83	10	25	23.9	49.7	192	10	2486	206	0	301	181	10386	583	704	0	1409	0	1469
40055	84	10	29	24.0	51.5	165	5	0	0	0	0	0	0	0	0	0	0	0	0
40061	85	10	31	17.3	36.7	219	6	3997	279	54	1306	217	13395	1824	435	0	4219	0	1742
40067	87	11	4	14.7	31.6	209	5	5292	665	63	917	0	27459	1455	474	0	11483	0	664
40073	88	11	7	22.3	48.3	254	3	671	212	41	0	0	82	0	144	0	642	0	165
40079	89	11	10	23.3	50.2	116	2	4161	821	0	438	0	15392	0	199	0	4540	258	358
40087	91	11	16	24.1	52.9	69	4	1033	193	0	623	0	2890	0	94	0	1020	245	151
40090	92	11	20	24.1	54.2	210	6	1027	189	0	1033	202	7067	0	221	0	2103	0	1162
40089	93	11	22	24.2	54.3	281	4	191	188	0	405	36	2245	0	257	0	570	239	147
40092	94	11	28	24.0	54.8	98	7	1262	523	0	200	73	7268	0	182	0	2739	0	365
40100	97	12	6	13.9	30.5	75	6	340	700	98	5677	722	9156	0	623	0	820	0	1673

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 4 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
40104	98	12	10	24.0	52.6	103	12	1335	402	133	95	0	10135	0	228	0	3270	0	608
40111	99	12	12	24.0	53.2	37	9	1248	192	18	2610	56	12283	0	375	0	3981	0	93
40115	101	12	16	20.8	46.3	209	10	1652	221	0	2679	172	7132	950	561	0	3112	0	972
40119	102	12	19	24.0	53.2	307	3	1021	841	0	921	0	3686	733	94	0	2595	0	188
40124	103	12	22	24.0	54.1	229	12	1530	189	18	2920	406	10129	0	517	0	3216	0	1201
40130	106	1	9	24.0	57.1	221	12	1097	410	87	2681	543	9113	0	560	0	1770	0	1735
40141	107	1	11	12.9	30.5	190	1	340	777	32	1969	0	5021	0	328	0	2756	0	164
40146	108	1	15	24.0	56.4	243	14	1182	181	53	1774	88	11036	0	496	0	4985	0	1579
40151	109	1	17	19.6	44.1	244	6	1650	821	90	498	0	13272	0	90	0	9127	0	0
40156	110	1	21	22.3	51.8	336	4	200	197	0	1158	0	7512	0	173	0	3109	0	463
40161	112	1	27	17.0	38.2	237	6	1307	268	0	1726	837	9102	1334	366	0	8631	0	1098
40167	113	1	30	24.1	54.4	277	9	190	188	0	698	238	6027	0	220	0	2517	0	349
40173	114	2	2	24.1	54.4	254	10	536	188	0	1028	900	0	0	385	0	3196	0	275
40179	116	2	8	24.0	54.0	251	13	661	487	0	129	0	13793	0	370	0	8665	0	666
40190	117	2	12	21.2	47.7	43	3	616	665	0	1510	20	3357	0	251	0	881	0	146
40196	118	2	14	16.5	37.1	68	4	279	275	0	2664	0	4818	0	457	0	2234	0	511
40202	119	2	20	9.8	22.9	220	6	454	448	87	1268	43	26847	0	1180	0	7608	0	3716
40208	120	2	22	14.6	32.9	247	6	1725	311	0	151	0	27347	0	577	0	7748	0	1002
40214	121	2	26	24.0	53.2	43	11	601	192	0	131	0	2930	0	169	0	1052	0	0
40220	122	2	28	9.5	20.9	220	4	496	489	0	6542	1528	9933	0	1337	0	4011	0	1050
40225	123	3	4	24.1	55.1	171	15	188	185	0	90	0	7490	0	0	0	2285	0	489
40231	124	3	7	24.1	52.7	61	4	804	415	37	284	0	9523	0	0	0	2750	56	607
40237	125	3	10	6.0	13.0	235	13	795	785	76	5363	1762	63804	0	4214	0	12337	0	8275
40243	126	3	14	24.1	52.7	243	15	399	194	0	1801	891	9140	0	398	0	3451	0	1593
40249	127	3	16	5.0	11.7	232	12	886	874	0	4010	5290	10238	0	1621	0	3839	0	5716
40255	128	3	20	24.0	52.0	247	1	3059	197	38	7381	768	11380	0	0	0	4306	0	922
40261	129	3	22	23.5	50.5	28	2	1503	441	79	2277	99	4872	0	336	0	1723	0	594
40267	130	3	26	24.0	52.3	253	13	1174	867	0	1203	936	12571	1700	534	0	2598	0	515
40273	131	3	28	24.0	52.9	177	7	1551	193	0	415	132	6685	226	264	0	1378	0	793
S T A T I S T I C S: AVERAGE								1586.3	580.5	43.0	1173.7	279.6	11480.7	176.8	401.1	11.1	3919.0	45.4	846.8
STANDARD DEVIATION								1679.1	621.1	66.6	1670.1	736.4	11377.8	414.5	583.0	79.6	3501.8	85.9	1332.6

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 5 FINE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
20005	40	6	25	6.5	13.4	226	5	31	1306	1762	10	10	207	10	0	10	10	2373
20011	41	6	27	6.3	13.0	212	5	45	201	169	403	10	944	42	0	10	1602	4457
20026	49	7	19	10.0	19.5	193	6	134	2199	113	170	7	4257	49	0	14	2944	23542
20040	51	7	25	9.3	17.8	209	5	60	1669	124	54	7	3105	31	0	23	1032	5131
20050	54	8	2	6.3	12.2	197	0	83	1717	181	11	56	2024	22	0	34	648	9074
20054	55	8	6	17.9	32.1	330	2	54	1352	963	138	4	1585	25	0	21	475	5240
20062	56	8	8	10.2	19.9	219	13	77	439	111	327	13	7998	216	13	6	1352	10600
20074	59	8	15	5.6	9.5	150	4	159	772	1180	58	14	5088	174	14	14	1443	18792
20078	60	8	18	16.0	25.9	156	3	37	845	855	117	5	1096	32	5	5	433	2862
20118	61	8	22	13.7	23.5	238	4	51	1108	377	41	5	2053	29	0	5	1044	5346
20105	62	8	24	10.1	17.2	211	7	112	725	128	257	8	7122	185	8	8	2183	17854
20085	64	8	30	18.1	31.5	187	3	33	1203	584	35	4	1041	21	4	4	456	2139
20091	65	9	1	13.6	19.1	235	1	98	1806	1175	420	7	2408	94	7	7	950	5209
20099	66	9	7	17.9	32.9	284	3	26	332	328	50	4	677	25	4	4	345	3430
20102	67	9	11	11.7	18.0	204	11	107	645	122	253	30	5092	122	7	46	1021	17829
20222	68	9	13	23.5	41.8	47	9	7	241	202	3	3	26	3	0	3	23	400
40004	69	9	17	23.6	49.3	51	3	23	575	1025	247	2	84	5	0	2	19	986
40011	70	9	19	24.0	48.2	32	4	18	508	589	2	2	57	2	0	2	120	1601
20205	72	9	23	24.0	46.8	92	2	12	737	1080	2	2	103	2	0	2	109	677
40020	73	9	26	19.8	34.8	205	3	34	1390	1394	3	3	1274	31	0	3	410	2007
40026	74	9	29	24.1	39.5	114	2	30	965	1512	24	7	182	7	0	3	119	1326
40029	76	10	5	24.0	39.0	163	8	28	379	163	35	10	869	3	0	17	142	4090
40042	77	10	7	24.1	48.5	274	10	34	599	168	82	2	2376	77	0	2	119	4629
40038	78	10	11	24.0	36.7	168	3	120	1138	1334	52	22	1270	26	0	3	731	5895
20125	80	10	17	24.0	49.5	64	1	19	1158	2555	2	2	260	16	0	5	81	660
20234	82	10	23	24.0	49.3	313	6	26	522	409	42	2	1094	28	0	2	519	1878
40050	83	10	25	24.0	56.8	192	10	33	336	39	124	21	1567	39	0	24	321	5074
40056	84	10	29	23.9	56.5	165	5	17	397	580	2	4	186	14	0	7	139	1642
40062	85	10	31	20.1	53.8	219	6	55	788	533	607	28	3923	100	0	36	1708	7695
40068	87	11	4	15.3	37.4	209	5	77	839	384	136	11	1417	48	3	3	1302	11441
40074	88	11	7	22.8	56.0	254	3	17	721	1065	17	7	289	9	0	9	103	1144
40080	89	11	10	24.1	64.7	116	2	43	989	1516	96	6	563	21	2	12	167	5415
40086	91	11	16	24.4	55.5	69	4	18	828	1655	14	2	157	4	0	4	124	1283
40101	96	12	4	24.1	58.3	43	17	31	470	342	156	2	3053	95	0	21	1190	4072
40105	97	12	6	14.8	32.3	75	0	63	1312	1248	810	8	3500	72	0	4	1303	4272

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 5 FINE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
40108	98	12	10	24.1	51.9.	103.	12	36	384	283	56	5	2146	146	0	2	256	4993
40112	99	12	12	22.4	51.4	37	9	60.	1288	819	113	13	3041	78	2	21	480	6965
40116	101	12	16	20.3.	44.5	209	10	41	342	342	137	3	1202	34	0	21	744	6325
40120	102	12	19	24.0	53.5	307	3	17	274	357	33	7	357	20	0	5	259	2243
40127	104	12	28	23.9	57.6	322	4	29	661	1046	62	2	471	21	0	2	180	3129
40132	105	1	2	24.1	63.1	288	7	28	739	168	61	8	1127	39	0	2	195	3004
40137	106	1	9	24.1	59.6	221	12	32	267	206	76	6	997	44	0	2	237	2996
40142	107	1	11	8.1	17.0	190	1	51	1346	1689	48	16	465	32	0	24	269	3966
40147	108	1	15	24.1	53.3	243	14	28	438	311	49	2	1223	49	0	2	670	3059
40152	109	1	17	15.3	32.0	244	6	38	683	475	4	12	925	17	0	8	216	5737
40155	110	1	21	19.3	42.5	336	4	30	570	400	42	9	765	9	0	29	153	2779
40160	112	1	27	15.9	35.5	237	6	36	752	561	183	7	2678	66	0	3	689	3184
40.168	113	1	30	29.2	66.6	277	9	15	317	209	39	2	536	27	0	2	81	1211
40174	114	2	2	16.1	39.8	254	10	45	1580	849	111	3	2711	52	0	3	845	1333
40180	115	2	6	17.6	39.8	241	3	41	511	427	93	3	2381	45	0	13	493	4950
40185	116	2	8	15.4	36.1	251	13	50	1428	833	119	3	2549	38	0	11	844	3862
40191	117	2	12	20.8	46.5	43	3	27	618	833	2	2	101	0	0	5	110	2118
40197	118	2	14	21.5	47.7	68	4	25	383	502	55	2	220	20	0	11	107	2580
40203	119	2	20	13.5	30.3	220	6	62	511	269	123	4	2086	68	4	4	529	11142
40209	120	2	22	15.6	34.5	247	6	64	505	397	176	4	1256	44	8	4	606	9636
40215	121	2	26	24.0	52.8	43	11	12	81	41	2	2	34	0	0	15	62	1688
40221	122	2	28	18.5	40.6	220	4	59	614	638	317	3	2714	112	0	10	460	6269
40226	123	3	4	24.0	50.7	171	15	19	103	109	13	2	499	16	0	8	163	3369
40232	124	3	7	24.2	51.7	61	4	27	291	342	21	2	182	5	2	2 .	109.	4705
40238	125	3	10	20.5	44.1.	235	13	64	1381	763	65	3	1036	34	0	3	266	2173
40244	126	3	14	16.3	35.6	243	15	56	1747	793	214	7	5662	143	3	3	1019	4043
40250	127	3	16	21.9	47.9	232	12	64	509	384	434	2	10600	419	2	14	1744	5041
40256	128	3	20	17.1	36.4	247	1	92	2489	1069	171	3	5242	110	0	26	2044	4758
40262	129	3	22	24.0	50.8	28	2	35	512	698	24	2	633	32	2	8	458	2774
40268	130	3	26	10.4	22.2	253	13	59	1575	604	479	6	4054	105	0	6	1363	2204
40274	131	3	28	24.1	52.1	177	7	22	148	170	58	7	765	13	0	18	151	3023

S T A T I S T I C S

	FSP	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
AVERAGE	46.6	823.0	644.7	.123.9	7.3	1903.1	53.3	1.4	10.0	613.5	4929.2
STANDARD DEVIATION	30.8	530.1	516.7	155.9	8.5	2077.1	60.0	3.0	9.6	612.9	4517.5

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 5 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
20005	40	6	25	6.5	13.4	226	5	777	757	22	726	22	5389	0	112	0	2612	232	299
20011	41	6	27	6.3	13.0	212	5	2823	735	0	1003	153	8007	766	153	0	2835	0	613
20026	49	7	19	10.0	19.5	193	6	5796	1071	133	0	138	26470	0	947	0	9938	0	2694
20040	51	7	25	9.3	17.8	209	5	1925	574	241	397	224	12567	0	448	0	3755	0	2186
20050	54	8	2	6.3	12.2	197	6	3320	841	213	0	451	21880	0	410	0	9195	0	1642
20054	55	8	6	17.9	32.1	330	2	1408	695	0	421	0	13948	62	124	0	4210	155	1091
20062	56	8	8	10.2	19.9	219	13	1506	516	191	206	85	9944	176	302	0	4179	65	352
20074	59	8	15	5.6	9.5	150	4	3221	2172	0	105	105	64737	105	947	0	20421	210	1894
20078	60	8	18	16.0	25.9	156	3	401	395	77	347	77	6720	0	463	0	695	154	1815
20118	61	8	22	13.7	23.5	238	4	1516	436	85	298	85	12356	0	298	0	1959	0	2897
20105	62	8	24	10.1	17.2	211	7	2046	596	58	0	0	43073	290	639	0	11809	0	698
20085	64	8	30	18.1	31.5	187	3	329	325	95	285	31	4631	63	190	0	539	95	1300
20091	65	9	1	13.6	19.1	235	1	3511	1175	52	785	0	12362	157	576	0	1885	157	3300
20099	66	9	7	17.9	32.9	284	3	2121	311	91	121	0	7203	0	121	0	3009	0	91
20102	67	9	11	11.7	18.0	204	11	5515	1820	55	55	55	58236	332	499	443	11480	0	499
20222	68	9	13	23.5	41.8	47	9	841	245	0	71	95	956	0	191	0	0	0	0
40004	69	9	17	23.6	49.3	51	3	210	207	40	405	101	2332	0	0	0	1014	141	0
40011	70	9	19	24.0	48.2	32	4	750	434	103	41	0	3466	41	62	0	1307	83	0
20205	72	9	23	24.0	46.8	92	2	222	219	0	85	64	1710	0	106	0	213	149	0
40020	73	9	26	19.8	34.8	205	3	298	294	143	143	201	4544	0	230	0	402	172	1608
40026	74	9	29	24.1	39.5	114	2	835	968	50	0	50	2078	0	76	0	557	177	0
40029	76	10	5	24.0	39.0	163	8	1345	543	51	0	25	10151	0	179	0	4204	0	0
40042	77	10	7	24.1	48.5	274	10	213	211	0	82	82	9268	535	350	0	2286	0	1606
40038	78	10	11	24.0	36.7	168	3	2906	1161	0	163	108	12629	571	381	0	4572	108	1279
20125	80	10	17	24.0	49.5	64	1	209	710	0	262	80	1818	0	60	0	202	363	60
20234	82	10	23	24.0	49.3	313	6	1210	207	0	709	324	4865	0	405	0.	1216	0	1419
40050	83	10	25	24.0	56.8	192	10	2066	431	0	0	17	15329	915	228	0	3643	0	316
40056	84	10	29	23.9	56.5	165	5	845	181	53	548	70	3238	548	123	0	1628	0	0
40062	85	10	31	20.1	53.8	219	6	1228	190	74	688	37	18526	148	483	0	4129	0	1506
40068	87	11	4	15.3	37.4	209	5	3108	958	80	1469	0	25754	1415	454	0	6492	0	1576
40074	88	11	7	22.8	56.0	254	3	706	921	0	0	0	3033	0	107	0	785	0	0
40080	89	11	10	24.1	64.7	116	2	3845	880	0	340	0	13729	0	123	0	4004	200	278
40086	91	11	16	24.4	55.5	69	4	187	686	0	594	0	2487	0	108	0	847	234	144
40101	96	12	4	24.1	58.3	43	17	178	175	68	995	257	7822	0	480	0	1646	0	1080
40105	97	12	6	14.8	32.3	75	6	321	776	154	5450	3004	7122	0	774	0	2601	0	5357

B21

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 5 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
40108	98	12	10	24.1	51.9	103	12	448	453	134	1233	154	9774	0	481	0	2525	0	1947
40112	99	12	12	22.4	51.4	37	9	202	199	0	1323	759	13337	2433	428	0	6308	0	4341
40116	101	12	16	20.3	44.5	209	10	1395	464	0	944	0	11670	652	269	0	6881	0	449
40120	102	12	19	24.0	53.5	307	3	805	191	0	785	0	3797	280	149	0	2525	0	261
40127	104	12	28	23.9	57.6	322	4	562	177	0	1215	52	5817	712	69	0	4150	0	156
40132	105	1	2	24.1	63.1	288	7	438	162	15	1536	490	6714	0	253	0	2596	0	823
40137	106	1	9	24.1	59.6	221	12	881	467	0	705	0	6446	755	218	0	3307	0	470
40142	107	1	11	8.1	17.0	190	1	612	1534	0	2298	0	6069	0	235	0	3299	0	0
40147	108	1	15	24.1	53.3	243	14	194	192	56	1612	262	5850	0	450	0	2287	0	1275
40152	109	1	17	15.3	32.0	244	6	1094	653	93	468	156	10059	0	406	0	6216	0	249
40155	110	1	21	19.3	42.5	336	4	244	241	0	823	188	5364	0	305	0	2117	0	1152
40160	112	1	27	15.9	35.5	237	6	292	288	0	1745	1379	6051	675	731	0	2195	0	3264
40168	113	1	30	29.2	66.6	277	9	438	448	0	285	1035	2536	135	540	0	870	0	1020
40174	114	2	2	16.1	39.8	254	10	261	257	0	628	4925	2261	0	879	0	4473	0	502
40180	115	2	6	17.6	39.8	241	3	1220	674	0	2434	0	9663	1004	602	0	5220	0	1480
40185	116	2	8	15.4	36.1	251	13	287	284	27	2744	2411	7235	0	803	0	5128	0	8816
40191	117	2	12	20.8	46.5	43	3	223	220	0	1117	0	3501	0	279	0	945	0	107
40197	118	2	14	21.5	47.7	68	4	1187	444	0	1781	0	4296	0	419	0	1823	0	356
40203	119	2	20	13.5	30.3	220	6	1785	337	32	0	131	29179	0	230	0	4154	0	428
40209	120	2	22	15.6	34.5	247	6	1143	296	0	376	0	24717	0	579	0	6519	0	1593
40215	121	2	26	24.0	52.8	43	11	697	194	18	18	0	2878	0	132	0	889	0	0
40221	122	2	28	18.5	40.6	220	4	2595	1147	0	4561	0	12795	0	517	0	4018	0	493
40226	123	3	4	24.0	50.7	171	15	671	202	0	118	0	5737	0	216	0	1735	0	492
40232	124	3	7	24.2	51.7	61	4	200	198	38	251	0	9972	0	0	0	3015	0	560
40238	125	3	10	20.5	44.1	235	13	235	571	0	816	1315	3854	0	476	0	1927	0	1814
40244	126	3	14	16.3	35.6	243	15	291	287	0	2388	2584	8345	0	786	0	3540	0	3877
40250	127	3	16	21.9	47.9	232	12	1145	214	83	6519	20	11847	0	1379	0	2904	0	1567
40256	128	3	20	17.1	36.4	247	1	2543	1008	247	7174	4150	11105	0	0	0	5112	0	3573
40262	129	3	22	24.0	50.8	28	2	1991	201	78	2167	118	5200	0	275	0	2226	0	689
40268	130	3	26	10.4	22.2	253	13	467	460	0	1798	3147	5665	5485	539	0	2832	584	854
40274	131	3	28	24.1	52.1	177	7	938	196	38	230	0	7968	0	0	0	2361	0	460

S T A T I S T I C S

	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
AVERAGE	1270.0	538.4	45.3	1013.4	442.7	10880.0	276.6	360.5	6.7	3551.0	49.7	1223.2
STANDARD DEVIATION	1251.5	411.1	62.3	1460.1	1009.7	11747.1	771.1	273.3	54.5	3297.4	104.5	1506.5

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 6 FINE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
20006	41	6	27	5.4	10.5	212	5	40	92	211	13	13	52	0	0	13	13	3363
20027	49	7	19	21.5	44.1	193	6	67	191	301	44	28	330	3	0	3	119	9235
20041	51	7	25	17.7	34.4	209	5	39	28	64	32	12	225	12	0	4	32	4286
20048	53	7	31	17.7	36.4	215	5	19	26	60	3	3	34	3	0	3	3	2512
20051	54	8	2	13.7	26.5	197	6	48	125	365	5	5	193	5	0	5	5	6149
20052	55	8	6	17.9	37.3	330	2	37	341	348	74	3	438	7	0	11	3	4517
20063	56	8	8	17.6	33.8	219	13	48	102	65	12	4	217	16	4	4	110	8026
20070	58	8	12	17.7	34.9	181	4	40	261	194	27	3	198	11	3	7	63	4998
20079	60	8	18	17.7	34.1	156	3	22	28	430	4	4	150	12	4	4	4	2311
20119	61	8	22	18.0	37.1	238	4	32	313	59	3	7	160	18	0	3	97	4659
20108	62	8	24	17.7	34.2	211	7	54	275	64	20	8	400	20	8	4	64	5296
20086	64	8	30	17.7	36.0	187	3	18	199	61	3	3	80	3	3	3	42	2301
20092	65	9	1	17.9	37.4	235	1	29	322	277	11	3	162	25	0	3	151	2828
20111	66	9	7	17.9	36.6	284	3	23	98	60	22	3	200	11	7	7	113	3468
20103	67	9	11	23.6	49.3	204	11	69	171	44	2	2	303	11	5	2	87	6940
20212	68	9	13	23.6	48.6	47	9	6	62	142	2	2	8	0	2	5	14	344
40005	69	9	17	23.7	49.5	51	3	14	363	408	2	2	86	2	0	2	2	1237
40012	70	9	19	23.6	49.6	32	4	28	544	410	75	2	725	22	0	5	164	3317
20206	72	9	23	23.7	48.5	92	2	11	259	45	2	2	88	0	0	2	2	950
40021	73	9	26	23.8	50.1	205	3	12	135	179	2	2	58	5	0	5	16	1604
40027	74	9	29	23.8	50.1	114	2	12	218	104	8	2	91	5	2	2	69	1679
40015	76	10	5	23.8	50.6	163	8	17	139	104	2	57	90	10	0	2	46	2347
40039	78	10	11	23.9	50.0	168	3	23	221	133	22	5	113	2	0	2	105	3752
20123	80	10	17	23.7	49.5	64	1	10	268	486	2	2	123	5	0	2	2	693
20216	82	10	23	23.8	49.7	313	6	13	156	44	2	2	50	5	0	2	13	1659
40051	83	10	25	23.7	50.0	192	10	19	180	119	33	8	349	16	0	2	127	3082
40057	84	10	29	23.9	50.7	165	5	12	278	188	2	5	92	5	0	5	40	1680
40063	85	10	31	23.8	50.0	219	6	27	265	102	24	5	268	19	0	5	141	4416
40069	87	11	4	15.7	33.1	209	5	63	435	410	100	4	619	33	4	8	192	10930
40075	88	11	7	23.8	50.5	254	3	9	258	433	2	2	63	8	0	2	43	982
40081	89	11	10	19.5	41.0	116	2	44	661	378	111	3	729	40	6	3	249	6401
40082	91	11	16	23.7	52.4	69	4	17	390	441	2	2	126	5	2	2	84	1793
40094	92	11	20	23.8	53.1	210	6	14	88	41	2	2	41	2	0	2	106	2613
40096	93	11	22	23.9	52.8	281	4	14	154	41	2	2	28	5	0	2	57	1690
40093	94	11	28	23.9	53.4	98	7	15	101	41	18	2	69	7	0	2	62	2319

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 6   FINE PARTICULATE DATA   (PART - 1)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	FSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
40102	95	11	30	23.8	53.6	80	9	11	18	41	10	2	36	5	0	5	46	1967
40098	96	12	4	24.1	51.7	43	17	10	77	42	2	2	56	2	0	2	77	2404
40106	97	12	6	23.8	51.7	75	6	20	187	235	72	2	190	13	0	2	83	2424
40109	98	12	10	24.0	50.8	103	12	10	95	174	2	2	24	2	0	8	54	1815
40113	99	12	12	23.8	54.2	37	9	18	168	40	33	2	155	10	0	2	84	3782
40117	101	12	16	23.8	53.5	209	10	21	222	463	38	2	202	7	2	5	113	2989
40121	102	12	19	23.8	52.4	307	3	9	124	129	2	2	60	7	0	2	74	1318
40126	103	12	22	23.8	53.2	229	12	13	80	177	10	2	83	7	0	2	62	2164
40128	104	12	28	24.0	54.5	322	4	12	254	274	10	2	43	2	0	5	71	1685
40138	107	1	11	24.0	53.2	190	1	14	330	343	2	5	65	7	0	2	20	1370
40148	108	1	15	24.0	52.5	243	14	13	105	255	21	5	158	7	0	2	65	2343
40153	109	1	17	24.0	52.6	244	6	26	126	213	10	7	108	10	0	2	36	4842
40154	110	1	21	24.0	52.9	336	4	16	220	133	10	7	47	2	0	23	44	2983
40159	112	1	27	23.8	53.0	237	6	15	57	41	2	2	0	7	0	10	7	2868
40169	113	1	30	23.8	53.7	277	9	5	18	41	2	2	0	0	0	5	15	1081
40175	114	2	2	23.9	54.0	254	10	6	71	41	2	2	30	0	0	2	105	571
40181	115	2	6	20.1	44.8	241	3	26	234	179	49	3	145	21	0	3	108	4240
40186	116	2	8	23.9	53.0	251	13	12	101	41	15	2	41	5	0	2	93	2642
40192	117	2	12	21.2	46.8	43	3	26	292	408	32	2	207	11	0	8	94	3254
40198	118	2	14	23.8	52.6	68	4	20	244	313	13	2	142	15	0	2	102	2590
40204	119	2	20	16.6	30.7	220	6	60	264	60	105	3	403	30	3	3	143	9508
40210	120	2	22	23.2	51.5	247	6	50	239	274	10	2	131	10	0	2	51	9177
40216	121	2	26	23.9	52.6	43	11	15	103	42	2	2	123	5	0	15	65	2254
40222	122	2	28	21.1	45.6	220	4	38	355	327	97	3	355	33	0	3	188	5441
40227	123	3	4	23.8	51.6	171	15	5	107	42	2	2	0	0	0	5	16	3441
40233	124	3	7	23.9	51.8	61	4	24	168	42	8	2	179	13	0	2	115	3887
40239	125	3	10	23.9	50.3	235	13	20	82	140	2	2	60	2	0	2	57	3990
40245	126	3	14	23.9	51.5	243	15	23	48	43	2	2	61	2	0	5	56	2266
40251	127	3	16	23.9	51.5	232	12	23	131	43	26	2	215	16	2	2	91	2688
40257	128	3	20	23.5	49.4	247	1	27	229	481	2	2	330	11	0	8	131	2395
40263	129	3	22	23.8	50.1	28	2	22	326	591	19	2	254	11	0	2	177	1845
40269	130	3	26	23.9	50.6	253	13	20	41	43	2	2	24	5	0	5	49	1472
40275	131	3	28	23.8	51.0	177	7	12	73	162	2	5	103	5	0	2	116	2346

S T A T I S T I C S

	FSP	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
AVERAGE	23.6	191.9	187.1	19.2	4.4	161.6	9.4	.8	4.2	74.2	3300.3
STANDARD DEVIATION	15.5	126.9	152.6	27.4	7.5	156.9	8.6	1.8	3.6	53.3	2234.1

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 6   FINE PARTICULATE DATA   (PART - 2)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
20006	41	6	27	5.4	10.5	212	5	993	979	28	391	76	7275	0	143	0	3336	0	382
20027	49	7	19	21.5	44.1	193	6	3882	955	68	0	49	16938	0	320	0	5145	0	186
20041	51	7	25	17.7	34.4	209	5	1559	298	130	63	58	15581	0	174	0	5090	0	203
20048	53	7	31	17.7	36.4	215	5	852	281	71	0	54	6225	0	82	0	3133	0	137
20051	54	8	2	13.7	26.5	197	6	2312	386	154	0	113	19253	0	226	0	6671	0	263
20052	55	8	6	17.9	37.3	330	2	790	274	53	187	174	12455	0	134	0	5038	53	268
20063	56	8	8	17.6	33.8	219	13	2084	651	112	289	62	14586	136	680	0	4346	0	1094
20070	58	8	12	17.7	34.9	181	4	1712	293	123	117	8	7733	57	28	0	3777	0	57
20079	60	8	18	17.7	34.1	156	3	304	792	58	0	58	5837	0	146	0	2786	0	29
20119	61	8	22	18.0	37.1	238	4	1845	276	26	26	53	11329	0	80	0	4612	0	0
20108	62	8	24	17.7	34.2	211	7	2872	299	87	0	0	28045	58	116	0	6222	0	0
20086	64	8	30	17.7	36.0	187	3	776	618	83	55	0	4605	55	138	0	2192	27	0
20092	65	9	1	17.9	37.4	235	1	2458	273	106	213	0	6655	106	106	133	1149	160	267
20111	66	9	7	17.9	36.6	284	3	1635	280	82	54	0	7654	0	27	0	3663	0	0
20103	67	9	11	23.6	49.3	204	11	3041	690	81	20	81	41351	0	223	0	5759	0	162
20212	68	9	13	23.6	48.6	47	9	213	210	0	0	82	1028	0	82	0	61	0	0
40005	69	9	17	23.7	49.5	51	3	750	422	0	161	101	3395	424	0	0	1576	60	0
40012	70	9	19	23.6	49.6	32	4	1397	206	80	60	0	8037	60	100	0	2800	40	322
20206	72	9	23	23.7	48.5	92	2	744	211	0	61	82	2678	0	103	0	947	0	0
40021	73	9	26	23.8	50.1	205	3	951	204	79	0	0	3055	0	0	0	1477	0	0
40027	74	9	29	23.8	50.1	114	2	815	204	0	0	0	2393	0	59	0	1376	0	39
40015	76	10	5	23.8	50.6	163	8	1246	506	0	415	158	6586	0	19	0	2254	0	0
40039	78	10	11	23.9	50.0	168	3	1518	205	40	160	200	7784	1220	200	180	3241	0	0
20123	80	10	17	23.7	49.5	64	1	209	545	0	80	40	1615	0	80	0	323	60	0
20216	82	10	23	23.8	49.7	313	6	1132	563	0	60	120	4228	0	181	0	1812	0	0
40051	83	10	25	23.7	50.0	192	10	1757	205	0	60	20	6084	700	240	0	2441	0	160
40057	84	10	29	23.9	50.7	165	5	497	584	59	138	78	3097	0	78	0	1736	0	0
40063	85	10	31	23.8	50.0	219	6	3906	867	20	80	20	8761	320	200	0	4600	20	0
40069	87	11	4	15.7	33.1	209	5	5314	921	120	241	0	22527	1088	302	0	6954	0	574
40075	88	11	7	23.8	50.5	254	3	688	203	0	0	0	1843	0	99	0	455	0	59
40081	89	11	10	19.5	41.0	116	2	4777	628	0	268	0	14919	0	268	0	4851	0	438
40082	91	11	16	23.7	52.4	69	4	794	195	0	419	0	3546	0	133	0	1525	0	152
40094	92	11	20	23.8	53.1	210	6	792	542	56	225	18	4707	0	94	0	2052	0	338
40096	93	11	22	23.9	52.8	281	4	196	194	56	227	18	3069	0	94	0	1250	0	151
40093	94	11	28	23.9	53.4	98	7	194	191	56	0	0	4134	0	93	0	1833	0	280

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 6 FINE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
40102	95	11	30	23.8	53.6	80	9	193	191	111	149	0	3337	0	93	0	1211	0	242
40098	96	12	4	24.1	51.7	43	17	201	549	38	0	38	4277	0	116	0	1819	0	0
40106	97	12	6	23.8	51.7	75	6	1202	198	135	967	19	4410	0	174	0	1818	0	464
40109	98	12	10	24.0	50.8	103	12	204	490	157	0	39	2933	0	137	0	1023	0	0
40113	99	12	12	23.8	54.2	37	9	1124	189	0	129	0	6366	848	92	0	5093	147	0
40117	101	12	16	23.8	53.5	209	10	1658	191	0	467	0	4676	1795	93	0	3928	0	0
40121	102	12	19	23.8	52.4	307	3	1044	946	0	114	0	2118	209	57	0	1183	76	0
40126	103	12	22	23.8	53.2	229	12	1635	513	37	413	18	3798	488	56	0	2632	0	94
40128	104	12	28	24.0	54.5	322	4	424	188	36	275	18	3065	0	128	91	1009	73	0
40138	107	1	11	24.0	53.2	190	1	195	192	18	507	0	2313	601	75	0	1166	0	0
40148	108	1	15	24.0	52.5	243	14	1017	195	76	114	0	3996	0	114	0	2531	0	0
40153	109	1	17	24.0	52.6	244	6	1240	194	57	76	38	10272	0	76	0	6106	0	0
40154	110	1	21	24.0	52.9	336	4	196	193	0	94	113	5105	0	56	0	4141	0	0
40159	112	1	27	23.8	53.0	237	6	927	386	0	75	0	4998	509	94	0	3394	0	0
40169	113	1	30	23.8	53.7	277	9	193	190	0	0	0	2012	0	74	0	447	0	93
40175	114	2	2	23.9	54.0	254	10	636	189	0	222	166	1000	0	92	0	166	37	0
40181	115	2	6	20.1	44.8	241	3	1334	457	22	156	0	8809	1159	200	0	5530	111	200
40186	116	2	8	23.9	53.0	251	13	498	193	56	37	0	4769	0	75	0	2884	0	0
40192	117	2	12	21.2	46.8	43	3	911	218	0	469	0	4849	0	341	0	1666	0	149
40198	118	2	14	23.8	52.6	68	4	197	194	0	437	0	4201	0	285	0	1482	0	228
40204	119	2	20	16.6	36.7	220	6	2165	279	27	0	81	27750	0	108	0	2505	0	81
40210	120	2	22	23.2	51.5	247	6	201	199	0	0	0	26855	0	272	0	4372	0	446
40216	121	2	26	23.9	52.6	43	11	497	194	18	0	0	4160	0	189	0	1063	0	0
40222	122	2	28	21.1	45.6	220	4	2497	224	0	43	0	12291	0	0	1.75	3177	0	153
40227	123	3	4	23.8	51.6	171	15	514	198	0	0	0	7164	0	154	0	1103	38	290
40233	124	3	7	23.9	51.8	61	4	438	198	38	57	0	9602	0	0	0	2936	0	618
40239	125	3	10	23.9	50.3	235	13	1499	981	0	19	139	8097	179	238	0	2248	0	397
40245	126	3	14	23.9	51.5	243	15	608	199	38	0	19	3769	0	136	0	1340	0	485
40251	127	3	16	23.9	51.5	232	12	1351	807	0	3089	0	5596	0	0	0	2701	0	427
40257	128	3	20	23.5	49.4	247	1	1437	207	40	2326	0	5158	0	0	0	2488	0	485
40263	129	3	22	23.8	50.1	28	2	1286	204	79	758	119	3135	0	279	0.	1218	0	499
40269	130	3	26	23.9	50.6	253	13	610	202	0	79	217	3241	177	79	0	533	0	217
40275	131	3	28	23.8	51.0	177	7	1295	505	19	156	0	4196	0	196	0.	1803	0	372
S T A T I S T I C S							AVERAGE	1241.6	376.5	41.6	225.0	40.4	7754.8	149.8	134.2	8.5	2694.1	13.3	169.1
							STANDARD DEVIATION	1075.4	243.3	44.6	478.9	55.8	7437.9	350.1	107.0	35.4	1730.6	33.3	210.7

APPENDIX C

The data base for the entire project is listed here and represents all of the dichotomous particulate filters which were collected for the coarse particle fraction. Each filter is printed along with information describing the date (month and day), elapsed time, sampled air volume (flow), meteorological data, and concentrations of particulate weight and various chemical components. A series-30000 filter reflects the use of 0.5μ pore diameter filters while the series 50000 reflects the change to 1.0μ pore diameter filters. The series-30000 filter data for coarse particulates corresponds to the series-20000 filter data for fine particulates which is presented in Appendix B. Similarly, the series-50000 filter data for coarse particulates corresponds to the series-40000 data for fine particulates in Appendix B.

FILTER SERIES DESIGNATION

	PARTICULATES	
FILTER PORE DIAMETER	FINE	COARSE
0.5μ	20,000	30,000
1.0μ	40,000	50,000

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 1 COARSE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
30001	41	6	27	5.8	12.2	212	5	31	79	181	11	22	2797	11	11	11	4733	939
30021	49	7	19	7.3	15.7	193	6	79	246	810	96	8	5564	167	8	8	6920	2165
30028	50	7	21	6.6	15.1	205	5	46	229	146	9	9	1699	45	9	9	2378	1671
30036	51	7	25	7.5	15.2	209	5	44	209	145	209	9	2051	45	9	9	2780	647
30073	68	9	13	23.6	56.1	47	9	10	175	39	2	2	269	9	4	4	565	59
30077	60	8	18	17.7	41.1	156	3	30	323	235	3	6	1431	50	10	3	2324	397
30080	61	8	22	17.7	39.0	238	4	24	152	170	3	3	976	14	7	10	1654	497
30081	64	8	30	17.7	43.1	187	3	23	144	295	3	3	1241	48	6	3	2750	357
30087	65	9	1	18.0	45.3	235	1	14	259	571	15	9	1299	30	3	3	2766	424
30094	79	10	13	23.6	42.8	15	2	12	200	305	3	3	678	16	3	3	953	320
30095	66	9	7	18.0	43.4	284	3	22	67	194	3	3	864	28	3	3	1410	386
30100	67	9	11	17.2	43.7	204	11	32	88	50	60	3	2473	69	6	3	2216	1519
30109	62	8	24	7.1	17.7	211	7	25	109	125	23	23	1944	31	0	7	1466	1560
30201	72	9	23	23.9	50.0	92	2	11	279	393	2	8	343	5	5	2	1075	160
30214	82	10	23	23.6	58.6	313	6	6	54	37	2	2	257	4	0	2	311	125
50003	69	9	17	23.6	53.2	51	3	5	109	41	2	2	93	0	0	5	351	106
50007	70	9	19	23.6	54.0	32	4	12	87	307	2	2	394	12	0	2	1579	666
50016	73	9	26	23.7	51.2	205	3	20	205	324	2	2	876	29	0	2	1878	395
50022	74	9	29	23.6	51.6	114	2	16	287	330	2	10	391	10	0	2	1134	174
50028	78	10	11	23.8	54.4	168	3	25	333	272	2	2	1156	30	0	2	2700	606
50034	76	10	5	23.7	54.1	163	8	14	196	304	2	2	954	17	0	10	1608	485
50040	77	10	7	23.8	55.2	274	10	4	42	40	2	5	107	0	0	2	208	52
50046	83	10	25	23.6	70.3	192	10	42	175	165	47	5	3968	139	3	3	5210	1001
50052	84	10	29	23.7	70.6	165	5	7	119	192	1	3	319	7	0	7	609	198
50058	85	10	31	23.5	67.5	219	6	27	209	221	82	2	2686	55	0	4	3149	1119
50064	87	11	4	6.9	19.7	209	5	32	400	765	7	21	1004	21	7	7	2106	449
50070	88	11	7	23.0	66.3	254	3	8	0	0	2	2	361	10	0	2	0	0
50076	89	11	10	23.7	68.5	116	2	30	378	590	48	2	1641	38	8	12	3348	742
50133	106	1	9	23.8	68.6	221	12	12	131	153	22	8	1739	38	2	4	1001	848
50136	105	1	2	23.7	70.1	288	7	5	67	150	1	7	288	7	0	3	262	383
50139	107	1	11	14.8	42.9	190	1	6	222	255	3	3	458	9	0	16	575	377
50144	108	1	15	23.8	68.7	243	14	24	161	92	14	10	1698	40	0	8	1887	951
50149	109	1	17	10.9	31.2	244	6	14	620	332	4	4	385	8	0	4	545	372
50158	110	1	21	23.8	71.6	336	4	2	38	30	1	1	63	1	0	1	131	218
50163	112	1	27	23.9	70.9	237	6	11	58	105	25	7	91	1	0	5	599	3313

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 1 COARSE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
50164	113	1	30	23.8	71.8	277	9	3	13	96	1	1	77	0	0	3	140	204
50170	114	2	2	24.0	69.7	254	10	12	61	85	1	1	316	7	0	1	1148	699
50176	115	2	6	11.6	35.1	241	3	13	110	63	86	3	790	7	0	7	1477	869
50182	116	2	8	23.9	69.3	251	13	13	33	31	83	1	389	5	0	11	1509	589
50187	117	2	12	22.0	63.7	43	3	9	95	265	2	2	228	4	0	4	593	356
50193	118	2	14	12.0	34.7	68	4	22	163	63	3	3	423	11	3	3	4977	846
50199	119	2	20	6.7	19.4	220	6	19	348	348	7	7	3183	49	0	7	541	1196
50205	120	2	22	14.1	41.7	247	6	11	63	149	3	3	295	6	0	9	1520	902
50211	121	2	26	23.8	67.9	43	11	4	14	152	2	2	328	10	0	4	379	369
50217	122	2	28	9.5	28.1	220	4	12	88	310	4	4	2877	34	4	4	612	730
50223	123	3	4	23.8	52.9	171	15	9	18	183	2	2	421	7	0	2	474	351
50228	124	3	7	20.6	46.4	61	4	23	247	187	2	2	957	17	0	5	2723	757
50234	125	3	10	23.9	52.7	235	13	14	68	42	2	2	956	13	0	5	1235	1369
50240	126	3	14	23.9	54.2	243	15	13	94	209	2	2	897	10	2	2	904	697
50246	127	3	16	23.8	53.8	232	12	12	159	105	2	2	1285	10	2	2	685	909
50252	128	3	20	19.3	43.2	247	1	67	275	189	41	3	2988	109	3	9	7654	904
50258	129	3	22	23.8	52.0	28	2	42	285	42	21	2	1319	37	2	2	4634	501
50264	130	3	26	23.9	52.7	253	13	24	39	131	55	2	1068	23	2	7	1651	640
50270	131	3	28	23.8	53.0	177	7	36	96	229	39	2	1514	52	2	2	4399	655
							AVERAGE	20.1	161.5	209.3	19.9	4.8	1164.2	26.9	2.3	5.0	1861.0	689.3
STATISTICS							STANDARD DEVIATION	15.4	120.7	171.8	36.3	4.9	1108.6	32.7	3.2	3.3	1705.9	573.2

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 1   COARSE PARTICULATE DATA   (PART - 2)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
30001	41	6	27	5.8	12.2	212	5	6692	1947	163	981	490	1962	0	327	0	163	0	0
30021	49	7	19	7.3	15.7	193	6	23940	4516	0	2479	101	4055	686	133	0	1036	0	508
30028	50	7	21	6.6	15.1	205	5	12077	679	0	1790	198	2917	0	530	0	795	0	198
30036	51	7	25	7.5	15.2	209	5	8570	2589	0	724	131	1250	0	329	0	0	0	197
30073	68	9	13	23.6	56.1	47	9	2605	182	0	35	89	231	0	107	0	0	0	17
30077	60	8	18	17.7	41.1	156	3	8766	1526	0	827	97	681	0	97	0	24	0	72
30080	61	8	22	17.7	39.0	238	4	4613	1242	0	615	76	846	179	76	0	76	0	51
30081	64	8	30	17.7	43.1	187	3	4541	1180	0	255	46	557	0	69	0	23	0	46
30087	65	9	1	18.0	45.3	235	1	8488	1253	0	1368	176	728	0	66	0	0	0	44
30094	79	10	13	23.6	42.8	15	2	4830	1267	0	373	70	723	0	46	0	46	0	23
30095	66	9	7	18.0	43.4	284	3	7271	1311	0	691	115	898	0	69	0	23	0	46
30100	67	9	11	17.2	43.7	204	11	7665	1173	22	938	183	4053	0	206	0	778	0	45
30109	62	8	24	7.1	17.7	211	7	6242	1636	0	1019	283	3001	0	113	0	506	0	113
30201	72	9	23	23.9	50.0	92	2	3251	205	0	100	120	180	0	120	0	0	0	200
30214	82	10	23	23.6	58.6	313	6	1931	174	0	187	51	0	0	51	0	17	0	34
50003	69	9	17	23.6	53.2	51	3	1878	549	0	94	94	225	0	18	0	0	0	0
50007	70	9	19	23.6	54.0	32	4	3034	646	0	425	55	1240	0	55	0	0	0	0
50016	73	9	26	23.7	51.2	205	3	6858	1686	0	332	0	586	0	97	0	58	0	58
50022	74	9	29	23.6	51.6	114	2	5215	1269	0	116	0	251	0	58	0	58	0	0
50028	78	10	11	23.8	54.4	168	3	10767	1941	18	423	73	846	0	110	0	0	0	0
50034	76	10	5	23.7	54.1	163	8	5181	1046	18	184	36	609	0	55	0	0	0	0
50040	77	10	7	23.8	55.2	274	10	918	185	0	90	18	144	0	18	0	0	0	0
50046	83	10	25	23.6	70.3	192	10	7995	1439	185	256	128	1608	0	99	0	42	0	71
50052	84	10	29	23.7	70.6	165	5	2707	827	0	84	70	339	0	28	0	0	0	0
50058	85	10	31	23.5	67.5	219	6	8665	1542	0	755	14	1835	0	44	0	59	0	59
50064	87	11	4	6.9	19.7	209	5	9755	1861	101	1825	354	1115	0	0	0	0	0	0
50070	88	11	7	23.0	60.3	254	3	0	0	0	135	45	512	0	30	0	0	0	0
50076	89	11	10	23.7	68.5	116	2	12080	1767	43	29	102	145	0	14	0	0	0	0
50133	106	1	9	23.8	68.6	221	12	2019	335	0	247	102	1560	0	116	0	131	43	0
50136	105	1	2	23.7	70.1	288	7	1373	490	0	99	57	642	0	185	0	142	0	0
50139	107	1	11	14.8	42.9	190	1	1221	239	0	186	0	559	0	349	0	93	0	0
50144	108	1	15	23.8	68.7	243	14	3719	566	0	436	757	1980	0	975	0	43	0	0
50149	109	1	17	10.9	31.2	244	6	8729	2008	64	512	64	672	0	448	0	0	0	0
50158	110	1	21	23.8	71.6	336	4	380	533	0	41	69	307	0	251	0	69	0	0
50163	112	1	27	23.9	70.9	237	6	689	447	0	352	70	6795	0	0	0	1860	0	169

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 1   COARSE PARTICULATE DATA   (PART - 2)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
50164	113	1	30	23.8	71.8	277	9	447	142	0	83	111	306	0	0	0	292	69	55
50170	114	2	2	24.0	69.7	254	10	1168	147	0	86	975	1392	0	803	0	114	0	86
50176	115	2	6	11.6	35.1	241	3	1524	292	0	513	0	1369	0	427	0	171	0	199
50182	116	2	8	23.9	69.3	251	13	1597	147	0	230	158	1052	0	0	0	836	0	230
50187	117	2	12	22.0	63.7	43	3	2028	430	0	109	957	486	0	423	0	2589	0	298
50193	118	2	14	12.0	34.7	68	4	3447	1022	0	374	144	1153	0	605	0	173	0	0
50199	119	2	20	6.7	19.4	220	6	5782	1288	0	719	0	2827	0	0	0	0	0	0
50205	120	2	22	14.1	41.7	247	6	1516	245	0	263	287	1725	0	479	0	287	0	167
50211	121	2	26	23.8	67.9	43	11	1172	150	0	0	0	0	0	58	0	0	0	0
50217	122	2	28	9.5	28.1	220	4	370	365	0	748	0	1568	0	178	0	142	0	213
50223	123	3	4	23.8	52.9	171	15	1409	193	0	56	113	699	0	132	0	56	0	37
50228	124	3	7	20.6	46.4	61	4	10807	2103	0	366	64	1098	366	172	1098	172	0	64
50234	125	3	10	23.9	52.7	235	13	2568	194	75	455	113	2941	0	75	208	664	151	113
50240	126	3	14	23.9	54.2	243	15	2062	189	0	221	0	1679	0	92	0	166	0	110
50246	127	3	16	23.8	53.8	232	12	2501	190	0	930	613	2194	0	744	0	688	0	0
50252	128	3	20	19.3	43.2	247	1	14356	3161	0	671	1342	1528	0	2384	0	231	138	162
50258	129	3	22	23.8	52.0	28	2	11510	1649	0	827	481	827	0	923	0	96	0	0
50264	130	3	26	23.9	52.7	253	13	3954	764	0	151	474	1611	0	682	0	246	0	0
50270	131	3	28	23.8	53.0	177	7	7406	1469	0	207	1319	1319	0	1771	0	377	0	0
							AVERAGE	5190.5	1008.3	12.8	481.7	212.7	1293.1	22.8	282.2	24.2	248.2	7.4	68.2
							STANDARD DEVIATION	4532.6	882.1	37.6	498.7	314.9	1219.1	107.2	437.5	151.6	471.2	29.3	98.8

S T A T I S T I C S

NIAGARA FRONTIER STUDY

***** SITE # 2 COARSE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
30002	40	6	25	6.1	12.5	226	5	18	309	540	11	44	805	11	11	11	1180	242
30008	41	6	27	6.1	12.5	212	5	42	277	177	11	44	4742	88	0	11	3043.	1032
30022	49	7	19	8.8	18.3	193	6	69	324	120	90	7	4231	166	7	7	5614	1647
30029	51	7	25	13.5	27.1	209	5	32	112	81	5	5	1454	61	5	5	2481	612
30066	61	8	22	10.3	20.4	238	4	33	47	312	6	6	1263	47	6	6	1691	563
30071	60	8	18	18.1	43.8	156	3	24	129	281	3	3	1281	37	3	3	1766	392
30082	64	8	30	18.1	38.8	187	3	24	132	367	35	3	1213	24	7	3	2159	442
30088	65	9	1	15.3	32.2	235	1	46	266	219	25	4	1660	68	4	12	3812	593
30110	62	8	24	18.1	38.0	211	7	25	116	58	3	3	1005	43	0	3	2168	965
30112	67	9	11	6.8	14.6	204	11	42	66	151	9	9	4026	85	0	9	4945.	1762
30122	80	10	17	23.7	48.7	64	1	21	352	650	8	2	818	34	0	14	2663	181
30202	72	9	23	24.0	47.3	92	2	10	178	377	2	8	313	5	5	2	852	128
30231	68	9	13	23.4	50.3	47	9	5	66	192	2	2	115	2	0	2	478	60
50002	69	9	17	20.8	43.2	51	3	6	192	51	3	3	166	9	0	3	570	150
50008	70	9	19	21.8	45.7	32	4	20	118	315	9	3	545	18	0	3	2505	751
50017	73	9	26	24.0	50.3	205	3	17	178	225	2	5	958	33	0	2	1806	289
50023	74	9	29	24.0	50.3	114	2	10	300	515	2	2	336	8	0	2	1088	170
50033	76	10	5	24.0	52.7	163	8	8	57	42	2	2	596	15	0	2	711	236
50035	78	10	11.	12.5	26.0	168	3	28	250	527	5	5	1453	122	5	5	2790	564
50041	77	10	7	24.0	53.1	274	10	11	130	41	7	2	2759	36	0	2	1224	247
50047	83	10	25	24.0	52.8	192	10	41	139	41	2	7	4126	97	2	2	6614	952
50053	84	10	29	24.1	53.2	165	5	8	143	127	2	15	445	10	0	7	689	335
50059	85	10	31	24.1	49.8	219	6	34	144	166	2	2	2736	69	0	16	4551	825
50065	87	11	4	13.1	28.6	209	5	41	106	372	4	4	2352	48	0	19	4051	1098
50071	88	11	7	20.1	42.2	254	3	12	226	321	3	3	495	13	0	3	1365	462
50077	89	11	10	22.7	50.0	116	2	27	435	673	49	2	1322	36	2	11	2838	673
50143	112	1	27	24.2	53.0	237	6	6	57	41	2	10	151	2	0	5	219	1243
50165	113	1	30	24.2	52.8	277	9	10	70	41	2	2	2475	41	2	2	912	393
50171	114	2	2	24.3	53.7	254	10	12	74	41	2	2	1213	43	2	5	1469	518
50177	115	2	6	12.0	26.5	241	3	18	36	83	5	5	1172	31	0	5	1098	811
50183	116	2	8	24.3	52.8	251	13	18	83	136	2	2	1503	31	0	2.	1075	766
50188	117	2	12	22.7	50.0	43	3	11	155	249	2	2	657	22	0	2	803	399
50194	118	2	14	24.3	53.4	68	4	6	49	41	2	2	285	7	0	5	337	285
50200	119	2	20	11.4	26.2	220	6	12	111	84	5	5	884	21	5	5	624	698
50206	120	2	22	13.2	28.9	247	6	7	33	76	4	4	532	14	0	4	460	844

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 2 COARSE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
50212	121	2	26	24.3	52.0	43	11	5	77	215	2	2	245	13	2	2	397	471
50218	122	2	28	16.3	35.4	220	4	18	219	62	3	3	1901	31	0	3	1087	575
50224	123	3	4	24.3	51.4	171	15	3	18	43	2	2	223	5	0	2	123	169
50229	124	3	7	24.2	52.2	61	4	30	135	42	7	2	1009	39	0	2	4192	631
50235	125	3	10	24.2	51.3	235	13	16	51	129	2	2	1098	26	0	2	1169	558
50241	126	3	14	24.2	52.3	243	15	18	18	137	2	2	2482	68	2	5	1242	723
50247	127	3	16	24.3	52.0	232	12	9	18	42	2	2	391	5	0	2	540	311
50253	128	3	20	16.6	35.4	247	1	75	199	168	3	3	4447	211	7	11	9081	1190
50259	129	3	22	24.3	50.8	28	2	52	212	168	38	2	2262	92	2	5.	7358	809
50265	130	3	26	24.2	51.0	253	13	31	92	43	2	2	2887	92	2	5	2464	822
50271	131	3	28	24.3	51.4	177	7	19	99	43	2	2	1080	35	0	2	1859	417
						AVERAGE		22.4	143.4	191.8	8.5	5.5	1480.7	43.8	1.8	5.2	2177.5	608.8
S T A T I S T I C S																		
						STANDARD DEVIATION		16.5	98.4	172.2	15.9	8.7	1255.3	43.0	2.7	4.2	1998.4	378.8

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 2 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
30002	40	6	25	6.1	12.5	226	5	4635	816	0	79	239	478	79	79	0	0	398	0
30008	41	6	27	6.1	12.5	212	5	7085.	2521	0	641	320	801	80	400	0	0	0	320
30022	49	7	19	8.8	18.3	193	6	19093	559	0	3136	136	3835	561	223	0	507	0	289
30029	51	7	25	13.5	27.1	209	5	6075	377	0	700	73	1179	73	221	0	110	0	110
30066	61	8	22	10.3	20.4	238	4	5807	1304	49	588	49	882	0	49	0	0	0	98
30071	60	8	18	18.1	43.8	156	3	5902	889	0	891	137	548	205	114	0	22	0	45
30082	64	8	30	18.1	38.8	187	3	6883	1127	0	309	51	850	0	103	0	0	0	77
30088	65	9	1	15.3	32.2	235	1	9117	2224	0	1801	248	931	0	124	0	0	0	62
30110	62	8	24	18.1	38.0	211	7	5381	1264	0	789	105	1789	0	52	0	210	0	52
30112	67	9	11	6.8	14.6	204	11	7048	2264	0	410	341	752	0	410	0	0	205	410
30122	80	10	17	23.7	48.7	64	1	6923	1494	0	164	82	266	0	41	0	0	102	20
30202	72	9	23	24.0	47.3	92	2	3416	653	0	655.	126	444	0	42	0	0	0	63
30231	68	9	13	23.4	50.3	47	9	1809	412	39	0	0	0	19	0	0	0	39	0
50002	69	9	17	20.8	43.2	51	3	1698	237	0	115	69	208	0	23	0	0	46	0
50008	70	9	19	21.8	45.7	32	4	4843	839	0	524	43	1487	0	43	0	0	0	0
50017	73	9	26	24.0	50.3	205	3	5308	707	0	337	0	437	0	99	0	59	0	0
50023	74	9	29	24.0	50.3	114	2	3976	994	0	179	59	179	0	99	0	59	0	0
50033	76	10	5	24.0	52.7	163	8	3916	551	0	227	113	492	0	94	0	0	0	0
50035	78	10	11	12.5	26.0	168	3	9217	1874	0	499	115	807	0	115	0	38	0	0
50041	77	10	7	24.0	53.1	274	10	1339	193	18	188	18	395	0	37	0	18	0	0
50047	83	10	25	24.0	52.8	192	10	12018	1980	75	871	208	1704	0	56	0	0	0	56
50053	84	10	29	24.1	53.2	165	5	2264	640	0	75	37	469	0	0	0	0	0	0
50059	85	10	31	24.1	49.8	219	6	8603	1690	20	702	0	1124	0	20	0	0	0	0
50065	87	11	4	13.1	28.6	209	5	14246	2125	104	3075	384	1712	0	69	0	34	0	0
50071	88	11	7	20.1	42.2	254	3	4153	242	0	118	47	616	0	71	0	47	0	23
50077	89	11	10	22.7	50.0	116	2	9262	1371	0	880	20	1060	0	80	0	40	0	0
50143	112	1	27	24.2	53.0	237	6	519	193	0	622	0	2130	0	94	0	924	0	0
50165	113	1	30	24.2	52.8	277	9	891	194	0	75	56	549	0	0	0	189	56	113
50171	114	2	2	24.3	53.7	254	10	1458	190	0	167	167	949	0	186	0	0	93	0
50177	115	2	6	12.0	26.5	241	3	4041	1836	113	868	604	1548	0	642	0	75	0	0
50183	116	2	8	24.3	52.8	251	13	2658	1005	0	189	0	1061	0	0	0	246	18	208
50188	117	2	12	22.7	50.0	43	3	1738	205	0	180	820	740	0	440	0	2301	0	380
50194	118	2	14	24.3	53.4	68	4	596	192	0	206	74	524	0	18	0	0	56	0
50200	119	2	20	11.4	26.2	220	6	3298	825	38	420	267	1452	0	267	0	229	0	114
50206	120	2	22	13.2	28.9	247	6	1693	355	0	138	207	1385	69	242	0	346	0	311

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 2 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO_3	CL	SO_4	NO_2	NA	PO_4	NH_4	BR-S	K
								NANOGRAMS/M**3											
50212	121	2	26	24.3	52.0	43	11	1713	580	0	0	0	0	0	134	0	38	38	57
50218	122	2	28	16.3	35.4	220	4	4719	1444	56	1780	339	1130	0	28	0	0	0	0
50224	123	3	4	24.3	51.4	171	15	889	199	19	0	77	311	0	38	0	19	0	38
50229	124	3	7	24.2	52.2	61	4	7625	857	0	421	153	1016	0	95	0	0	0	0
50235	125	3	10	24.2	51.3	235	13	3507	472	58	350	116	1111	0	19	292	38	194	0
50241	126	3	14	24.2	52.3	243	15	2535	463	0	191	0	1434	0	57	0	38	0	57
50247	127	3	16	24.3	52.0	232	12	2424	836	0	615	0	596	0	96	0	57	0	0
50253	128	3	20	16.6	35.4	247	1	15470	1722	28	847	593	1695	0	1017	141	169	141	169
50259	129	3	22	24.3	50.8	28	2	14321	1466	0	905	787	1062	0	865	0	0	0	0
50265	130	3	26	24.2	51.0.	253	13	4228	914	0	156	19	1587	0	78	0	97	0	0
50271	131	3	28	24.3	51.4	177	7	4834	832	38	194	272	914	0	350	0	214	0	0
							AVERAGE	5399.4	959.3	14.2	571.2	164.6	970.4	23.6	159.3	9.4	134.4	30.1	66.8
S T A T I S T I C S							STANDARD DEVIATION	4255.9	658.2	27.9	678.0	199.7	670.2	88.7	216.5	47.4	373.9	74.1	109.5

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 3 COARSE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
30003	40	6	25	5.6	11.6	226	5	31	249	190	11	23	475	11	11	11	1035	130
30009	41	6	27	5.9	12.3	212	5	50	293	180	11	45	7212	90	0	11	7651	2197
30024	49	7	19	12.5	25.8	193	6	56	139	332	26	5	3702	69	5	5	5143	1269
30032	50	7	21	17.7	30.5	205	5	40	91	326	68	3	3038	83	3	7	3490	1103
30038	51	7	25	18.2	37.4	209	5	23	85	196	40	3	1080	33	0	7	1502	462
30053	55	8	6	17.2	35.1	330	2	22	157	189	3	3	654	19	3	3	1250	354
30055	54	8	2	16.4	31.0	197	6	35	62	187	4	4	1618	40	4	4	2092	554
30059	58	8	12	13.5	25.6	181	4	34	162	216	5	10	1110	27	5	16	1631	677
30060	56	8	8	10.8	21.1	219	13	40	45	255	6	6	2557	39	13	6	2190	1062
30064	61	8	22	18.1	35.4	238	4	24	105	309	3	3	1119	27	3	3	1616	446
30072	60	8	18	18.2	30.3	156	3	25	228	259	3	3	1220	38	3	3	1689	366
30075	59	8	15	18.2	34.8	150	4	27	210	325	11	3	1617	31	3	3	2349	966
30083	64	8	30	18.1	37.4	187	3	20	99	244	3	3	980	33	3	3	1609	303
30089	65	9	1	16.7	34.5	235	1	34	300	288	20	4	1336	40	4	12	2279	425
30096	66	9	7	18.2	35.4	284	3	23	27	62	3	7	886	27	3	3	1457	398
30107	62	8	24	12.5	23.8	211	7	57	151	93	75	5	5712	139	5	11	6318	1911
30127	80	10	17	23.6	48.7	64	1	28	284	367	22	2	950	25	0	5	2655	185
30203	72	9	23	23.6	45.2	92	2	10	272	462	3	3	275	9	3	3	820	119
30211	68	9	13	24.1	49.6	47	9	5	97	44	2	2	92	0	0	2	259	33
30215	82	10	23	23.5	47.3	313	6	8	140	140	2	2	275	8	0	2	547	201
50006	69	9	17	24.1	50.5	51	3	6	117	274	2	2	98	2	0	2	397	82
50009	70	9	19	24.1	50.2	32	4	14	85	286	2	2	295	8	0	2	1499	719
50013	107	1	11	15.8	34.4	190	1	16	112	362	4	4	624	20	0	4	2537	471
50018	73	9	26	23.7	49.4	205	3	14	218	336	2	2	723	22	0	2	1455	260
50024	74	9	29	23.6	49.0	114	2	11	291	455	2	2	299	5	0	2	879	115
50030	77	10	7	23.7	50.2	274	10	5	93	93	2	2	234	5	0	2	471	132
50031	76	10	5	23.8	49.4	163	8	4	19	44	2	5	515	2	0	2	403	187
50036	78	10	11	23.7	48.1	168	3	23	195	368	17	2	1068	25	0	2	2070	374
50049	83	10	25	23.7	49.3	192	10	9	117	199	2	5	2113	47	2	2	3059	659
50060	85	10	31	23.7	49.1	219	6	28	95	146	2	2	2263	53	0	8	3549	780
50066	87	11	4	16.6	34.6	209	5	37	275	287	3	3	1951	39	0	19	3174	859
50072	88	11	7	22.5	47.0	254	3	12	265	574	2	2	486	14	0	2	1143	395
50078	89	11	10	23.7	49.5	116	2	25	391	705	44	5	1116	25	0	2	2256	652
50088	94	11	28	23.7	52.5	98	7	6	18	42	2	2	240	2	0	2	720	237
50091	93	11	22	23.6	51.8	281	4	15	133	267	2	2	313	2	0	5	1257	302

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 3 COARSE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
50097	96	12	4	23.7	47.6	43	17	9	72	46	2	2	1054	20	0	2	1511	448
50099	95	11	30	23.6	46.7	80	9	17	53	124	2	2	921	23	0	2	2411	444
50103	97	12	6	23.7	48.1	75	6	31	83	230	8	2	1860	51	0	2	4593	792
50107	98	12	10	23.6	47.4	103	12	12	20	46	2	2	362	14	0	2	1017	216
50110	99	12	12	23.7	47.8	37	9	8	156	188	2	2	744	5	2	2	1023	588
50114	101	12	16	23.7	48.1	209	10	17	72	46	20	2	1094	23	0	5	1561	579
50118	102	12	19	23.6	49.3	307	3	17	87	126	2	2	668	16	0	2	1617	393
50122	104	12	28	23.7	50.3	322	4	13	173	44	2	8	1837	33	0	2	1066	432
50123	103	12	22	23.7	49.6	229	12	12	41	44	2	2	1198	22	0	2	1229	366
50134	106	1	9	23.7	48.3	221	12	19	88	197	2	8	1947	37	0	2	3165	1536
50135	105	1	2	23.7	50.5	288	7	7	60	43	2	2	460	5	2	2	411	263
50145	108	1	15	23.7	47.6	243	14	18	96	46	2	5	1556	29	0	2	2398	727
50150	109	1	17	20.6	41.8	244	6	8	82	53	3	3	222	6	0	3	265	341
50157	110	1	21	15.3	31.4	336	4	5	30	70	4	4	61	0	0	4	136	229
50162	112	1	27	23.8	52.1	237	6	7	18	42	2	7	201	2	0	2	786	781
50166	113	1	30	24.0	52.5	277	9	4	63	42	2	2	197	2	0	7	368	187
50172	114	2	2	24.0	52.4	254	10	4	36	166	2	2	171	7	0	2	485	200
50178	115	2	6	18.8	41.3	241	3	14	23	53	3	3	1367	26	0	6	1437	821
50184	116	2	8	24.0	52.4	251	13	7	52	42	2	2	341	7	0	2	684	370
50189	117	2	12	22.9	50.1	43	3	9	140	218	2	2	201	5	0	5	715	414
50195	118	2	14	18.1	39.3	68	4	8	63	176	3	3	415	14	0	3	816	380
50201	119	2	20	9.9	21.6	220	6	24	96	102	6	6	2721	32	0	6	3395	1334
50207	120	2	22	14.3	31.0	247	6	3	31	71	4	4	111	4	0	4	611	723
50213	121	2	26	23.5	50.5	43	11	4	60	150	2	2	164	5	0	2	266	312
50219	123	3	4	24.0	50.7	171	15	3	51	150	2	2	62	0	0	2	224	213
50230	124	3	7	24.0	51.2	61	4	19	51	43	2	2	802	16	0	2	2562	583
50236	125	3	10	24.0	50.3	235	13	10	93	44	2	5	973	11	0	2	814	654
50242	126	3	14	24.0	51.5	243	15	10	37	43	2	2	1271	34	2	2	927	500
50248	127	3	16	24.0	51.0	232	12	17	67	43	2	2	1692	32	0	2	1399	703
50254	128	3	20	19.2	40.5	247	1	50	239	133	3	3	2568	99	3	3	6128	721
50260	129	3	22	24.0	49.7	28	2	47	167	44	36	2	2218	80	2	5	6686	684
50266	130	3	26	24.0	50.1	253	13	18	63	44	2	2	1210	30	2	2	1727	367
50272	131	3	28	24.0	50.9	177	7	15	48	43	2	2	725	27	0	2	1677	375
S T A T I S T I C S							AVERAGE	18.9	119.6	177.3	8.0	4.1	1171.2	26.1	1.3	4.0	1861.2	545.0
							STANDARD DEVIATION	13.6	80.6	141.6	14.3	5.8	1236.3	26.0	2.4	3.4	1611.3	406.2

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 3 COARSE PARTICULATE DATA (PART - 2) *****

NANOGRAMS/M**3

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
30003	40	6	25	5.6	11.6	226	5	4378	880	0	429	257	515	85	171	0	0	0	85
30009	41	6	27	5.9	12.3	212	5	7651	2389	488	1139	0	2522	0	406	0	0	0	325
30024	49	7	19	12.5	25.8	193	6	14648	2952	11	2282	119	2108	580	81	0	406	0	205
30032	50	7	21	17.7	36.5	205	5	11460	1680	0	1015	109	2191	0	164	0	629	0	136
30038	51	7	25	18.2	37.4	209	5	5281	273	0	694	53	988	0	80	0	80	0	106
30053	55	8	6	17.2	35.1	330	2	5643	291	85	1480	56	1025	0	56	0	28	0	28
30055	54	8	2	16.4	31.0	197	6	10443	1788	64	1194	129	1097	0	96	0	0	0	32
30059	58	8	12	13.5	25.6	181	4	8062	1051	0	1956	195	1017	0	195	0	0	39	78
30060	56	8	8	10.8	21.1	219	13	6111	1921	0	804	94	2130	47	236	0	189	0	189
30064	61	8	22	18.1	35.4	238	4	5482	289	0	791	28	706	0	84	0	0	0	56
30072	60	8	18	18.2	36.3	156	3	6823	1010	0	853	110	385	0	82	0	27	0	82
30075	59	8	15	18.2	34.8	150	4	6694	640	0	574	172	1607	373	86	0	200	0	57
30083	64	8	30	18.1	37.4	187	3	6018	1157	0	293	106	427	0	133	0	0	0	26
30089	65	9	1	16.7	34.5	235	1	7452	866	0	1941	289	782	0	202	0	0	0	86
30096	66	9	7	18.2	35.4	284	3	7329	761	0	733	169	959	0	56	0	0	0	56
30107	62	8	24	12.5	23.8	211	7	11728	2075	0	1599	252	3367	0	168	0	168	0	168
30127	80	10	17	23.6	48.7	64	1	8709	1380	0	164	102	308	0	61	0	0	102	20
30203	72	9	23	23.6	45.2	92	2	3429	658	0	397	132	950	0	66	0	22	0	110
30211	68	9	13	24.1	49.6	47	9	745	206	0	0	20	0	0	40	0	0	0	0
30215	82	10	23	23.5	47.3	313	6	2937	719	0	274	21	337	0	63	0	0	0	21
50006	69	9	17	24.1	50.5	51	3	934	202	0	98	59	178	0	19	0	0	39	0
50009	70	9	19	24.1	50.2	32	4	3055	587	0	517	19	1652	0	79	0	0	0	0
50013	107	1	11	15.8	34.4	190	1	1212	298	0	174	203	523	0	174	0	0	0	0
50018	73	9	26	23.7	49.4	205	3	4751	925	0	344	0	344	0	60	0	60	0	0
50024	74	9	29	23.6	49.0	114	2	3308	797	20	163	81	265	0	61	0	0	0	0
50030	77	10	7	23.7	50.2	274	10	1152	203	0	0	19	258	0	19	0	0	0	0
50031	76	10	5	23.8	49.4	163	8	1274	207	20	101	20	161	0	20	0	0	0	0
50036	78	10	11	23.7	48.1	168	3	9447	1373	0	478	41	602	0	20	0	0	0	0
50049	83	10	25	23.7	49.3	192	10	7508	783	60	466	162	1134	0	40	0	0	141	20
50060	85	10	31	23.7	49.1	219	6	8671	1423	0	854	0	1180	0	40	0	20	0	0
50066	87	11	4	16.6	34.6	209	5	12506	2263	86	3724	317	1732	0	57	0	28	0	0
50072	88	11	7	22.5	47.0	254	3	4174	955	0	106	0	617	0	42	0	0	0	0
50078	89	11	10	23.7	49.5	116	2	8954	2046	0	1050	20	970	0	80	0	40	0	0
50088	94	11	28	23.7	52.5	98	7	962	195	19	95	38	285	0	76	0	38	0	0
50091	93	11	22	23.6	51.8	281	4	4308	955	0	115	5255	289	0	1081	0	0	0	38

NIAGARA FRONTIER STUDY

***** SITE # 3 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
50097	96	12	4	23.7	47.6	43	17	2414	215	0	105	0	630	0	168	0	0	0	0
50099	95	11	30	23.6	46.7	80	9	4109	722	0	128	385	684	0	128	0	0	0	42
50103	97	12	6	23.7	48.1	75	6	5460	622	0	457	83	1247	0	103	0	0	0	103
50107	98	12	10	23.6	47.4	103	12	3325	908	0	21	0	211	0	253	0	42	0	0
50110	99	12	12	23.7	47.8	37	9	2336	669	41	334	0	837	0	146	0	62	0	0
50114	101	12	16	23.7	48.1	209	10	3440	593	0	811	852	894	0	644	0	0	0	0
50118	102	12	19	23.6	49.3	307	3	3887	845	20	0	953	588	0	648	0	0	0	0
50122	104	12	28	23.7	50.3	322	4	1432	203	19	258	954	636	0	676	0	0	0	0
50123	103	12	22	23.7	49.6	229	12	2464	572	20	342	1089	585	0	726	0	0	0	0
50134	106	1	9	23.7	48.3	221	12	3446	427	0	641	20	1863	0	144	0	62	0	0
50135	105	1	2	23.7	50.5	288	7	1503	938	0	99	79	336	0	158	0	79	0	0
50145	108	1	15	23.7	47.6	243	14	3434	215	0	420	189	1155	0	441	0	42	0	0
50150	109	1	17	20.6	41.8	244	6	1515	245	23	239	47	670	0	335	0	0	0	0
50157	110	1	21	15.3	31.4	336	4	1181	326	0	95	127	381	0	509	0	0	0	0
50162	112	1	27	23.8	52.1	237	6	826	196	19	364	115	1477	0	57	0	0	0	57
50166	113	1	30	24.0	52.5	277	9	490	195	0	76	19	304	0	0	0	209	0	114
50172	114	2	2	24.0	52.4	254	10	198	393	0	95	0	495	0	190	0	0	0	0
50178	115	2	6	18.8	41.3	241	3	3077	1216	0	508	24	968	0	48	0	871	0	242
50184	116	2	8	24.0	52.4	251	13	652	195	0	190	190	725	0	0	0	0	0	0
50189	117	2	12	22.9	50.1	43	3	1845	204	0	159	818	798	0	379	0	2214	0	359
50195	118	2	14	18.1	39.3	68	4	1837	260	127	355	101	686	0	76	0	788	50	0
50201	119	2	20	9.9	21.6	220	6	3170	474	0	880	0	2687	0	0	0	0	0	0
50207	120	2	22	14.3	31.0	247	6	1375	330	0	96	161	999	0	257	0	128	0	96
50213	121	2	26	23.5	50.5	43	11	1075	649	39	118	0	613	0	0	0	0	0	0
50219	123	3	4	24.0	50.7	171	15	1068	202	78	138	118	473	0	19	0	0	0	19
50230	124	3	7	24.0	51.2	61	4	5761	1297	0	390	136	897	0	58	0	0	0	0
50236	125	3	10	24.0	50.3	235	13	2607	203	59	178	99	913	0	39	0	79	0	39
50242	126	3	14	24.0	51.5	243	15	1688	198	0	135	0	1145	0	38	0	0	0	0
50248	127	3	16	24.0	51.0	232	12	3126	489	0	686	98	1490	0	137	0	98	0	0
50254	128	3	20	19.2	40.5	247	1	12335	2428	98	444	518	1111	0	1160	0	49	0	0
50260	129	3	22	24.0	49.7	28	2	17736	1901	0	743	301	723	0	140	0	140	0	0
50266	130	3	26	24.0	50.1	253	13	3848	577	0	79	39	758	0	79	0	99	0	0
50272	131	3	28	24.0	50.9	177	7	4632	997	78	196	215	686	0	235	0	196	0	0

S T A T I S T I C S

	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
AVERAGE	4713.7	825.0	21.7	548.2	240.8	915.8	16.0	182.1	.0	104.3	5.5	44.0
STANDARD DEVIATION	3762.8	662.8	64.2	642.9	662.8	650.1	83.5	235.7	.0	308.7	22.5	76.4

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 4 COARSE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
30004	40	6	25	6.5	13.7	226	5	25	273	456	131	10	1642	20	10	10	2494	324
30010	41	6	27	6.3	11.9	212	5	43	175	186	11	11	1751	11	0	11	980	315
30025	49	7	19	7.8	16.1	193	6	89	60	137	85	17	6586	180	8	17	8481	1114
30039	51	7	25	12.3	24.8	209	5	34	211	89	5	5	3328	66	5	5	2759	535
30044	60	8	18	23.9	49.3	156	3	22	154	177	39	2	1697	36	2	8	2023	320
30056	54	8	2	5.0	9.8	197	6	72	268	225	14	14	3755	84	14	14	3035	592
30057	55	8	6	16.7	35.7	330	2	32	27	236	3	3	1226	23	7	7	1456	392
30061	58	8	12	7.1	14.0	181	4	48	69	158	9	9	2740	49	19	9	2789	751
30076	59	8	15	6.8	13.2	150	4	63	282	606	10	10	4550	94	10	10	5083	1150
30084	64	8	30	17.7	37.8	187	3	29	146	216	14	7	1710	40	7	3	3687	512
30090	65	9	1	17.7	37.9	235	1	42	208	599	69	3	2494	62	3	3	3460	647
30097	66	9	7	17.7	35.8	284	3	33	85	61	3	3	1538	38	3	11	3385	645
30101	67	9	11	11.1	24.9	204	11	37	205	88	5	5	3327	94	5	5	4083	933
30106	62	8	24	5.1	10.7	211	7	79	90	206	38	12	8467	193	12	12	11694	2026
30117	61	8	22	16.2	34.1	238	4	34	81	65	40	20	3435	44	8	8	3264	678
30124	80	10	17	16.2	34.0	64	1	12	28	354	4	4	382	12	0	4	1217	134
30204	72	9	23	24.0	50.3	92	2	8	79	440	2	2	377	5	0	2	533	96
30223	68	9	13	24.2	50.9	47	9	4	19	133	2	2	280	8	0	8	261	13
50001	69	9	17	24.1	51.9	51	3	5	111	125	2	2	197	5	0	2	386	98
50010	70	9	19	24.1	51.9	32	4	11	127	221	2	2	290	10	0	2	1005	543
50019	73	9	26	23.9	51.5	205	3	16	158	295	2	2	1543	26	0	2	1611	260
50025	74	9	29	23.9	51.3	114	2	13	167	350	2	2	720	16	0	5	1204	191
50032	76	10	5	24.0	51.2	163	8	14	137	124	2	2	894	16	0	2.	1383	454
50043	77	10	7	23.9	54.8	274	10	7	134	128	2	2	455	7	0	5	419	154
50048	83	10	25	23.9	49.7	192	10	52	139	153	8	5	3415	78	2	2	6292	800
50055	84	10	29	24.0	51.5	165	5	26	128	185	2	2	437	8	0	2	561	252
50061	85	10	31	17.3	36.7	219	6	46	150	60	15	3	4551	113	3	11	5976	1021
50067	87	11	4	14.7	31.6	209	5	43	210	394	14	4	2751	52	0	17	3754	1161
50073	88	11	7	22.3	48.3	254	3	13	183	220	2	2	917	20	0	2	1279	438
50079	89	11	10	23.3	50.2	116	2	32	319	209	33	2	1756	41	0	2	3645	794
50087	91	11	16	24.1	52.9	69	4	10	78	348	2	2	400	2	0	2	795	104
50089	93	11	22	24.2	54.3	281	4	15	196	252	2	2	685	5	0	2	996	214
50090	92	11	20	24.1	54.2	210	6	11	17	40	2	2	1211	7	0	5	1495	406
50092	94	11	28	24.0	54.8	98	7	13	17	217	2	2	548	7	0	2	503	485
50100	97	12	6	13.9	30.5	75	6	48	181	72	4	9	3254	72	0	4	11527	1468

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 4   COARSE PARTICULATE DATA   (PART - I)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
50104	98	12	10	24.0	52.6	103	12	23	47	42	2	2	1645	23	0	2	995	379
50111	99	12	12	24.0	53.2	37	9	17	88	41	10	2	1807	28	2	2	2593	777
50115	101	12	16	20.8	46.3	209	10	27	20	230	2	2	1813	17	0	2	3954	790
50119	102	12	19	24.0	53.2	307	3	13	36	140	2	2	708	15	0	2.	1294	317
50124	103	12	22	24.0	54.1	229	12	24	74	40	2	2	2411	30	0	2	2805	616
50130	106	1	9	24.0	57.1	221	12	35	123	38	29	9	3058	46	0	4	7694	1956
50141	107	1	11	12.9	30.5	190	1	11	177	350	4	4	781	13	0	13	2777	518
50146	108	1	15	24.0	56.4	243	14	27	71	100	27	7	3108	31	2	2	3491	899
50151	109	1	17	19.6	44.1	244	6	10	147	50	3	3	718	3	0	6	432	539
50156	110	1	21	22.3	51.8	336	4	5	61	42	2	2	401	8	0	2	243	353
50161	112.	1	27	17.0	38.2	237	6	9	86	307	3	3	1554	7	0	3	481	655
50167	113	1	30	24.1	54.4	277	9	6	17	129	2	2	704	20	0	2	529	363
50173	114	2	2	24.1	54.4	254	10	19	55	173	2	2	2849	53	2	2	1613	791
50179	116	2	8	24.0	54.0	251	13	16	46	41	2	2	2564	46	0	2	1112	679
50190	117	2	12	21.2	47.7	43	3	6	58	191	2	2	215	0	0	2	581	363
50196	118	2	14	16.5	37.1	68	4	10	186	59	3	3	1062	11	0	3	1010	413
50202	119	2	20	9.8	22.9	220	6	35	96	260	6	6	3021	36	0	6	7987	1913
50208	120	2	22	14.6	32.9	247	6	7	96	67	4	4	1603	33	0	8	753	669
50214	121	2	26	24.0	53.2	43	11	3	18	41	2	2	161	5	0	2	189	234
50220	122	2	28	9.5	20.9	220	4	22	46	105	6	6	4385	112	0	6	4722	1236
50225	123	3	4	24.1	55.1	171	15	6	47	40	2	2	665	12	0	2	371	354
50231	124	3	7	24.1	52.7	61	4	16	39	42	2	5	888	23	0	2	2504	520
50237	125	3	10	6.0	13.0	235	13	27	445	169	127	21	10220	244	10	10	26192	6272
50243	126	3	14	24.1	52.7	243	15	20	81	42	2	2	2933	76	2	2	2187	635
50249	127	3	16	5.0	11.7	232	12	58	82	555	11	11	5932	94	11	11	11273	2363
50255	128	3	20	24.0	52.0	247	1	71	223	189	45	2	6609	218	5	15	8687	1150
50261	129	3	22	23.5	50.5	28	2	41	126	260	2	2	1854	60	2	2	6504	674
50267	130	3	26	24.0	52.3	253	13	29	74	42	15	2	.3612	63	0	5	1677	732
50273	131	3	28	24.0	52.9	177	7	17	81	164	2	2	1213	34	0	2	1624	478
							AVERAGE	26.4	119.7	184.0	15.1	4.7	2216.6	45.4	2.4	5.3	3278.9	744.7
							STANDARD DEVIATION	19.7	84.1	140.4	27.4	4.5	2021.5	51.7	4.2	4.2	4087.2	850.1

S T A T I S T I C S

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 4 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
30004	40	6	25	6.5	13.7	226	5	8557	750	0	512	292	658	0	219	0	0	73	0
30010	41	6	27	6.3	11.9	212	5	2475	864	0	0	252	252	0	337	0	0	0	252
30025	49	7	19	7.8	16.1	193	6	22108	4133	30	1820	216	2043	1393	191	0	0	0	408
30039	51	7	25	12.3	24.8	209	5	7036	1689	0	322	120	845	0	161	0	0	40	120
30044	60	8	18	23.9	49.3	156	3	6577	1258	0	588	81	405	20	81	0	0	0	60
30056	54	8	2	5.0	9.8	197	6	6762	1044	0	1325	713	2548	101	1325	0	0	0	407
30057	55	8	6	16.7	35.7	330	2	5843	287	0	1289	252	1037	56	308	0	0	0	168
30061	58	8	12	7.1	14.0	181	4	8171	732	0	2142	214	1000	785	214	0	0	0	142
30076	59	8	15	6.8	13.2	150	4	16622	2468	0	755	151	2190	0	226	0	151	0	226
30084	64	8	30	17.7	37.8	187	3	5852	1018	423	317	79	898	0	79	0	0	0	105
30090	65	9	1	17.7	37.9	235	1	7049	1390	0	2007	264	1373	0	132	0	0	0	79
30097	66	9	7	17.7	35.8	284	3	11396	2198	0	781	139	1534	0	195	0	0	0	139
30101	67	9	11	11.1	24.9	204	11	7733	1288	0	0	160	1885	681	120	0	40	0	120
30106	62	8	24	5.1	10.7	211	7	12675	3562	0	1584	372	3261	372	186	0	186	0	186
30117	61	8	22	16.2	34.1	238	4	6927	1426	0	792	146	1232	0	88	0	88	0	88
30124	80	10	17	16.2	34.0	64	1	4425	1021	0	58	88	205	0	58	0	0	0	0
30204	72	9	23	24.0	50.3	92	2	2936	1197	0	99	119	238	178	59	0	0	59	19
30223	68	9	13	24.2	50.9	47	9	946	201	0	0	39	19	0	58	0	0	0	19
50001	69	9	17	24.1	51.9	51	3	1479	423	0	115	57	211	0	38	0	0	38	0
50010	70	9	19	24.1	51.9	32	4	2330	759	0	442	0	1251	0	77	0	0	0	0
50019	73	9	26	23.9	51.5	205	3	4787	710	0	330	0	427	0	58	0	38	0	0
50025	74	9	29	23.9	51.3	114	2	4441	529	19	194	77	253	0	0	0	0	0	0
50032	76	10	5	24.0	51.2	163	8	4938	548	0	195	39	487	0	39	0	0	0	0
50043	77	10	7	23.9	54.8	274	10	1701	187	0	91	36	237	0	54	0	18	0	0
50048	83	10	25	23.9	49.7	192	10	7142	1343	261	382	241	1268	0	120	0	0	60	100
50055	84	10	29	24.0	51.5	165	5	1329	198	0	96	19	426	0	19	0	0	0	0
50061	85	10	31	17.3	36.7	219	6	9596	776	81	952	0	1579	0	136	0	27	0	81
50067	87	11	4	14.7	31.6	209	5	10235	1866	126	3353	411	3005	0	63	0	253	0	126
50073	88	11	7	22.3	48.3	254	3	4231	843	0	1242	82	1739	0	103	41	41	0	20
50079	89	11	10	23.3	50.2	116	2	10535	2435	0	975	79	1373	0	79	0	39	0	0
50087	91	11	16	24.1	52.9	69	4	2334	193	18	132	18	170	0	56	0	0	0	0
50089	93	11	22	24.2	54.3	281	4	2916	188	0	110	2153	0	0	2558	0	92	0	0
50090	92	11	20	24.1	54.2	210	6	2039	434	0	221	313	756	0	55	0	0	0	92
50092	94	11	28	24.0	54.8	98	7	2683	412	0	109	54	620	0	127	0	0	0	0
50100	97	12	6	13.9	30.5	75	6	5927	786	590	689	820	2264	0	164	0	0	0	229

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 4   COARSE PARTICULATE DATA   (PART - 2)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO_3	CL	SO_4	NO_2	NA	PO_4	NH_4	BR-S	K
								NANOGRAMS/M**3											
50104	98	12	10	24.0	52.6	103	12	4045	539	0	95	.456	570	0	380	0	38	0	0
50111	99	12	12	24.0	53.2	37	9	2382	192	37	432	732	1540	0	206	0	56	0	0
50115	101	12	16	20.8	46.3	209	10	3660	221	0	756	2939	821	0	1728	0	0	0	0
50119	102	12	19	24.0	53.2	307	3	2623	192	18	37	846	564	0	620	0	0	37	0
50124	103	12	22	24.0	54.1	229	12	3778	660	0	295	776	1090	0	1386	0	0	0	0
50130	106	1	9	24.0	57.1	221	12	2669	179	35	473	52	3049	0	245	0	0	0	0
50141	107	1	11	12.9	30.5	190	1	1836	336	0	262	0	590	0	295	0	65	98	0
50146	108	1	15	24.0	56.4	243	14	4293	955	195	496	266	1277	0	408	0	35	0	35
50151	109	1	17	19.6	44.1	244	6	2556	232	22	339	90	906	0	543	0	0	0	0
50156	110	1	21	22.3	51.8	336	4	1000	197	0	115	38	579	0	328	0	0	0	0
50161	112	1	27	17.0	38.2	237	6	865	208	0	130	52	993	0	156	0	52	0	104
50167	113	1	30	24.1	54.4	277	9	1784	618	0	55	0	441	0	110	0	0	0	91
50173	114	2	2	24.1	54.4	254	10	3972	452	0	55	220	1157	0	220	0	18	0	0
50179	116	2	8	24.0	54.0	251	13	2572	384	37	333	166	1481	0	333	0	37	0	0
50190	117	2	12	21.2	47.7	43	3	1429	215	62	104	545	545	272	272	0	1888	0	0
50196	118	2	14	16.5	37.1	68	4	1547	275	26	215	107	565	0	376	0	107	0	0
50202	119	2	20	9.8	22.9	220	6	454	448	87	699	874	3891	0	43	0	0	0	0
50208	120	2	22	14.6	32.9	247	6	315	311	0	60	182	1124	0	334	60	212	0	182
50214	121	2	26	24.0	53.2	43	11	195	192	37	18	0	526	0	0	0	0	0	0
50220	122	2	28	9.5	20.9	220	4	.2645	489	47	811	477	2292	0	238	0	191	0	47
50225	123	3	4	24.1	55.1	171	15	1406	386	0	36	72	507	0	54	0	36	0	.54
50231	124	3	7	24.1	52.7	61	4	3765	856	0	379	94	910	0	75	0	113	0	0
50237	125	3	10	6.0	13.0	235	13	795	785	536	1532	459	7586	0	459	0	229	0	229
50243	126	3	14	24.1	52.7	243	15	2474	590	0	189	37	1593	0	56	0	37	0	0
50249	127	3	16	5.0	11.7	232	12	1973	874	85	1791	938	4607	0	341	0	0	1791	85
50255	128	3	20	24.0	52.0	247	1	16057	2337	96	768	826	1480	0	1614	0	249	0	326
50261	129	3	22	23.5	50.5	28	2	12009	1549	0	871	574	1128	0	554	0	0	0	0
50267	130	3	26	24.0	52.3	253	13	4307	558	0	229	343	1471	0	229	0	0	0	0
50273	131	3	28	24.0	52.9	177	7	4726	428	0	94	434	755	0	528	0	0	0	0
							AVERAGE	4929.1	866.8	44.8	557.6	323.3	1277.0	60.3	311.2	1.6	67.7	34.3	67.8
S T A T I S T I C S																			
							STANDARD DEVIATION	4302.7	804.5	116.3	646.8	483.9	1228.2	219.9	456.5	9.0	240.8	223.9	100.1

NIAGARA FRONTIER STUDY

***** SITE # 5 COARSE PARTICULATE DATA (PART - 1) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
30005	40	6	25	6.5	13.4	226	5	31	217	1109	10	10	1109	20	0	10	2177	145
30011	41	6	27	6.3	13.0	212	5	40	74	169	10	10	880	21	0	10	6940	1135
30026	49	7	19	10.0	19.5	193	6	68	198	113	70	7	6854	141	7	7	8954	1475
30040	51	7	25	9.3	17.8	209	5	50	194	124	54	7	5356	93	7	7	4735	706
30050	54	8	2	6.3	12.2	197	6	51	79	181	11	11	4286	79	11	22	4252	773
30054	55	8	6	17.9	32.1	330	2	37	293	401	77	4	3209	34	4	4	2414	483
30062	56	8	8	10.2	19.9	219	13	47	48	111	6	6	2670	83	6	6	8452	1436
30074	59	8	15	5.6	9.5	150	4	99	233	918	72	29	9024	189	14	14	11531	2434
30078	60	8	18	16.0	25.9	156	3	40	171	251	42	5	3824	53	10	5	4290	470
30085	64	8	30	18.1	31.5	187	3	27	175	386	4	4	3093	43	4	4.	2394	355
30091	65	9	1	13.6	19.1	235	1	64	232	116	137	7	6783	152	7	21	5455	667
30099	66	9	7	17.9	32.9	284	3	31	63	324	4	4	2016	42	4	4	2786	543
30102	67	9	11	11.7	18.0	204	11	62	53	122	23	7	3664	122	0	7	7412	1874
30105	62	8	24	10.1	17.2	211	7	69	56	491	56	8	6050	161	0	8	13213	2255
30118	61	8	22	13.7	23.5	238	4	43	118	94	5	11	6143	64	0	5	4980	619
30125	80	10	17	24.0	49.5	64	1	15	198	470	2	2	873	22	0	2	1340	148
30205	72	9	23	24.0	46.8	92	2	9	118	316	2	5	666	11	0	2	769	130
30222	68	9	13	23.5	41.8	47	9	6	23	53	3	3	308	3	0	6	324	43
30234	82	10	23	24.0	49.3	313	6	20	70	44	2	2	2060	25	0	5	2271	454
50004	69	9	17	23.6	49.3	51	3	13	106	334	19	5	528	5	2	2	483	157
50011	70	9	19	24.0	48.2	32	4	12	158	261	2	2	445	8	0	2	1187	715
50020	73	9	26	19.8	34.8	205	3	24	179	274	3	3	3079	51	0	3	2820	314
50026	74	9	29	24.1	39.5	114	2	10	203	221	3	3	768	7	0	3	884	189
50029	76	10	5	24.0	39.0	163	8	10	78	56	3	3	1448	7	0	3	493	227
50038	78	10	11	24.0	36.7	108	3	1	237	422	3	7	5360	101	0	7	5914	844
50042	77	10	7	24.1	48.5	274	10	12	19	45	2	2	2875	25	0	5	447	302
50050	83	10	25	24.0	56.8	192	10	22	104	102	19	9	2439	51	0	2	2691	631
50056	84	10	29	23.9	56.5	165	5	8	149	257	2	4	725	7	0	4	735	237
50062	85	10	31	20.1	53.8	219	6	42	159	97	79	7	4168	82	2	2	9467	1197
50068	87	11	4	15.3	37.4	209	5	55	144	155	48	3	4048	77	3	3	10430	1383
50074	88	11	7	22.8	56.0	254	3	12	145	410	9	2	988	12	2	2	1005	343
50080	89	11	10	24.1	64.7	116	2	23	201	312	40	2	1835	27	2	2	2115	543
50086	91	11	16	24.4	55.5	69	4	11	189	354	2	2	724	7	0	9	998	229
50101	96	12	4	24.1	58.3	43	17	17	38	38	21	2	2005	57	2	2	4017	734
50105	97	12	6	14.8	32.3	75	6	44	90	317	81	17	7218	94	4	4	6691	1394

N I A G A R A   F R O N T I E R   S T U D Y

*****   S I T E # 5   COARSE PARTICULATE DATA   (PART - I)   *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
50108	98	12	10	24.1	51.9	103	12	33	18	42	34	2	4328	72	0	5	2002	688
50112	99	12	12	22.4	51.4	37	9	18	18	43	2	8	4071	32	0	10	2025	897
50116	101	12	16	20.3	44.5	209	10	20	59	49	12	3	1339	31	0	3	3030	853
50120	102	12	19	24.0	53.5	307	3	13	111	41	2	2	940	15	2	2	1557	365
50127	104	12	28	23.9	57.6	322	4	12	110	360	2	2	834	21	0	2	841	370
50132	105	1	2	24.1	63.1	288	7	11	41	35	2	8	1739	19	0	2	1283	710
50137	106	1	9	24.1	59.6	221	12	15	32	134	6	2	1776	25	0	2	1429	720
50142	107	1	11	8.1	17.0	190	1	6	204	571	8	8	742	16	0	8	1101	342
50147	108	1	15	24.1	53.3	243	14	27	59	41	31	10	3646	41	0	2	3222	1069
50152	109	1	17	15.3	32.0	244	6	12	103	69	4	4	1124	12	0	4	830	661
50155	110	1	21	19.3	42.5	336	4	8	22	52	3	13	1671	16	0	3	690	374
50160	112	1	27	15.9	35.5	237	6	27	27	229	23	3	4264	35	0	3	5531	1699
50168	113	1	30	29.2	66.6	277	9	3	60	33	2	2	669	8	0	6	191	141
50174	114	2	2	16.1	39.8	254	10	25	142	55	10	3	6474	76	3	3	3170	612
50180	115	2	6	17.6	39.8	241	3	19	104	55	3	3	2947	38	0	3	3187	862
50185	116	2	8	15.4	36.1	251	13	24	103	61	95	3	4884	57	0	7	3505	1163
50191	117	2	12	20.8	46.5	43	3	10	160	47	2	2	467	5	0	11	761	437
50197	118	2	14	21.5	47.7	68	4	9	69	46	2	2	737	17	0	5	870	493
50203	119	2	20	13.5	30.3	220	6	17	63	73	4	4	1529	54	0	9	3420	803
50209	120	2	22	15.6	34.5	247	6	20	152	64	4	4	2379	68	0	4	4009	1167
50215	121	2	26	24.0	52.8	43	11	4	41	41	2	2	199	2	0	2	194	173
50221	122	2	28	18.5	40.6	220	4	29	191	266	27	3	3950	61	0	17	3332	894
50226	123	3	4	24.0	50.7	171	15	5	43	188	2	2	461	8	0	2	857	275
50232	124	3	7	24.2	51.7	61	4	13	50	246	2	2	687	16	0	5	1499	463
50238	125	3	10	20.5	44.1	235	13	27	153	50	3	3	1642	15	0	3	876	386
50244	126	3	14	16.3	35.6	243	15	23	159	62	3	3	3720	73	0	3	3848	972
50250	127	3	16	21.9	47.9	232	12	25	20	46	37	2	2824	107	0	8	6534	865
50256	128	3	20	17.1	36.4	247	1	80	285	593	68	3	14478	262	7	11	10435	1130
50262	129	3	22	24.0	50.8	28	2	44	117	43	27	2	3036	79	2	2	5566	627
50268	130	3	26	10.4	22.2	253	13	38	217	99	56	6	5361	74	0	6	6638	1507
50274	131	3	28	24.1	52.1	177	7	19	154	42	50	2	2329	50	0	2	1712	478
						AVERAGE		26.7	119.7	200.4	22.0	5.0	2920.7	51.2	1.6	5.4	3472.9	723.9
S T A T I S T I C S																		
						STANDARD DEVIATION		20.2	71.8	207.8	29.0	4.4	2507.6	49.4	3.0	4.3	3086.2	509.6

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 5 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO_3	CL	SO_4	NO_2	NA	PO_4	NH_4	BR-S	K
								NANOGRAMS/M**3											
30005	40	6	25	6.5	13.4	226	5	5038	767	0	673	299	823	374	598	0	0	74	224
30011	41	6	27	6.3	13.0	212	5	2578	785	0	459	76	1149	76	229	0	0	0	229
30026	49	7	19	10.0	19.5	193	6	16191	2291	56	2295	281	2715	1280	107	0	235	0	409
30040	51	7	25	9.3	17.8	209	5	5077	574	56	952	224	504	56	224	0	0	0	1289
30050	54	8	2	6.3	12.2	197	6	7516	1933	164	1477	0	1313	82	82	0	0	0	164
30054	55	8	6	17.9	32.1	330	2	6251	1719	62	1746	218	1029	0	155	0	0	0	93
30062	56	8	8	10.2	19.9	219	13	6102	1548	1258	906	151	2114	0	251	0	302	0	201
30074	59	8	15	5.6	9.5	150	4	20804	4155	736	1263	526	3789	526	315	0	315	0	315
30078	60	8	18	16.0	25.9	156	3	5734	930	0	1081	193	733	347	115	0	38	0	193
30085	64	8	30	18.1	31.5	187	3	5110	325	0	285	158	571	0	63	0	0	0	95
30091	65	9	1	13.6	19.1	235	1	9845	3460	0	3038	523	1571	0	157	0	0	0	261
30099	66	9	7	17.9	32.9	284	3	7830	884	0	851	121	1367	0	91	0	0	0	60
30102	67	9	11	11.7	18.0	204	11	14479	1574	0	1164	166	3716	0	221	0	277	0	110
30105	62	8	24	10.1	17.2	211	7	11771	1901	523	1919	349	4653	0	232	0	639	0	174
30118	61	8	22	13.7	23.5	238	4	7045	1640	0	809	340	1065	0	127	0	0	0	298
30125	80	10	17	24.0	49.5	64	1	5037	736	0	141	121	181	0	40	0	0	80	40
30205	72	9	23	24.0	46.8	92	2	1906	692	0	42	85	235	0	21	0	0	64	0
30222	68	9	13	23.5	41.8	47	9	1334	844	0	23	23	71	0	47	0	0	0	0
30234	82	10	23	24.0	49.3	313	6	3509	839	40	263	121	425	0	40	0	0	0	0
50004	69	9	17	23.6	49.3	51	3	1812	1137	0	243	243	649	0	283	0	0	0	0
50011	70	9	19	24.0	48.2	32	4	2469	474	0	477	0	1349	0	103	0	0	0	0
50020	73	9	26	19.8	34.8	205	3	6118	888	0	402	57	488	0	115	0	57	0	0
50026	74	9	29	24.1	39.5	114	2	4355	607	50	202	76	202	0	0	0	0	0	0
50029	76	10	5	24.0	39.0	163	8	2929	262	0	0	102	333	0	128	0	0	0	0
50038	78	10	11	24.0	36.7	168	3	11833	2024	81	680	190	1143	0	54	0	27	0	0
50042	77	10	7	24.1	48.5	274	10	1417	658	0	0	41	514	0	61	0	20	0	0
50050	83	10	25	24.0	56.8	192	10	9221	1657	17	299	105	1038	0	52	0	0	0	35
50056	84	10	29	23.9	56.5	165	5	2423	948	0	88	17	424	0	17	0	0	0	0
50062	85	10	31	20.1	53.8	219	6	5917	922	316	911	260	1897	0	37	0	0	0	55
50068	87	11	4	15.3	37.4	209	5	10183	1720	213	3927	534	2324	0	26	0	0	0	80
50074	88	11	7	22.8	56.0	254	3	3796	1033	0	142	0	606	0	89	0	35	0	1.7
50080	89	11	10	24.1	64.7	116	2	8325	1745	30	618	108	479	0	46	0	46	0	0
50086	91	11	16	24.4	55.5	69	4	3508	372	18	216	18	216	0	18	0	18	0	0
50101	96	12	4	24.1	58.3	43	17	2311	175	0	85	0	1115	0	68	0	0	0	51
50105	97	12	6	14.8	32.3	75	6	5889	317	92	588	2136	2539	0	185	0	0	0	340

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 5 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO_3	CL	SO_4	NO_2	NA	PO_4	NH_4	BR-S	K
								NANOGRAMS/M**3											
50108	98	12	10	24.1	51.9	103	12	4290	675	0	96	1465	848	0	443	0	77	0	38
50112	99	12	12	22.4	51.4	37	9	2518	428	58	369	1966	1732	0	136	0	58	0	214
50116	101	12	16	20.3	44.5	209	10	3173	1093	22	921	1214	1529	0	854	0	0	0	0
50120	102	12	19	24.0	53.5	307	3	3015	191	18	18	654	673	0	411	0	0	0	0
50127	104	12	28	23.9	57.6	322	4	3466	365	0	243	243	677	0	538	0	0	104	0
50132	105	1	2	24.1	63.1	288	7	1418	162	0	158	0	1076	0	158	0	0	0	0
50137	106	1	9	24.1	59.0	221	12	2183	462	0	369	33	1191	0	184	0	50	0	0
50142	107	1	11	8.1	17.0	190	1	3027	1240	0	353	0	707	0	471	0	117	176	0
50147	108	1	15	24.1	53.3	243	14	2828	529	75	525	300	1893	0	450	0	18	0	0
50152	109	1	17	15.3	32.0	244	6	2829	320	0	437	93	999	0	374	0	0	0	0
50155	110	1	21	19.3	42.5	336	4	866	241	23	117	94	517	0	258	0	0	0	0
50160	112	1	27	15.9	35.5	237	6	292	288	225	112	168	2730	0	281	0	84	0	0
50168	113	1	30	29.2	66.6	277	9	369	153	0	0	15	195	0	0	0	150	0	90
50174	114	2	2	16.1	39.8	254	10	2756	793	0	0	452	1105	0	201	0	75	0	50
50180	115	2	6	17.6	39.8	241	3	2777	980	0	727	803	1480	0	25	0	0	0	0
50185	116	2	8	15.4	36.1	251	13	1685	936	110	138	776	2190	0	0	0	0	0	0
50191	117	2	12	20.8	46.5	43	3	1484	220	0	107	580	730	0	1417	0	171	0	0
50197	118	2	14	21.5	47.7	68	4	1207	214	0	230	125	649	0	20	0	0	0	0
50203	119	2	20	13.5	30.3	220	6	2584	1059	0	659	0	1582	0	0	0	0	0	0
50209	120	2	22	15.6	34.5	247	6	300	814	0	231	0	2057	0	144	0	57	0	173
50215	121	2	26	24.0	52.8	43	11	634	802	37	94	0	492	0	0	0	0	0	0
50221	122	2	28	18.5	40.6	220	4	6604	1393	49	1109	320	1676	0	345	0	49	0	147
50226	123	3	4	24.0	50.7	171	15	909	202	0	59	59	473	0	0	0	19	0	39
50232	124	3	7	24.2	51.7	61	4	3993	444	77	560	154	869	0	77	251	38	0	38
50238	125	3	10	20.5	44.1	235	13	235	232	45	22	181	680	0	90	0	45	0	0
50244	126	3	14	16.3	35.6	243	15	2155	287	112	224	224	2304	0	112	0	56	56	84
50250	127	3	16	21.9	47.9	232	12	1594	662	104	773	229	1190	0	271	0	104	0	167
50256	128	3	20	17.1	36.4	247	1	11706	2371	412	769	797	1704	0	1044	0	82	0	302
50262	129	3	22	24.0	50.8	28	2	12428	1549	0	788	354	807	0	768	0	157	0	0
50268	130	3	26	10.4	22.2	253	13	2665	1015	44	269	539	3237	0	179	0	0	0	0
50274	131	3	28	24.1	52.1	177	7	4675	1154	0	192	211	883	115	211	0	0	0	0
							AVERAGE	4792.8	966.8	77.6	589.9	301.7	1245.7	43.3	210.0	3.8	51.8	8.4	92.0
							STANDARD DEVIATION	4142.6	764.0	195.4	713.2	421.4	944.5	178.9	258.0	30.9	104.4	29.4	182.5

S T A T I S T I C S

NIAGARA FRONTIER STUDY

***** SITE # 6 COARSE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
30006	41	6	27	5.4	10.5	212	5	36	92	211	13	13	185	0	0	13	26	304
30027	49	7	19	21.5	44.1	193	6	21	53	50	3	3	848	15	0	3	710	905
30041	51	7	25	17.7	34.4	209	5	17	116	64	4	4	640	12	4	4	422	402
30048	53	7	31	17.7	36.4	215	5	11	83	60	3	3	175	0	0	3	171	312
30051	54	8	2	13.7	26.5	197	6	23	36	83	5	5	678	10	0	10	537	490
30052	55	8	6	17.9	37.3	330	2	16	100	167	3	3	768	11	0	7	452	267
30063	56	8	8	17.6	33.8	219	13	20	28	196	4	4	364	0	4	4	405	728
30070	58	8	12	17.7	34.9	0	0	18	67	63	3	3	404	7	7	3	416	384
30079	60	8	18	17.7	34.1	156	3	15	28	272	4	4	316	4	4	4	288	146
30086	64	8	30	17.7	36.0	187	3	10	26	61	3	3	165	11	3	3	557	226
30092	65	9	1	17.9	37.4	235	1	18	96	59	3	3	425	22	3	3	1203	310
30103	67	9	11	23.6	49.3	204	11	12	19	44	2	2	474	11	2	2	511	1095
30108	62	8	24	17.7	34.2	211	7	15	28	64	4	4	509	4	0	4	586	918
30111	66	9	7	17.9	36.6	284	3	14	26	60	3	3	283	15	0	3	560	215
30119	61	8	22	18.0	37.1	238	4	17	74	59	3	3	392	29	0	3	1371	519
30123	80	10	17	23.7	49.5	64	1	4	47	195	2	2	229	8	0	2	176	64
30206	72	9	23	23.7	48.5	92	2	6	68	142	2	2	162	5	0	2	174	85
30212	68	9	13	23.6	48.6	47	9	5	48	45	2	2	111	5	0	2	165	68
30216	82	10	23	23.8	49.7	313	6	4	19	44	2	2	100	2	0	2	153	108
50005	69	9	17	23.7	49.5	51	3	4	19	44	2	2	47	0	0	2	106	78
50012	70	9	19	23.6	49.6	32	4	14	86	89	2	2	1010	16	0	2	1182	987
50015	76	10	5	23.8	50.6	163	8	7	19	128	2	2	.134	2	0	2	156	117
50021	73	9	26	23.8	50.1	205	3	9	38	44	2	16	226	8	0	2	456	165
50027	74	9	29	23.8	50.1	114	2	6	55	44	2	5	237	5	0	2	331	118
50039	78	10	11	23.9	50.0	168	3	11	72	44	2	2	249	5	0	2	335	227
50051	83	10	25	23.7	50.0	192	10	10	44	138	2	11	518	8	0	2	421	263
50057	84	10	29	23.9	50.7	165	5	4	81	191	2	2	136	2	0	2	210	131
50063	85	10	31	23.8	50.0	219	6	12	47	144	2	5	540	11	0	5	656	304
50069	87	11	4	15.7	33.1	209	5	23	142	67	4	4	1168	12	0	8	1013	536
50075	88	11	7	23.8	50.5	254	3	5	19	43	2	2	120	2	2	2	282	214
50081	89	11	10	19.5	41.0	116	2	20	94	162	3	3	911	27	0	3	1627	543
50082	91	11	16	23.7	52.4	69	4	8	63	42	2	2	285	2	0	7	438	147
50093	94	11	28	23.9	53.4	98	7	1	18	41	2	2	28	0	0	2	114	212
50094	92	11	20	23.8	53.1	210	6	3	18	41	2	2	33	2	0	2	182	114
50096	93	11	22	23.9	52.8	281	4	6	57	41	2	2	139	5	0	2	228	209

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 6 COARSE PARTICULATE DATA (PART - I) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	CSP UGM/M**3	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
									NANOGRAMS/M**3									
50098	96	12	4	24.1	51.7	43	17	3	42	42	2	2	58	2	0	2	160	168
50102	95	11	30	23.8	53.6	80	9	2	18	41	2	2	72	2	0	2	183	126
50106	97	12	6	23.8	51.7	75	6	7	18	42	2	2	257	8	0	5	388	192
50109	98	12	10	24.0	50.8	103	12	6	19	43	2	2	73	5	0	2	152	125
50113	99	12	12	23.8	54.2	37	9	4	92	107	2	2	176	0	2	2	217	247
50117	101	12	16	23.8	53.5	209	10	63	18	41	2	2	0	0	0	2	38	31
50121	102	12	19	23.8	52.4	307	3	3	42	42	2	5	518	5	0	2	718	309
50126	103	12	22	23.8	53.2	229	12	3	18	41	2	7	104	0	0	2	213	135
50128	104	12	28	24.0	54.5	322	4	4	17	170	2	2	99	5	0	2	231	172
50138	107	1	11	24.0	53.2	190	1	0	96	177	2	5	44	0	0	2	101	106
50148	108	1	15	24.0	52.5	243	14	5	18	42	2	2	234	2	0	5	192	258
50153	109	1	17	24.0	52.6	244	6	4	60	42	2	2	94	0	0	2	121	358
50154	110	1	21	24.0	52.9	336	4	1	57	149	2	2	18	0	0	5	123	204
50159	112	1	27	23.8	53.0	237	6	1	18	41	2	2	2	0	0	2	109	352
50169	113	1	30	23.8	53.7	277	9	0	18	41	2	2	0	0	0	2	126	118
50175	114	2	2	23.9	54.0	254	10	1	17	117	2	2	7	0	0	2	182	84
50181	115	2	6	20.1	44.8	241	3	6	21	49	3	3	188	6	0	3	206	287
50186	116	2	8	23.9	53.0	251	13	2	18	41	2	2	23	0	0	2	159	250
50192	117	2	12	21.2	46.8	43	3	7	20	47	2	2	301	5	0	2	420	287
50198	118	2	14	23.8	52.6	68	4	4	47	42	2	2	152	5	0	2	210	242
50204	119	2	20	16.6	36.7	220	6	6	26	60	3	3	275	3	0	3	196	546
50210	120	2	22	23.2	51.5	247	6	2	18	43	2	2	123	5	0	5	196	675
50216	121	2	26	23.9	52.6	43	11	2	18	42	2	2	68	2	0	2	149	192
50222	122	2	28	21.1	45.6	220	4	11	57	48	15	3	713	6	0	3	612	433
50227	123	3	4	23.8	51.6	171	15	1	40	136	2	2	8	0	0	8	34	134
50233	124	3	7	23.9	51.8	61	4	10	18	42	2	2	444	10	0	2	808	379
50239	125	3	10	23.9	50.3	235	13	2	19	44	2	2	63	5	0	2	104	272
50245	126	3	14	23.9	51.5	243	15	2	18	107	2	2	80	2	0	2	107	104
50251	127	3	16	23.9	51.5	232	12	9	18	177	2	2	384	8	0	2	398	193
50257	128	3	20	23.5	49.4	247	1	14	19	44	2	2	627	14	0	5	1053	221
50263	129	3	22	23.8	50.1	28	2	20	19	44	8	2	716	16	0	5	1562	298
50269	130	3	26	23.9	50.6	253	13	3	19	158	2	2	164	2	0	2	213	112
50275	131	3	28	23.8	51.0	177	7	7	19	241	8	2	219	5	0	2	325	173

S T A T I S T I C S

	CSP	PB	BR	ZN	NI	FE	MN	CR	V	CA	S
AVERAGE	9.4	42.8	85.1	2.9	3.1	284.0	5.9	.5	3.2	391.6	289.6
STANDARD DEVIATION	9.7	30.1	59.8	2.3	2.5	268.6	6.3	1.3	2.1	361.4	226.8

N I A G A R A   F R O N T I E R   S T U D Y

***** S I T E # 6 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO3	CL	SO4	NO2	NA	PO4	NH4	BR-S	K
								NANOGRAMS/M**3											
30006	41	6	27	5.4	10.5	212	5	5852	2621	0	0	286	764	764	669	0	0	0	286
30027	49	7	19	21.5	44.1	193	6	12325	2316	29	1059	40	1518	574	0	0	553	0	90
30041	51	7	25	17.7	34.4	209	5	7851	978	58	523	0	756	232	58	0	87	0	58
30048	53	7	31	17.7	36.4	215	5	3156	281	54	192	0	604	274	82	0	27	0	54
30051	54	8	2	13.7	26.5	197	6	7773	386	75	1168	75	980	0	150	0	0	0	37
30052	55	8	6	17.9	37.3	330	2	3663	1091	80	911	0	696	0	80	0	26	0	26
30063	56	8	8	17.6	33.8	219	13	4037	303	29	1005	59	1241	0	147	0	118	0	59
30070	58	8	12	17.7	34.9	0	0	5680	1252	0	1202	114	744	0	143	0	0	0	57
30079	60	8	18	17.7	34.1	156	3	4578	1458	0	557	146	381	264	176	0	29	0	58
30086	64	8	30	17.7	36.0	187	3	3201	1054	0	138	110	332	0	83	0	0	0	55
30092	65	9	1	17.9	37.4	235	1	5283	1169	0	1283	106	534	0	106	0	0	0	53
30103	67	9	11	23.6	49.3	204	11	6609	1145	0	831	101	3001	0	101	0	790	0	40
30108	62	8	24	17.7	34.2	211	7	5887	853	0	1022	29	2249	116	58	0	496	0	87
30111	66	9	7	17.9	36.6	284	3	5887	1249	0	191	218	382	0	109	0	0	82	136
30119	61	8	22	18.0	37.1	238	4	6740	1173	0	674	80	1025	0	53	0	26	0	53
30123	80	10	17	23.7	49.5	64	1	1331	206	0	141	60	161	0	40	0	0	0	40
30206	72	9	23	23.7	48.5	92	2	1897	445	0	164	0	144	0	41	0	0	20	0
30212	68	9	13	23.6	48.6	47	9	2552	210	0	61	20	20	82	41	0	0	20	0
30216	82	10	23	23.8	49.7	313	6	1439	206	0	181	20	221	0	40	0	0	20	20
50005	69	9	17	23.7	49.5	51	3	940	207	0	80	40	202	0	20	0	0	20	0
50012	70	9	19	23.6	49.6	32	4	3322	772	0	463	20	2195	0	120	0	0	0	0
50015	76	10	5	23.8	50.6	163	8	1692	202	0	178	0	336	0	98	0	59	0	0
50021	73	9	26	23.8	50.1	205	3	4052	647	0	279	0	259	0	59	0	59	0	0
50027	74	9	29	23.8	50.1	114	2	2909	433	39	199	59	259	0	19	0	0	0	0
50039	78	10	11	23.9	50.0	168	3	5978	989	0	300	20	420	0	20	0	0	0	0
50051	83	10	25	23.7	50.0	192	10	6076	1180	40	220	120	440	0	80	0	0	0	20
50057	84	10	29	23.9	50.7	165	5	1000	202	0	39	0	256	0	0	0	0	0	0
50063	85	10	31	23.8	50.0	219	6	7630	1642	40	820	80	580	0	20	0	0	0	0
50069	87	11	4	15.7	33.1	209	5	9720	2060	60	2479	272	1209	0	60	0	0	0	0
50075	88	11	7	23.8	50.5	254	3	1734	203	59	118	158	336	0	19	0	0	158	0
50081	89	11	10	19.5	41.0	116	2	7161	1992	24	780	73	487	0	24	0	24	0	0
50082	91	11	16	23.7	52.4	69	4	4981	427	38	133	19	133	57	38	0	38	0	0
50093	94	11	28	23.9	53.4	98	7	663	191	0	18	0	261	0	149	0	0	0	0
50094	92	11	20	23.8	53.1	210	6	996	192	0	56	0	301	0	169	0	0	0	0
50096	93	11	22	23.9	52.8	281	4	3007	398	0	132	151	341	0	416	0	0	0	0

N I A G A R A F R O N T I E R S T U D Y

***** S I T E # 6 COARSE PARTICULATE DATA (PART - 2) *****

FILTER #	RUN	MON	DAY	TIME HRS	FLOW M**3	WIND DIR DEG	WIND SPD MPH	SI	AL	F	NO_3	CL	SO_4	NO_2	NA	PO_4	NH_4	BR-S	K
								NANOGRAMS/M**3											
50098	96	12	4	24.1	51.7	43	17	1088	458	0	19	0	251	0	232	0	0	0	0
50102	95	11	30	23.8	53.6	80	9	1283	645	0	55	0	298	0	93	0	0	0	37
50106	97	12	6	23.8	51.7	75	6	2641	447	0	386	0	309	0	96	0	38	0	0
50109	98	12	10	24.0	50.8	103	12	2167	201	19	0	0	78	0	137	0	39	0	0
50113	99	12	12	23.8	54.2	37	9	2136	805	36	258	0	461	0	92	0	36	0	0
50117	101	12	16	23.8	53.5	209	10	194	191	18	37	0	18	0	74	0	0	0	0
50121	102	12	19	23.8	52.4	307	3	6787	549	19	858	248	458	0	209	0	0	0	0
50126	103	12	22	23.8	53.2	229	12	2203	500	0	282	0	338	0	112	0	0	0	0
50128	104	12	28	24.0	54.5	322	4	1449	188	0	55	18	275	0	293	183	0	36	0
50138	107	1	11	24.0	53.2	190	1	547	526	0	94	0	112	0	225	0	75	0	0
50148	108	1	15	24.0	52.5	243	14	2219	195	95	361	95	323	0	361	0	38	0	0
50153	109	1	17	24.0	52.6	244	6	1678	194	0	228	0	532	0	266	0	0	0	0
50154	110	1	21	24.0	52.9	336	4	196	193	0	75	37	302	0	189	0	0	0	0
50159	112	1	27	23.8	53.0	237	6	195	193	0	37	56	452	0	150	0	75	0	56
50169	113	1	30	23.8	53.7	277	9	193	190	0	18	0	204	0	0	0	74	0	111
50175	114	2	2	23.9	54.0	254	10	1082	505	0	37	0	314	0	55	0	0	0	0
50181	115	2	6	20.1	44.8	241	3	1161	228	0	446	267	557	0	22	0	0	0	0
50186	116	2	8	23.9	53.0	251	13	195	433	0	94	56	339	0	433	0	0	0	0
50192	117	2	12	21.2	46.8	43	3	1736	887	106	213	234	405	0	149	0	1089	0	0
50198	118	2	14	23.8	52.6	68	4	639	194	0	285	57	323	0	19	0	0	0	0
50204	119	2	20	16.6	36.7	220	6	1882	279	81	1007	0	1225	0	0	0	0	0	0
50210	120	2	22	23.2	51.5	247	6	855	199	0	155	0	1127	0	136	0	155	19	77
50216	121	2	26	23.9	52.6	43	11	991	194	56	56	0	455	0	0	0	0	0	0
50222	122	2	28	21.1	45.6	220	4	4618	546	0	613	153	635	0	197	0	65	0	87
50227	123	3	4	23.8	51.6	171	15	201	198	0	19	0	309	0	0	0	19	0	19
50233	124	3	7	23.9	51.8	61	4	5001	519	0	405	19	598	0	115	0	115	0	0
50239	125	3	10	23.9	50.3	235	13	1496	421	0	79	0	636	0	39	0	0	0	0
50245	126	3	14	23.9	51.5	243	15	1178	551	0	58	0	388	0	58	0	58	0	58
50251	127	3	16	23.9	51.5	232	12	3278	686	58	544	136	272	0	97	174	38	155	38
50257	128	3	20	23.5	49.4	247	1	7007	1288	0	445	80	384	0	80	0	40	0	0
50263	129	3	22	23.8	50.1	28	2	9089	1286	0	599	139	359	0	279	0	59	0	0
50269	130	3	26	23.9	50.6	253	13	2698	514	59	0	0	652	0	0	0	79	0	0
50275	131	3	28	23.8	51.0	177	7	2740	437	0	98	117	313	0	78	0	0	0	0
							AVERAGE	3359.2	661.5	17.2	375.2	61.6	551.0	34.7	114.3	5.2	65.1	7.8	25.2
							STANDARD DEVIATION	2728.1	558.5	28.1	437.2	77.8	521.9	125.4	118.1	30.4	180.7	28.6	45.6

S T A T I S T I C S

APPENDIX D

The following tabulated information represents the entire Whatman-41 hi-vol data base which was produced within the project. Revelant data is presented here regarding the date, particulate mass, air volume sampled (flow), and SP concentration.

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10001	3-14-78	162.6	2453.7	66
2	10002	3-14-78	152.8	2142.4	71
3	10003	3-14-78	135.6	2476.7	55
4	10004	3-14-78	189.4	2465.1	77
5	10005	3-14-78	187.2	2442.6	77
2	10009	3-16-78	216.9	2003.7	108
1	10010	3-16-78	216.4	2307.6	94
3	10011	3-16-78	184.1	2279.5	81
6	10012	3-16-78	95.0	2340.2	41
5	10013	3-16-78	212.5	2444.3	87
4	10014	3-16-78	165.5	2530.2	65
6	10006	3-14-78	125.1	2334.8	54
6	10015	3-21-78	122.6	2373.2	52
5	10016	3-21-78	225.5	2493.6	90
3	10017	3-21-78	195.8	2407.1	81
2	10018	3-21-78	183.9	2282.9	81
1	10019	3-21-78	230.8	2191.5	105
4	10020	3-21-78	250.9	2605.0	96
6	10021	3-23-78	104.0	2450.3	42
3	10022	3-23-78	196.3	2479.6	79
1	10109	4-29-78	255.4	2246.5	114
2	10110	4-29-78	319.1	2462.6	130
3	10111	4-29-78	305.8	1982.8	154
5	10112	4-29-78	360.3	2164.8	166
4	10113	4-29-78	403.4	2335.0	173
6	10114	4-29-78	218.0	2355.8	93

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
2	10023	3-23-78	179.1	2284.0	78
1	10024	3-23-78	297.6	2458.5	121
4	10027	3-23-78	271.5	2559.1	106
5	10028	3-23-78	279.5	2370.9	118
6	10029	3-28-78	130.3	2448.3	53
3	10030	3-30-78	226.0	2414.7	94
5	10031	3-28-78	370.0	2343.2	158
4	10033	3-30-78	349.1	2404.9	145
2	10034	3-28-78	190.1	2396.5	79
5	10036	3-30-78	389.5	2161.7	180
3	10037	4 -1-78	172.1	2212.2	78
1	10038	3-30-78	222.4	2251.0	99
2	10039	3-30-78	196.2	2255.1	87
2	10040	4 -1-78	218.0	2005.5	109
5	10041	4 -1-78	249.1	2262.4	110
4	10042	4 -1-78	242.5	2174.4	112
1	10043	4 -4-78	283.1	2161.2	131
3	10044	4 -4-78	231.8	2012.6	115
2	10045	4 -4-78	243.0	1808.4	134
5	10046	4 -4-78	276.5	2162.9	128
4	10048	4 -4-78	304.1	2016.8	151
1	10049	4 -6-78	233.1	2189.7	106
2	10050	4 -6-78	165.7	2111.3	78
3	10051	4 -6-78	156.6	1853.2	84
5	10052	4 -6-78	125.2	2474.4	51
4	10053	4 -6-78	100.3	611.6	164
1	10064	4 -1-78	224.0	2338.7	96

SITE NO.	FILTER NO.	DATE.	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
6	10035	4 -6-78	90.6	2434.1	37
6	10047	4 -4-78	198.6	2374.8	84
4	10054	4 -8-78	200.3	2083.5	96
6	10055	4 -8-78	97.9	2463.1	40
5	10056	4 -8-78	310.1	2241.6	138
2	10057	4 -8-78	237.4	2110.0	113
3	10058	4 -8-78	173.4	2181.7	79
1	10059	4 -8-78	145.0	2425.9	60
6	10060	4-11-78	130.3	2514.2	52
5	10061	4-11-78	279.6	2162.8	129
2	10062	4-11-78	226.5	2108.8	107
3	10063	4-11-78	291.2	2112.9	138
1	10065	4-11-78	265.7	1958.1	136
4	10066	4-11-78	352.9	2024.8	174
2	10067	4-13-78	248.6	2109.6	118
2	10068	4-15-78	188.1	2072.5	91
3	10069	4-13-78	307.6	2011.5	153
3	10070	4-15-78	185.7	2183.7	85
5	10071	4-13-78	380.3	2217.1	172
5	10072	4-15-78	300.8	2087.3	144
6	10073	4-13-78	150.7	2356.8	64
6	10074	4-15-78	76.3	1753.3	44
4	10075	4-13-78	314.6	1920.9	164
4	10076	4-15-78	390.9	1986.4	197
1	10077	4-13-78	221.0	2278.9	97
1	10078	4-15-78	169.8	2389.3	71

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10079	4-18-78	298.4	2160.3	138
2	10080	4-18-78	190.1	2108.8	90
3	10081	4-18-78	172.9	2145.8	81
5	10082	4-18-78	181.9	2374.9	77
4	10083	4-18-78	238.7	2051.4	116
6	10084	4-18-78	137.4	2353.0	58
4	10085	4-20-78	182.5	2302.5	79
6	10086	4-20-78	87.9	2604.9	34
5	10087	4-20-78	189.4	2399.2	79
3	10088	4-20-78	109.5	2314.1	47
2	10089	4-20-78	126.8	2072.0	61
1	10090	4-20-78	106.0	2483.9	43
4	10091	4-22-78	333.9	1987.1	168
1	10092	4-22-78	167.6	2273.3	74
6	10093	4-22-78	121.5	2518.6	48
2	10094	4-22-78	409.0	2050.7	199
3	10095	4-22-78	176.5	2079.1	85
2	10096	4-22-78	187.6	1863.0	101
1	10097	4-25-78	258.2	2133.7	121
2	10098	4-25-78	232.4	2075.1	112
3	10099	4-25-78	186.9	2150.2	87
6	10100	4-25-78	185.7	2137.5	87
5	10101	4-25-78	189.6	2295.2	83
4	10102	4-25-78	206.7	2177.1	95
1	10103	4-27-78	258.6	1930.2	134
2	10104	4-27-78	249.2	1936.3	129

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10115	5 -6-78	343.2	2553.4	134
2	10116	5 -6-78	205.9	2379.9	87
3	10117	5 -6-78	261.6	2179.7	120
5	10119	5 -6-78	604.1	2429.0	249
4	10120	5 -6-78	467.8	2118.8	221
4	10121	5 -9-78	352.4	1998.1	176
3	10122	5 -9-78	217.8	2090.5	104
2	10123	5 -9-78	224.5	2157.1	104
1	10124	5 -9-78	255.1	2137.0	119
4	10125	5 -4-78	196.3	2092.0	94
5	10126	5 -4-78	239.4	3539.0	68
1	10127	5 -4-78	319.3	2252.1	142
2	10128	5 -4-78	210.7	2155.4	98
3	10129	5 -4-78	171.9	2032.6	85
6	10130	5 -4-78	230.4	2194.8	105
3	10131	5-13-78	155.0	2295.0	68
2	10132	5-13-78	144.2	2338.1	62
1	10133	5-13-78	172.1	2485.8	69
6	10134	5-11-78	105.7	2359.0	45
5	10135	5-11-78	188.9	2342.0	81
4	10136	5-11-78	234.7	1972.7	119
3	10137	5-11-78	226.9	2044.6	111
2	10138	5-11-78	235.9	2066.0	114
1	10139	5-11-78	236.7	2199.0	108
6	10140	5 -9-78	65.2	2372.1	27
5	10141	5 -9-78	202.3	2316.5	87

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
4	10146	5-13-78	152.6	2247.7	68
6	10147	5-13-78	113.6	2275.6	50
1	10148	5-16-78	147.8	2405.8	61
2	10149	5-16-78	152.9	1945.1	79
5	10150	5-16-78	136.6	2586.7	53
1	10151	5-18-78	450.2	2377.2	189
2	10152	5-18-78	275.6	2167.8	127
3	10153	5-18-78	312.6	2138.4	146
5	10154	5-18-78	653.2	2250.2	290
6	10155	5-18-78	116.4	2421.1	48
4	10156	5-18-78	407.1	1971.5	206
1	10157	5-20-78	268.4	2327.0	115
2	10158	5-20-78	262.9	2337.7	112
3	10159	5-20-78	260.8	1761.1	148
5	10160	5-20-78	423.0	2261.0	187
6	10161	5-20-78	177.8	2344.9	76
4	10162	5-20-78	483.5	2174.3	222
1	10163	5-23-78	219.3	2224.6	99
2	10164	5-23-78	212.1	2040.3	104
3	10165	5-23-78	167.6	2183.4	77
6	10166	5-23-78	155.8	2204.5	71
5	10167	5-23-78	290.7	2273.5	128
1	10169	5-25-78	411.5	2222.8	185
2	10170	5-25-78	319.2	2056.2	155
3	10171	5-25-78	363.5	2322.5	157
6	10172	5-25-78	210.4	2217.0	95

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
3	10177	5-30-78	233.9	2121.9	110
6	10178	5-30-78	214.6	2328.4	92
5	10179	5-30-78	393.7	2152.6	183
4	10180	5-30-78	315.5	1899.8	166
1	10182	6 -1-78	198.6	2220.6	89
2	10183	6 -1-78	220.6	2003.0	110
3	10184	6 -1-78	190.9	2063.1	93
6	10185	6 -1-78	137.5	2361.6	58
5	10186	6 -1-78	316.1	2206.9	143
4	10187	6 -1-78	273.6	1886.6	145
1	10188	6 -6-78	179.5	2285.6	79
2	10189	6 -8-78	184.5	2256.3	82
5	10190	6 -6-78	276.4	2288.4	121
4	10191	6 -6-78	458.9	4038.3	114
2	10192	6-10-78	217.7	1842.7	118
6	10193	6 -8-78	82.8	2157.2	38
5	10194	6 -8-78	321.6	2219.7	145
3	10196	6 -8-78	259.9	2122.1	122
1	10197	6 -8-78	189.7	2389.1	79
6	10198	6-10-78	70.8	2071.0	34
1	10199	6-10-78	112.2	2131.6	53
3	10200	6-10-78	114.4	2308.6	50
5	10201	6-10-78	157.3	2322.3	68
1	10214	6-21-78	166.9	2261.0	74
2	10215	6-21-78	144.4	2179.2	66

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
6	10202	6-25-78	164.4	2150.6	76
6	10203	6-27-78	170.0	2307.7	74
6	10204	6-29-78	155.7	2304.0	68
3	10205	6-27-78	317.5	2062.8	154
3	10206	6-29-78	290.3	2107.3	138
2	10207	6-27-78	354.6	2193.2	162
2	10208	6-29-78	287.3	2267.4	127
4	10209	6-25-78	262.8	2125.4	124
5	10210	6-25-78	249.2	2166.7	115
3	10211	6-25-78	190.9	2183.4	87
2	10212	6-25-78	195.3	2114.7	92
1	10213	6-25-78	208.4	2148.4	97
3	10216	6-21-78	185.3	2179.7	85
6	10217	6-21-78	108.7	2294.0	47
5	10218	6-21-78	290.1	2178.9	133
4	10219	6-21-78	253.4	2089.0	121
5	10220	6-19-78	214.6	2180.8	98
6	10221	6-19-78	76.6	2112.2	36
3	10222	6-19-78	151.4	2046.3	74
2	10223	6-19-78	147.9	2140.4	69
1	10224	6-19-78	131.4	2299.9	57
5	10225	6-15-78	150.9	2234.3	68
6	10226	6-15-78	35.4	2024.4	17
3	10227	6-15-78	112.1	2012.8	56
2	10228	6-15-78	122.2	1974.4	62
1	10229	6-15-78	95.4	2172.6	44

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
3	10235	7 -1-78	115.6	2212.9	52
6	10236	7 -1-78	112.6	2241.5	50
2	10237	7 -1-78	119.5	2204.1	54
1	10238	6-27-78	302.8	2123.3	143
1	10239	6-29-78	272.5	2281.5	119
1	10240	7 -1-78	130.7	2260.6	58
5	10241	6-27-78	453.2	2081.4	218
5	10242	6-29-78	399.9	2166.7	185
5	10243	7 -1-78	140.3	2262.3	62
4	10244	6-27-78	505.1	2131.4	237
4	10245	6-29-78	389.1	2029.7	192
4	10246	7 -1-78	161.4	2212.5	73
1	10247	7 -7-78	262.4	2197.8	119
2	10248	7 -7-78	338.9	2166.2	156
3	10249	7 -7-78	264.0	2222.6	119
6	10250	7 -7-78	212.3	2278.6	93
5	10251	7 -7-78	369.1	2163.7	171
4	10252	7 -7-78	344.1	2098.7	164
1	10253	7-11-78	176.9	2332.7	76
2	10254	7-11-78	207.3	2113.0	98
3	10255	7-11-78	184.3	2138.1	86
6	10256	7-11-78	130.8	2339.3	56
5	10257	7-11-78	245.7	2402.5	102
4	10259	7-13-78	333.9	2115.6	158
1	10260	7-13-78	265.8	2193.5	121
2	10261	7-13-78	202.6	2217.3	91

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
2	10266	7-15-78	249.9	2086.1	120
3	10267	7-15-78	236.2	2091.2	113
5	10268	7-15-78	314.5	2093.7	150
6	10269	7-15-78	187.3	2513.9	74
4	10270	7-15-78	344.6	2113.6	163
6	10271	7-19-78	196.6	2058.9	95
5	10272	7-19-78	297.4	1990.5	149
2	10273	7-19-78	241.2	2112.7	114
4	10274	7-19-78	335.8	1965.7	171
3	10275	7-19-78	230.8	2029.8	114
1	10276	7-19-78	247.2	1947.9	127
3	10277	7-25-78	181.9	2137.5	85
6	10278	7-21-78	206.3	2261.9	91
2	10279	7-21-78	369.7	2165.8	171
4	10280	7-21-78	409.8	2085.9	196
1	10281	7-21-78	323.3	2106.6	153
5	10282	7-21-78	362.4	2122.0	171
4	10283	7 -4-78	96.4	2460.2	39
5	10284	7 -4-78	88.6	2521.8	35
6	10285	7 -4-78	81.3	2390.1	34
3	10286	7 -4-78	124.7	2108.9	59
2	10287	7 -4-78	113.4	2339.3	48
1	10288	7 -4-78	115.8	2539.9	46
4	10289	6 -3-78	150.7	2013.3	75
5	10290	6 -3-78	203.8	2296.4	89
1	10294	6 -3-78	150.5	2357.3	64

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
6	10300	7-25-78	119.8	2057.0	58
4	10302	7-27-78	207.2	1706.7	121
5	10303	7-27-78	281.7	2137.4	132
3	10304	7-31-78	110.6	2270.1	49
1	10305	7-27-31	189.2	2224.5	85
6	10306	7-27-78	96.4	2187.6	44
6	10307	7-31-78	73.9	2262.7	33
1	10308	7-31-78	130.4	2290.6	57
5	10310	7-31-78	154.4	2337.2	66
6	10312	8 -2-78	169.3	2316.8	73
5	10313	8 -2-78	224.1	2233.9	100
4	10314	8 -2-78	235.4	2072.6	114
3	10315	8 -2-78	204.8	2471.8	83
5	10316	8 -6-78	218.4	2414.0	90
1	10317	8 -2-78	239.7	2388.1	100
6	10319	8 -6-78	157.2	2436.6	64
1	10320	8 -6-78	165.2	2414.9	68
3	10321	8 -6-78	171.5	2459.5	70
1	10322	8 -8-78	290.8	2313.8	126
3	10323	8 -8-78	313.8	2324.8	135
4	10324	8-10-78	181.2	2292.6	79
5	10325	8 -8-78	318.4	2313.2	138
6	10326	8 -8-78	156.1	2505.0	62
1	10327	8-10-78	156.6	2293.0	68
3	10328	8-10-78	146.4	2267.7	65
4	10329	8-12-78	258.0	2372.5	109

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10334	8-15-78	211.3	2226.3	95
5	10335	8-12-78	276.6	2351.5	118
6	10336	8-12-78	120.7	2451.5	49
3	10337	8-15-78	198.9	2228.5	89
4	10338	8-15-78	187.8	1412.5	133
5	10339	8-15-78	233.5	4382.3	53
6	10340	8-15-78	145.9	2447.2	60
3	10341	8-18-78	136.5	2394.9	57
1	10342	8-18-78	180.2	2344.5	77
4	10343	8-18-78	184.5	2304.7	80
5	10344	8-18-78	190.6	2304.9	83
6	10345	8-18-78	97.1	2458.5	39
2	10346	8-18-78	161.8	2325.2	70
4	10347	8-22-78	214.2	2256.9	95
3	10348	8-22-78	153.0	2432.2	63
1	10349	8-22-78	172.9	2377.3	73
2	10350	8-22-78	163.7	2362.5	69
5	10351	8-22-78	215.1	2351.5	91
6	10352	8-22-78	128.3	2417.7	53
2	10353	8-24-78	400.6	2385.3	168
1	10354	8-24-78	320.6	2367.7	135
4	10355	8-24-78	447.4	2227.8	201
5	10356	8-24-78	310.0	2427.9	128
3	10357	8-24-78	307.8	2241.1	137
6	10358	8-24-78	162.8	1464.3	111
5	10359	8-26-78	95.9	2501.0	38

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
6	10364	8-26-78	50.8	2535.5	20
1	10365	8-30-78	73.1	2238.5	33
2	10366	8-30-78	87.8	2264.5	39
3	10367	8-30-78	53.5	2227.2	24
4	10368	8-30-78	86.4	2258.3	38
5	10369	8-30-78	87.2	2287.5	38
6	10370	8-30-78	2.8	2507.1	1
1	10371	9 -1-78	107.2	2055.3	52
2	10372	9 -1-78	98.1	2174.9	45
4	10374	9 -1-78	137.8	2099.6	66
5	10375	9 -1-78	146.0	2207.3	66
6	10376	9 -1-78	42.4	2566.8	17
3	10389	9-17-78	10.5	2624.6	4
5	10391	9-17-78	56.3	2497.1	23
1	10392	9-17-78	17.2	2591.3	7
2	10393	9-17-78	46.0	2546.2	18
4	10394	9-17-78	33.0	2393.9	14
6	10395	9-19-78	75.8	2529.5	30
5	10396	9-19-78	54.6	2077.3	26
4	10397	9-19-78	34.2	2406.6	14
3	10398	9-19-78	26.0	2546.3	10
2	10399	9-19-78	89.4	2387.2	37
1	10400	9-19-78	63.0	2467.3	26

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10401	9-21-78	204.5	2307.9	89
1	10402	9-23-78	0.9	2400.6	0
2	10403	9-21-78	194.1	2397.0	81
2	10404	9-23-78	13.1	2535.1	5
3	10405	9-21-78	177.0	2343.0	76
4	10407	9-21-78	318.2	2100.8	151
4	10408	9-23-78	6.9	2307.6	3
5	10409	9-21-78	245.0	2383.4	103
5	10410	9-23-78	6.1	2565.1	2
6	10411	9-21-78	91.6	2510.6	36
1	10413	9-26-78	52.6	2179.3	24
1	10414	9-29-78	61.4	2227.9	28
2	10415	9-26-78	123.9	2313.4	54
2	10416	9-29-78	126.1	2226.8	57
3	10417	9-26-78	87.0	2200.1	40
3	10418	9-29-78	110.0	2301.7	48
4	10419	9-26-78	122.8	2036.9	60
4	10420	9-29-78	139.3	2048.4	68
5	10421	9-26-78	120.7	2322.9	52
5	10422	9-29-78	112.0	2493.7	45
6	10423	9-26-78	59.5	2367.1	25
6	10424	9-29-78	94.4	2390.1	39
1	10425	10 -3-78	154.3	2212.5	70
2	10426	10 -3-78	140.0	2314.6	60

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
2	10455	12-12-78	177.4	2263.1	78
2	10456	12-14-78	215.0	1056.7	203
3	10458	12-12-78	116.6	2342.1	50
3	10459	12-14-78	174.6	2141.0	82
3	10460	12-16-78	126.6	2356.2	54
4	10461	12-14-78	282.7	2021.6	140
4	10462	12-16-78	197.1	2125.0	93
5	10463	12-12-78	210.3	2220.8	95
5	10464	12-14-78	180.7	2273.8	79
5	10465	12-16-78	166.8	2312.5	72
6	10466	12-12-78	84.4	2419.6	35
6	10467	12-14-78	65.1	2323.4	28
6	10468	12-16-78	89.6	2312.2	39
2	10470	12-19-78	158.5	2237.3	71
3	10471	12-19-78	130.4	2156.4	60
6	10472	12-19-78	58.4	2377.4	25
5	10473	12-19-78	123.7	2424.4	51
4	10474	12-19-78	133.8	2207.9	61
2	10476	12-22-78	226.3	2372.5	95
3	10477	12-22-78	123.5	4064.8	30
6	10478	12-22-78	73.8	2500.2	29
5	10479	12-22-78	179.3	2524.1	71
4	10480	12-22-78	206.2	2233.9	92
2	10482	12-28-78	137.6	2161.6	64
3	10483	12-28-78	132.1	2155.4	61
5	10485	12-28-78	121.6	2401.8	51

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
5	10489	10-17-78	82.8	2134.6	39
4	10490	10-17-78	117.1	1898.9	62
3	10491	10-17-78	118.7	2121.8	56
2	10492	10-17-78	118.1	2012.7	59
1	10493	10-17-78	121.7	1900.0	64
6	10494	10-17-78	55.1	2313.8	24
3	10495	9-11-78	342.7	2186.5	157
4	10496	9-11-78	438.6	2084.8	210
5	10497	9-11-78	271.0	2093.3	129
6	10498	9-11-78	203.9	2365.6	86
2	10499	9-11-78	134.6	2354.6	57
1	10500	9-11-78	332.0	2165.9	153
3	10427	10 -3-78	125.1	2328.4	54
4	10428	10 -3-78	146.2	2100.0	70
5	10429	10 -3-78	133.5	2421.0	55
6	10430	10 -3-78	107.2	2399.2	45
6	10431	10 -5-78	82.9	2440.5	34
1	10432	10 -5-78	153.9	2216.6	69
2	10433	10 -5-78	138.1	2396.9	58
4	10434	10 -5-78	145.5	2259.5	64
3	10435	10 -5-78	118.4	2463.9	48
5	10436	10 -5-78	727.2	2482.7	293
1	10437	10 -7-78	61.0	2479.8	25
2	10438	10 -7-78	137.0	2212.6	62
3	10439	10 -7-78	67.1	2453.5	27
5	10440	10 -7-78	131.0	2253.9	58

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
3	10445	10-11-78	145.2	2169.6	67
5	10446	10-11-78	189.9	1975.5	96
4	10447	10-13-78	124.7	2087.2	60
6	10448	10-11-78	79.1	2123.6	37
1	10449	10-13-78	117.4	1958.0	60
2	10450	10-13-78	146.5	2173.7	67
3	10451	10-13-78	118.5	2270.6	52
5	10452	10-13-78	116.7	2188.5	53
6	10453	10-13-78	69.8	2396.3	29
3	10501	11 -7-78	114.3	2284.8	50
4	10502	11 -7-78	123.4	2100.5	59
5	10503	11 -7-78	118.0	2191.8	54
6	10504	11 -7-78	73.0	2421.1	30
1	10601	10-19-78	186.9	2393.2	78
2	10602	10-19-78	229.2	2187.5	105
3	10603	10-19-78	189.1	2502.6	76
6	10604	10-19-78	123.9	2575.2	48
5	10605	10-19-78	253.9	2243.9	113
4	10606	10-19-78	206.3	2135.9	97
1	10607	10-25-78	266.5	2412.8	110
1	10608	10-23-78	119.6	2479.4	48
4	10609	10-23-78	198.3	2268.1	87
2	10610	10-23-78	159.9	2406.6	66
6	10611	10-23-78	80.1	2583.6	31
3	10612	10-23-78	124.9	2603.2	48
5	10613	10-23-78	190.0	2283.2	83

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10505	11-10-78	198.4	2152.2	92
2	10506	11-10-78	193.6	2012.3	96
3	10507	11-10-78	155.6	2167.7	72
4	10508	11-10-78	200.7	2074.5	97
5	10509	11-10-78	155.9	2388.3	65
6	10510	11-10-78	137.6	2111.9	65
1	10511	11-14-78	244.0	2288.4	107
3	10513	11-14-78	147.3	2434.3	60
4	10514	11-14-78	254.6	2172.7	117
5	10515	11-14-78	212.6	2272.2	94
6	10516	11-14-78	75.9	2448.1	31
6	10517	11-16-78	85.7	2460.2	35
1	10518	11-16-78	144.9	2311.9	63
2	10519	11-30-78	162.8	2174.9	75
3	10520	11-16-78	107.7	2476.6	43
5	10521	11-16-78	94.1	2388.9	39
4	10522	11-16-78	102.3	2316.7	44
1	10524	11-22-78	189.9	2372.4	80
3	10525	11-22-78	104.0	2302.3	45
6	10527	11-20-78	60.2	2722.7	22
4	10528	11-30-78	180.0	2135.6	84
5	10529	11-30-78	225.3	2327.9	97
6	10530	11-22-78	139.1	2315.8	60
1	10531	11-28-78	101.1	2542.7	40
3	10532	11-28-78	95.9	2409.5	40
6	10533	11-28-78	58.6	2490.9	24

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
6	10539	12 -4-78	67.5	2292.9	29
2	10540	12 -4-78	178.0	2274.8	78
4	10541	12 -6-78	308.0	2151.6	143
5	10542	12 -4-78	188.6	2484.4	76
1	10543	12 -6-78	175.3	2486.3	70
1	10544	12-10-78	127.5	2825.4	45
2	10545	12 -6-78	192.3	2174.6	88
2	10546	12-10-78	273.0	2226.1	123
3	10547	12 -6-78	201.6	2271.0	89
3	10548	12-10-78	141.6	2633.6	54
4	10549	12-10-78	284.1	2250.4	126
4	10550	12-12-78	202.2	2234.6	90
5	10551	12 -6-78	322.4	2361.5	137
5	10552	12-10-78	283.4	2500.1	113
6	10553	12 -6-78	76.9	2261.3	34
6	10554	12-10-78	71.7	2562.0	28
1	10555	12-12-78	206.7	2302.0	90
1	10556	12-14-78	227.5	2324.8	98
5	10557	1 -2-79	168.5	2696.2	62
3	10558	1 -2-79	95.5	2606.6	37
4	10559	1 -9-79	258.8	2060.3	126
1	10560	1 -9-79	191.8	2349.0	82
2	10561	1 -9-79	150.6	2240.7	67
3	10562	1 -9-79	148.8	2345.5	63
4	10563	1-11-79	48.2	2321.7	21
5	10564	1 -9-79	134.2	2584.5	52

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10567	1-15-79	183.4	2586.2	71
1	10568	1-17-79	157.7	2543.6	62
2	10570	1-15-79	218.2	2360.7	92
2	10571	1-17-79	174.0	2419.4	72
3	10573	1-15-79	131.2	2452.0	54
3	10574	1-17-79	108.4	2531.5	43
4	10575	1-15-79	196.6	2098.9	94
4	10576	1-17-79	174.4	2256.9	77
4	10577	1-21-79	132.9	2278.6	58
5	10578	1-11-79	127.4	2259.6	56
5	10579	1-15-79	178.8	2477.1	72
5	10580	1-17-79	210.2	2463.2	85
6	10581	1-15-79	72.1	2473.2	29
6	10582	1-17-79	93.0	2542.2	37
6	10583	1-21-79	71.2	2441.0	29
1	10584	1-21-79	93.6	2714.0	34
1	10586	1-30-79	78.3	2424.0	32
2	10587	1-21-79	98.7	2566.1	38
2	10588	1-25-79	112.2	2510.0	45
2	10589	1-27-79	119.6	2786.1	43
3	10590	1-21-79	103.6	2412.3	43
3	10591	1-25-79	114.4	2302.5	50
3	10592	1-27-79	122.1	2355.5	52
4	10593	1-25-79	157.4	2172.9	72
4	10594	1-27-79	180.3	2350.0	77
5	10595	1-21-79	157.8	2501.3	63

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
6	10618	10-25-78	91.3	2369.1	39
1	10619	10-29-78	104.6	2399.1	44
2	10620	10-29-78	121.1	2225.8	54
3	10621	10-29-78	107.3	2327.7	46
4	10622	10-29-78	109.9	2188.3	50
6	10624	10-29-78	68.1	2419.6	28
4	10625	10-31-78	244.8	2113.1	116
4	10626	11 -2-78	367.3	2100.5	175
4	10627	11 -4-78	337.1	1869.8	180
1	10628	10-31-78	209.2	2213.1	95
1	10629	11 -2-78	262.6	2167.3	121
1	10630	11 -4-78	273.8	2101.1	130
2	10631	10-31-78	220.2	2041.0	108
2	10632	11 -2-78	278.8	2053.9	136
2	10633	11 -4-78	267.3	2200.8	121
3	10634	10-31-78	180.6	2225.6	81
3	10635	11 -2-78	309.4	2213.1	140
3	10636	11 -4-78	256.2	1995.9	128
5	10637	10-29-78	99.0	2285.9	43
5	10638	10-31-78	285.2	2091.2	136
5	10639	11 -2-78	308.4	2093.4	147
6	10640	10-31-78	123.7	2293.3	54
6	10641	11 -2-78	124.0	2390.4	52
6	10642	11 -4-78	217.8	2250.2	97
5	10643	11 -4-78	284.5	1945.6	146
2	10644	11 -7-78	134.6	2121.5	63

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10663	3 -7-79	222.9	1885.3	118
1	10664	3-10-79	128.3	1625.9	79
2	10665	3 -7-79	239.8	2238.5	107
2	10666	3-10-79	175.8	2359.4	74
3	10667	3 -7-79	183.3	2356.3	78
3	10668	3-10-79	173.2	2464.9	70
4	10669	3 -7-79	187.0	2254.4	83
4	10670	3-10-79	294.5	2255.9	131
5	10671	3 -7-79	151.0	2322.4	65
5	10672	3-10-79	261.8	2147.8	122
6	10673	3 -7-79	137.2	2283.1	60
6	10674	3-10-79	83.8	2419.4	35
1	10675	3-14-79	145.1	2111.0	69
2	10676	3-14-79	168.9	2577.2	66
3	10677	3-14-79	147.3	2570.5	57
6	10678	3-14-79	76.9	2438.8	32
5	10679	3-14-79	194.8	2307.4	84
4	10680	3-14-79	205.0	2220.5	92
1	10681	3-16-79	194.7	2277.1	85
2	10682	3-16-79	164.9	2468.0	67
3	10683	3-16-79	226.6	2371.6	96
6	10684	3-16-79	118.4	2379.5	50
5	10685	3-16-79	265.4	2179.0	122
4	10686	3-16-79	324.1	2195.7	148
1	10687	3-20-79	303.3	1972.1	154
1	10688	3-22-79	194.4	1971.9	99

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
4	10646	2-26-79	93.2	2412.1	39
5	10647	2-22-79	255.1	2260.9	113
5	10648	2-26-79	85.8	2629.0	33
6	10649	2-22-79	145.7	2270.9	64
6	10650	2-26-79	81.8	2326.7	35
1	10651	2-28-79	249.6	1995.9	125
1	10652	3 -4-79	109.3	2472.6	44
2	10653	2-28-79	211.5	2081.7	102
2	10654	3 -4-79	104.5	2587.3	40
3	10655	2-28-79	201.6	1949.2	103
3	10656	3 -4-79	94.9	2529.8	37
4	10657	2-28-79	269.4	2029.4	133
4	10658	3 -4-79	125.8	2493.1	50
5	10659	2-28-79	223.6	2022.2	111
5	10660	3 -4-79	105.2	2579.7	41
6	10661	2-28-79	133.3	2182.5	61
6	10662	3 -4-79	74.0	2479.9	30
2	10701	1-30-79	142.3	2430.7	59
3	10702	1-30-79	98.8	2242.7	44
5	10703	1-30-79	270.7	2389.3	113
4	10704	1-30-79	133.4	2019.1	66
1	10705	2 -2-79	131.4	2261.8	58
2	10706	2 -2-79	140.5	2521.4	56
3	10707	2 -2-79	71.9	2231.0	32
6	10708	2 -2-79	45.0	2803.2	16
5	10709	2 -2-79	204.5	2412.0	85

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
4	10693	3-20-79	305.3	2044.3	149
4	10694	3-22-79	214.9	2057.2	104
5	10695	3-20-79	336.2	2175.7	155
5	10696	3-22-79	198.1	1927.3	103
6	10697	3-20-79	135.9	2194.2	62
6	10698	3-22-79	126.0	1964.1	64
1	10699	3-26-79	172.4	2299.9	75
1	10700	3-28-79	237.3	2219.4	107
4	10745	2-22-79	221.3	2255.4	98
2	10746	3-26-79	208.5	2360.3	88
2	10747	3-28-79	177.8	2476.0	72
3	10748	3-26-79	144.4	2517.0	57
3	10749	3-28-79	148.3	2557.9	58
4	10750	3-26-79	280.7	2109.5	133
4	10751	3-28-79	180.7	2378.1	76
5	10752	3-26-79	319.5	2093.6	153
5	10753	3-28-79	173.8	2536.2	69
6	10754	3-26-79	82.6	2420.8	34
6	10755	3-28-79	99.7	2450.6	41
3	10105	4-27-78	243.4	1982.9	123
5	10106	4-27-78	258.5	2191.0	118
4	10107	4-27-78	367.3	2017.4	182
6	10108	4-27-78	214.4	2248.8	95

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
4	10714	2 -8-79	211.5	2254.2	94
5	10715	2 -6-79	165.7	2596.7	64
6	10716	2 -6-79	95.6	2359.2	41
1	10717	2 -8-79	155.0	2373.4	65
2	10718	2 -8-79	222.3	2287.6	97
6	10720	2 -8-79	63.2	2491.1	25
5	10721	2 -8-79	270.7	2349.9	115
1	10722	2-12-79	134.5	2145.3	63
2	10723	2-12-79	122.1	2303.4	53
3	10724	2-14-79	84.1	2082.8	40
6	10725	2-12-79	107.1	2340.1	46
5	10726	2-12-79	109.6	2413.5	45
4	10727	2-12-79	117.1	2195.0	53
1	10728	2-14-79	146.3	2235.0	65
2	10729	2-14-79	102.9	2503.3	41
4	10730	2-14-79	110.5	2121.9	52
5	10731	2-14-79	105.7	2474.5	43
6	10732	2-14-79	74.2	2350.9	32
1	10733	2-20-79	321.7	2147.7	150
2	10734	2-20-79	232.0	2340.0	99
3	10735	2-20-79	218.9	2002.0	109
6	10736	2-20-79	136.3	2283.9	60
5	10737	2-20-79	242.6	2206.0	110
4	10738	2-20-79	283.9	1962.0	145
1	10739	2-22-79	244.8	2350.8	104
1	10740	2-26-79	106.6	2538.7	42

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
5	10173	5-25-78	514.4	2120.1	243
4	10174	5-25-78	428.9	1929.4	222
1	10175	5-30-78	277.5	2146.0	129
2	10176	5-30-78	246.8	2043.1	121
5	10231	6-13-78	129.4	2221.8	58
6	10232	6-13-78	27.9	2122.8	13
2	10233	6-13-78	100.5	1946.2	52
1	10234	6-13-78	61.8	2416.2	26
3	10262	7-13-78	257.9	2224.7	116
5	10263	7-13-78	351.7	2109.2	167
6	10264	7-13-78	186.3	2253.4	83
1	10265	7-15-78	224.4	2279.6	98
1	10295	7-25-78	158.4	2085.0	76
3	10297	7-27-78	141.7	2210.2	64
4	10298	7-25-78	174.4	1733.7	101
5	10299	7-25-78	205.0	2019.3	101
5	10330	8-10-78	176.9	2389.4	74
6	10331	8-10-78	91.5	2417.7	38
1	10332	8-12-78	204.6	2354.8	87
3	10333	8-12-78	187.1	2322.4	81
4	10360	8-26-78	102.1	2468.1	41
3	10361	8-26-78	80.9	2408.5	34
2	10362	8-26-78	104.9	2408.8	44
1	10363	8-26-78	72.1	2481.8	29

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
1	10377	9 -7-78	103.7	2449.8	42
4	10379	9 -7-78	172.5	2281.3	76
5	10380	9 -7-78	180.9	2298.3	79
2	10381	9 -7-78	122.2	2287.3	53
6	10382	9 -7-78	75.1	2466.7	30
1	10383	9-13-78	43.2	2127.8	20
4	10441	10 -7-78	95.5	2257.3	42
6	10442	10 -7-78	33.3	2519.3	13
2	10443	10-11-78	176.9	2000.0	88
1	10444	10-11-78	178.7	1844.6	97
2	10614	10-25-78	223.5	2262.9	99
3	10615	10-25-78	151.3	2299.6	66
4	10616	10-25-78	214.5	2101.6	102
5	10617	10-25-78	190.0	2190.3	87
1	10534	11-30-78	127.6	2484.6	51
1	10535	12 -4-78	169.5	2507.5	68
3	10536	11-30-78	139.8	2256.7	62
3	10537	12 -4-78	126.2	2590.4	49
6	10486	12-28-78	57.1	2388.5	24
2	10487	1 -2-79	132.3	2338.2	57
1	10488	1 -2-79	104.2	2363.3	44
6	10538	11-30-78	59.7	2326.0	26
6	10565	1-11-79	51.7	2402.5	22
1	10566	1-11-79	135.0	2227.7	61
2	10569	1-11-79	125.4	2109.1	59
3	10572	1-11-79	124.4	2063.8	60

SITE NO.	FILTER NO.	DATE	TSP (MG)	FLOW (M3)	CONC. (UG/M3)
5	10596	1-25-79	128.0	2426.8	53
5	10597	1-27-79	235.4	2637.3	89
6	10598	1-25-79	60.5	2505.5	24
6	10599	1-27-79	65.9	2548.2	26
6	10600	1-30-79	35.4	2575.7	14
1	10645	11 -7-78	122.2	2243.5	54
2	10689	3-20-79	332.0	2108.5	157
2	10690	3-22-79	230.0	2054.3	112
3	10691	3-20-79	288.6	2168.9	133
3	10692	3-22-79	200.6	2124.0	94
4	10710	2 -2-79	157.6	2183.3	72
1	10711	2 -6-79	214.1	2073.9	103
2	10712	2 -6-79	170.0	2290.9	74
3	10713	2 -6-79	138.7	2097.8	66
2	10741	2-22-79	243.5	2317.5	105
2	10742	2-26-79	118.1	2275.3	52
3	10743	2-22-79	173.3	2441.0	71
3	10744	2-26-79	82.3	2670.1	31

APPENDIX E

The following information represents the CEB computer results for the fine particulates. The resolution in this appendix was performed for six source categories and includes an analysis of the project's overall average values for each chemical component for each site. Additionally, the CEB program calculates a combined average fit for all sites and provides composite data for predicted source strength coefficients when multiplied by the respective marker element concentrations.

SITE 1 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0881	.0000	.2172	109.4406	601.6503	.0061	711.4022	682.0000	1.04
BR	.0557	.0000	.0000	2.2868	210.5776	.0041	212.9242	921.0000	4.33
ZN	.6470	17.5700	.9094	163.3442	13.2363	.0134	195.7203	171.0000	1.14
NI	.2516	.0000	6.7863	.2123	.3670	.0134	7.6307	7.0000	1.09*
FE	287.5614	377.8500	1.4930	3.9203	8.4231	4.0565	683.3042	684.0000	1.00
MN	3.5945	11.7134	.0380	.8004	1.2033	4.0565	21.4061	29.9000	1.40*
CR	.4493	.0000	.0421	.5064	.0000	.0073	1.0051	1.3500	1.34*
V	.5931	.0000	13.5726	.0229	.0000	.0134	14.2020	14.0000	1.01
CA	37.7424	52.7101	2.0359	4.9003	8.4231	202.8253	308.6371	309.0000	1.00
S	1.7973	.0378	.0000	.0000	.0000	6.0848	7.9198	5110.0000	*****
SI	1797.2585	3.7785	.0000	76.4451	.0000	46.6498	1924.1319	1830.0000	1.05
AL	449.3146	1.8893	8.2793	8.1672	.0000	8.1130	475.7634	558.0000	1.17
CL	1.5277	.0000	.0000	9.8007	46.9287	.1014	58.3585	74.2000	1.27*
NA	25.1616	.0000	8.8222	98.0065	.0000	.2637	132.2540	192.0000	1.45
K	83.0657	.0000	.0000	.0000	12.0330	1.8051	101.9038	308.0000	3.02*

	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING
COEFF	.9821	.5524	.9695	.9552	.8822	.6564
TSP	7189.	976.	194.	1856.	6017.	563.
% TSP	42.8	5.8	1.2	11.1	35.8	3.4

*AVG: 1.62

TOTAL PREDICTED TSP: 16795.

SITE 2 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.1042	.0000	.1277	14.9384	689.3899	.0060	704.5661	678.0000	1.04
BR	.0659	.0000	.0000	.3121	241.2865	.0040	241.6685	796.0000	3.29
ZN	.7653	28.4860	.5346	22.2961	15.1666	.0132	67.2617	58.6000	1.15
NI	.2976	.0000	3.9893	.0290	.4205	.0132	4.7496	4.7600	1.00*
FE	340.1348	612.6029	.8776	.5351	9.6515	4.0034	967.8053	972.0000	1.00
MN	4.2517	18.9907	.0223	.1093	1.3788	4.0034	28.7562	45.1000	1.57*
CR	.5315	.0000	.0247	.0691	.0000	.0072	.6325	1.3700	2.17*
V	.7015	.0000	7.9785	.0031	.0000	.0132	8.6964	8.5000	1.02
CA	44.6427	85.4581	1.1968	.6089	9.6515	200.1724	341.7903	343.0000	1.00
S	2.1258	.0613	.0000	.0000	.0000	6.0052	8.1923	4970.0000	*****
SI	2125.8424	6.1260	.0000	10.4346	.0000	46.0396	2188.4426	1910.0000	1.15
AL	531.4606	3.0630	4.8669	1.1148	.0000	8.0069	548.5122	564.0000	1.03
CL	1.8070	.0000	.0000	1.3378	53.7724	.1001	57.0172	150.0000	2.63*
NA	29.7618	.0000	5.1860	13.3776	.0000	.2602	48.5857	164.0000	3.38
K	104.1663	.0000	.0000	.0000	13.7878	1.7815	119.7356	336.0000	2.81*
COEFF	1.1130	.6302	.9387	.3805	1.0168	.5836		*AVG:	2.03
TSP	8503.	1583.	114.	253.	6894.	556.		TOTAL PREDICTED TSP:	17904.
% TSP	47.5	8.8	.6	1.4	38.5	3.1			

SITE 3 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0731	.0000	.1065	15.8567	559.1663	.0059	575.2084	552.0000	1.04
BR	.0462	.0000	.0000	.3313	195.7082	.0039	196.0897	636.0000	3.24
ZN	.5367	18.1686	.4461	23.6667	12.3017	.0129	55.1327	49.5000	1.11
NI	.2087	.0000	3.3288	.0308	.3411	.0129	3.9224	5.0900	1.30*
FE	238.5538	390.7229	.7323	.5680	7.8283	3.9166	642.3220	644.0000	1.00
MN	2.9819	12.1124	.0186	.1160	1.1183	3.9166	20.2639	22.8000	1.13*
CR	.3727	.0000	.0206	.0734	.0000	.0070	.4738	1.2700	2.68*
V	.4920	.0000	6.6577	.0033	.0000	.0129	7.1660	7.0400	1.02
CA	31.3102	54.5058	.9987	.7100	7.8283	195.8318	291.1848	292.0000	1.00
S	1.4910	.0391	.0000	.0000	.0000	5.8750	7.4050	4470.0000	*****
SI	1490.9615	3.9072	.0000	11.0760	.0000	45.0413	1550.9860	1410.0000	1.10
AL	372.7404	1.9536	4.0612	1.1833	.0000	7.8333	387.7718	449.0000	1.16
CL	1.2673	.0000	.0000	1.4200	43.6150	.0979	46.4002	54.0000	1.16*
NA	20.8735	.0000	4.3275	14.2000	.0000	.2546	39.6555	200.0000	5.04
K	73.0571	.0000	.0000	.0000	11.1833	1.7429	85.9833	312.0000	3.63*

	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING
COEFF	1.0574	.6067	.9457	.4781	1.0130	.6707
TSP	5964.	1010.	95.	269.	5592.	544.
% TSP	44.3	7.5	.7	2.0	41.5	4.0

*AVG: 1.98

TOTAL PREDICTED TSP: 13473.

SITE 4 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0751	.0000	.0977	33.7232	743.8083	.0146	777.7189	740.0000	1.05
BR	.0475	.0000	.0000	.7047	260.3329	.0097	261.0948	641.0000	2.46
ZN	.5521	72.8062	.4090	50.3331	16.3638	.0321	140.4962	123.0000	1.14
NI	.2147	.0000	3.0520	.0654	.4537	.0321	3.8179	5.8100	1.52*
FE	245.3595	1565.7257	.6714	1.2080	10.4133	9.7334	1833.1113	1840.0000	1.00
MN	3.0670	48.5375	.0171	.2466	1.4876	9.7334	63.0893	69.9000	1.11*
CR	.3834	.0000	.0189	.1560	.0000	.0175	.5758	1.8900	3.28*
V	.5061	.0000	6.1039	.0070	.0000	.0321	6.6491	6.5900	1.01
CA	32.2034	218.4187	.9156	1.5100	10.4133	486.6716	750.1326	753.0000	1.00
S	1.5335	.1566	.0000	.0000	.0000	14.6001	16.2902	5250.0000	*****
SI	1533.4967	15.6573	.0000	23.5559	.0000	111.9345	1684.6443	1590.0000	1.06
AL	383.3742	7.8286	3.7234	2.5167	.0000	19.4669	416.9097	581.0000	1.39
CL	1.3035	.0000	.0000	3.0200	58.0170	.2433	62.5838	280.0000	4.47*
NA	21.4690	.0000	3.9675	30.1998	.0000	.6327	56.2690	401.0000	7.13
K	75.1413	.0000	.0000	.0000	14.8762	4.3314	94.3489	847.0000	8.98*

	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING		
COEFF	.9645	.8509	.9262	.4092	1.0051	.0463	*AVG:	3.87
TSP	6134.	4046.	87.	572.	7438.	1352.	TOTAL PREDICTED TSP:	19629.
% TSP	31.2	20.6	.4	2.9	37.9	6.9		

SITE 5 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0598	.0000	.1555	31.4077	833.2439	.0101	864.8770	823.0000	1.05
BR	.0379	.0000	.0000	.0563	291.6354	.0067	292.3362	645.0000	2.21
ZN	.4396	77.9191	.0512	46.8771	18.3314	.0222	144.2406	124.0000	1.16
NI	.1709	.0000	4.8594	.0609	.5083	.0222	5.6218	7.3000	1.30*
FE	195.3590	1675.6801	1.0691	1.1251	11.6654	6.7392	1891.6379	1900.0000	1.00
MN	2.4420	51.9461	.0272	.2297	1.6665	6.7392	63.0507	53.3000	1.18*
CR	.3052	.0000	.0301	.1453	.0000	.0121	.4923	1.3600	2.76*
V	.4029	.0000	9.7188	.0066	.0000	.0222	10.1505	10.0000	1.02
CA	25.6409	233.7574	1.4578	1.4063	11.6654	336.9596	610.8873	613.0000	1.00
S	1.2210	.1676	.0000	.0000	.0000	10.1088	11.4973	4930.0000	*****
SI	1220.9938	16.7568	.0000	21.9385	.0000	77.5007	1337.1898	1270.0000	1.05
AL	305.2484	8.3784	5.9284	2.3439	.0000	13.4784	335.3775	538.0000	1.60
CL	1.0378	.0000	.0000	2.8126	64.9930	.1685	69.0120	443.0000	6.42*
NA	17.0939	.0000	6.3172	28.1263	.0000	.4380	51.9754	361.0000	6.95
K	59.8287	.0000	.0000	.0000	16.6049	2.9989	79.4925	1220.0000	15.35*
COEFF	.9614	.8819	.9719	.3780	1.0124	.5497			
TSP	4884.	4330.	139.	533.	8332.	936.			
% TSP	25.5	22.6	.7	2.8	43.5	4.9			

*AVG: 5.40

TOTAL PREDICTED TSP: 19154.

SITE 6 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0671	.0000	.0615	12.1918	189.4154	.0015	201.7374	192.0000	1.05
BR	.0425	.0000	.0000	.2548	66.2954	.0010	66.5936	187.0000	2.81
ZN	.4932	-2.8749	.2577	18.1968	4.1671	.0033	20.2432	19.2000	1.05
NI	.1918	.0000	1.9233	.0237	.1155	.0033	2.2576	4.4400	1.97*
FE	219.1804	-61.8269	.4231	.4367	2.6518	1.0042	161.8694	162.0000	1.00
MN	2.7398	-1.9166	.0108	.0892	.3788	1.0042	2.3061	9.3500	4.05*
CR	.3425	.0000	.0119	.0564	.0000	.0018	.4126	.8380	2.03*
V	.4521	.0000	3.8467	.0025	.0000	.0033	4.3046	4.2400	1.02
CA	28.7574	-8.6248	.5770	.5459	2.6518	50.2103	74.1276	74.2000	1.00
S	1.3699	-.0062	.0000	.0000	.0000	1.5063	2.8700	3300.0000	*****
SI	1369.8774	-.6183	.0000	8.5161	.0000	11.5484	1389.3236	1240.0000	1.12
AL	342.4693	-.3091	2.3465	.9098	.0000	2.0084	347.4249	377.0000	1.09
CL	1.1644	.0000	.0000	1.0918	14.7744	.0251	17.0557	40.4000	2.37*
NA	19.1783	.0000	2.5003	10.9181	.0000	.0653	32.6620	134.0000	4.10
K	67.1240	.0000	.0000	.0000	3.7883	.4469	71.3592	169.0000	2.37*
COEFF	1.1047	-.3816	.9072	.9477	.9865	.6767			*AVG: 2.56
TSP	5430.	-160.	55.	207.	1894.	139.			TOTAL PREDICTED TSP: 7615.
% TSP	72.0	-2.1	.7	2.7	24.9	1.3			

AVERAGE FIT FOR NIAGARA FRONTIER STUDY 6 SAMPLES (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S	MISSING
PB	.0779	.0000	.1277	36.2597	602.7790	.0074	639.2517	611.1667	1.05	
BR	.0493	.0000	.0000	.7577	210.9727	.0049	211.7845	637.6667	3.01	
ZN	.5723	35.3458	.5346	54.1190	13.2611	.0162	103.8491	90.8833	1.14	
NI	.2226	.0000	3.9898	.0704	.3677	.0162	4.6667	5.7333	1.23*	
FE	254.3581	766.1258	.8778	1.2989	8.4389	4.9089	1036.0084	1033.6667	1.00	
MN	3.1795	23.5639	.0223	.2652	1.2056	4.9089	33.1454	38.3917	1.16*	
CR	.3974	.0000	.0247	.1678	.0000	.0088	.5988	1.3463	2.25*	
V	.5246	.0000	7.9797	.0076	.0000	.0162	8.5281	8.3950	1.02	
CA	33.3845	106.0375	1.1970	1.6236	8.4389	245.4451	396.1266	397.3667	1.00	
S	1.5897	.0766	.0000	.0000	.0000	7.3634	9.0291	4671.6667	*****	
SI	1589.7384	7.6013	.0000	25.3277	.0000	56.4524	1679.1197	1541.6667	1.09	
AL	397.4346	3.8006	4.8676	2.7059	.0000	9.8178	418.6266	511.1667	1.22	
CL	1.3513	.0000	.0000	3.2471	47.0168	.1227	51.7379	173.6000	3.36*	
NA	22.2563	.0000	5.1868	32.4714	.0000	.3191	60.2336	242.0000	4.02	
K	77.8972	.0000	.0000	.0000	12.0556	2.1845	92.1372	532.0000	5.77*	

*AVG: 2.75

MAJOR ELEMENT	SI	FE	V	ZN	PB	CA	
EST. % WEIGHT	.250	.387	.070	.088	.100	.360	
TSP	6359.	1964.	114.	615.	6028.	682.	TOTAL PREDICTED TSP: 15762.
% TOTAL TSP	40.3	12.5	.7	3.9	38.2	4.3	

(SOURCE STRENGTH COEFFICIENT)*(MARKER ELEMENT CONCENTRATION)

SAMPLE	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING
SITE 1 AVG-	1797.258	377.850	13.573	163.344	601.650	202.825
SITE 2 AVG-	2125.842	612.603	7.979	22.296	689.390	200.172
SITE 3 AVG-	1490.961	390.723	6.658	23.667	559.166	195.832
SITE 4 AVG-	1533.497	1565.726	6.104	50.333	743.808	486.672
SITE 5 AVG-	1220.994	1675.680	9.719	46.877	833.244	336.960
SITE 6 AVG-	1369.877	-61.827	3.847	18.197	189.415	50.210

APPENDIX F

The following information represents the CEB computer results for the coarse particulates. The resolution in this appendix was performed for six source categories and includes an analysis of the project's overall average values for each chemical component for each site. Additionally, the CEB program calculates a combined average fit for all sites and provides composite data for predicted source strength coefficients when multiplied by the respective marker element concentration.

SITE 1 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.3001	.0000	.0573	5.3151	183.7434	.0488	189.4648	161.0000	1.18
BR	.1899	.0000	.0000	.2151	126.7830	.0326	127.2205	209.0000	1.64
ZN	2.2048	-3.8039	.2208	12.6551	9.5547	.1074	20.9389	19.9000	1.05
NI	.8574	.0000	1.4335	.0165	.1121	.1074	2.5269	4.8000	1.90*
FE	979.9150	-81.8035	.4300	5.1886	67.9851	32.5598	1004.2750	1160.0000	1.16
MN	12.2489	-2.5359	.0224	.4935	.3675	32.5598	43.1562	26.9000	1.60*
CR	1.5311	.0000	.0040	.3290	.0000	.0586	1.9223	2.3000	1.20*
V	2.0211	.0000	2.8670	.0139	.0000	.1074	5.0094	5.0000	1.00
CA	123.6138	-11.4116	2.4082	15.1861	75.3348	1627.9883	1838.1197	1860.0000	1.01
S	6.1245	-.0082	.0000	.0000	.0000	48.8396	54.9559	689.0000	12.54
SI	6124.4689	-.8180	.0000	5.9226	.0000	374.4373	6504.0107	5190.0000	1.25
AL	1531.1172	-.4090	.1319	11.7692	.0000	65.1195	1607.7288	1010.0000	1.59
CL	5.2058	.0000	.0000	29.1066	55.1230	.8140	90.2494	213.0000	2.36*
NA	85.7426	.0000	.7167	16.4516	.0000	2.1164	105.0273	282.0000	2.69
K	300.0990	.0000	.0000	.0000	3.6749	14.4891	318.2629	68.2000	4.67*

COEFF	1.1801	-.0705	.5734	.6359	1.1413	.8753	*AVG:	2.35
TSP	24498.	-211.	41.	144.	1837.	4522.	TOTAL PREDICTED TSP:	30831.
% TSP	79.5	-.7	.1	.5	6.0	14.7		

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.3260	.0000	.0536	-1.3448	168.3311	.0581	167.4290	143.0000	1.17
BR	.2063	.0000	.0000	-.0544	116.1484	.0387	116.3390	192.0000	1.65
ZN	2.3952	.4703	.2258	-3.2019	8.7532	.1277	8.7704	8.5400	1.03
NI	.9315	.0000	1.4662	-.0042	.1027	.1277	2.6239	5.5000	2.10*
FE	1064.5368	10.1133	.4399	-1.3128	62.2825	38.7080	1174.7677	1480.0000	1.26
MN	13.3067	.3135	.0229	-.1249	.3367	38.7080	52.5629	43.8000	1.20*
CR	1.6633	.0000	.0041	-.0832	.0000	.0697	1.6539	1.7600	1.06*
V	2.1956	.0000	2.9324	-.0035	.0000	.1277	5.2522	5.2400	1.00
CA	139.7205	1.4108	2.4632	-3.8422	69.0157	1935.4018	2144.1697	2180.0000	1.02
S	6.6534	.0010	.0000	.0000	.0000	58.0621	64.7164	609.0000	9.41
SI	6653.3548	.1011	.0000	-1.4985	.0000	445.1424	7097.0999	5400.0000	1.31
AL	1663.3387	.0506	.1349	-2.9777	.0000	77.4161	1737.9625	959.0000	1.81
CL	5.6554	.0000	.0000	-7.3643	50.4993	.9677	49.7581	165.0000	3.32*
NA	93.1470	.0000	.7331	-4.1624	.0000	2.5160	92.2337	159.0000	1.72
K	326.0144	.0000	.0000	.0000	3.3666	17.2251	346.6061	66.8000	5.19*
COEFF	1.2321	.0068	.5596	-.3749	1.1771	.8878		*AVG:	2.57
TSP	26613.	26.	42.	-36.	1683.	5376.		TOTAL PREDICTED TSP:	33704.
% TSP	79.0	.1	.1	-.1	5.0	16.0			

SITE 3 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2823	.0000	.0401	.3231	140.8155	.0497	141.5107	120.0000	1.18
BR	.1786	.0000	.0000	.0131	97.1627	.0331	97.3875	177.0000	1.82
ZN	2.0739	-2.1657	.1545	.7693	7.3224	.1093	8.2637	8.0400	1.03
NI	.8065	.0000	1.0034	.0010	.0859	.1093	2.0061	4.1500	2.07*
FE	921.7549	-46.5751	.3010	.3154	52.1017	33.1244	961.0223	1170.0000	1.22
MN	11.5219	-1.4438	.0157	.0300	.2816	33.1244	43.5297	26.1000	1.67*
CR	1.4402	.0000	.0028	.0200	.0000	.0596	1.5227	1.2600	1.21*
V	1.9011	.0000	2.0067	.0008	.0000	.1093	4.0180	4.0100	1.00
CA	120.9803	-6.4972	1.6857	.9231	57.7343	1656.2178	1831.0440	1860.0000	1.02
S	5.7610	-.0047	.0000	.0000	.0000	49.6865	55.4428	545.0000	9.83
SI	5760.9684	-.4658	.0000	.3600	.0000	380.9301	6141.7928	4710.0000	1.30
AL	1440.2421	-.2329	.0923	.7154	.0000	66.2487	1507.0657	825.0000	1.83
CL	4.8958	.0000	.0000	1.7693	42.2446	.8281	49.7389	241.0000	4.85*
NA	80.6536	.0000	.5017	1.0000	.0000	2.1531	84.3084	182.0000	2.16
K	282.2875	.0000	.0000	.0000	2.8163	14.7403	299.8441	44.0000	6.81*
COEFF	1.2231	-.0398	.5004	.0957	1.1735	.8904		*AVG:	3.32
TSP	23044.	-120.	29.	9.	1408.	4601.		TOTAL PREDICTED TSP:	28970.
% TSP	79.5	-.4	.1	.0	4.9	15.9			

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2763	.0000	.0653	-8.4268	148.5217	.0890	140.5260	120.0000	1.17
BR	.1748	.0000	.0000	-.3411	102.4800	.0593	102.3730	184.0000	1.80
ZN	2.0300	25.6534	.2532	-20.0637	7.7231	.1957	15.7917	15.1000	1.05
NI	.7894	.0000	1.6440	-.0261	.0906	.1957	2.6937	4.7200	1.75*
FE	902.2255	551.6860	.4932	-8.2261	54.9530	59.3073	1560.4389	2220.0000	1.42
MN	11.2778	17.1023	.0256	-.7825	.2970	59.3073	67.2276	45.4000	1.92*
CR	1.4097	.0000	.0046	-.5217	.0000	.1008	.9994	2.4100	2.41*
V	1.8008	.0000	3.2880	-.0221	.0000	.1957	5.3225	5.3100	1.00
CA	118.4171	76.9602	2.7619	-24.0765	60.8939	2965.3637	3200.3204	3280.0000	1.02
S	5.6389	.0552	.0000	.0000	.0000	88.9609	94.6550	745.0000	7.87
SI	5638.9095	5.5169	.0000	-9.3898	.0000	682.0337	6317.0702	4930.0000	1.28
AL	1409.7274	2.7584	.1512	-18.6592	.0000	118.6145	1512.5924	867.0000	1.74
CL	4.7931	.0000	.0000	-46.1465	44.5565	1.4827	4.6857	323.0000	68.93*
NA	78.9447	.0000	.8220	-26.0828	.0000	3.8550	57.5389	311.0000	5.41
K	276.3066	.0000	.0000	.0000	2.9704	26.3917	305.6687	67.8000	4.51*

	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING		
COEFF	1.1438	.2485	.0192	******	1.2377	.9041	*AVG:	15.91
TSP	22550.	1426.	47.	-228.	1485.	8237.	TOTAL PREDICTED TSP:	33522.
% TSP	67.3	4.3	.1	-.7	4.4	24.6		

SITE 5 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE - (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2770	.0000	.0679	-3.9681	144.5761	.0937	141.0465	120.0000	1.18
BR	.1752	.0000	.0000	-.1606	99.7575	.0625	99.8345	200.0000	2.00
ZN	2.0351	23.2329	.2614	-9.4479	7.5160	.2061	23.8056	22.0000	1.08
NI	.7914	.0000	1.6972	-.0123	.0882	.2061	2.7707	5.0500	1.82*
FE	904.4972	499.6323	.5092	-3.8736	53.4931	62.4643	1516.7225	2920.0000	1.93
MN	11.3062	15.4886	.0265	-.3085	.2892	62.4643	89.2063	51.2000	1.74*
CR	1.4133	.0000	.0048	-.2456	.0000	.1124	1.2848	1.5900	1.24*
V	1.8655	.0000	3.3944	-.0104	.0000	.2061	5.4556	5.4400	1.00
CA	118.7153	69.6987	2.8513	-11.3375	59.2762	3123.2153	3362.4192	3470.0000	1.03
S	5.6531	.0500	.0000	.0000	.0000	93.6965	99.3995	724.0000	7.28
SI	5653.1074	4.9963	.0000	-4.4216	.0000	718.3395	6372.0216	4790.0000	1.33
AL	1413.2769	2.4982	.1561	-8.7865	.0000	124.9286	1532.0732	967.0000	1.58
CL	4.8051	.0000	.0000	-21.7301	43.3728	1.5616	28.0094	302.0000	10.78*
NA	79.1435	.0000	.8486	-12.2822	.0000	4.0602	71.7700	210.0000	2.93
K	277.0023	.0000	.0000	.0000	2.8915	27.7966	307.6904	92.0000	3.34*

	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING
COEFF	1.1802	.1711	.0240	-.4294	1.2048	.9001
TSP	22612.	1291.	48.	-107.	1446.	8676.
% TSP	66.6	3.8	.1	-.3	4.3	25.5

*AVG: 3.79

TOTAL PREDICTED TSP: 33966.

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.1905	.0000	.0375	6.9187	44.1913	.0097	51.3476	42.8000	1.20
BR	.1205	.0000	.0000	.2800	30.4920	.0064	30.8990	85.1000	2.75
ZN	1.3996	-17.4393	.1442	16.4730	2.2979	.0213	2.8968	2.8800	1.01
NI	.5443	.0000	.9364	.0214	.0270	.0213	1.5503	3.1200	2.01*
FE	622.0354	-375.0381	.2809	6.7539	16.3506	6.4424	276.8254	284.0000	1.03
MN	7.7754	-11.6262	.0146	.0424	.0884	6.4424	3.3371	5.9000	1.77*
CR	.9719	.0000	.0026	.4283	.0000	.0116	1.4144	.4560	3.10*
V	1.2829	.0000	1.8729	.0181	.0000	.0213	3.1952	3.1900	1.00
CA	81.6421	-52.3178	1.5732	19.7676	18.1185	322.1197	390.9033	392.0000	1.00
S	3.8877	-.0375	.0000	.0000	.0000	9.6636	13.5138	290.0000	21.46
SI	3887.7214	-3.7504	.0000	7.7094	.0000	74.0875	3965.7679	3360.0000	1.18
AL	971.9304	-1.8752	.0862	15.3199	.0000	12.8848	998.3460	662.0000	1.51
CL	3.3046	.0000	.0000	37.8880	13.2574	.1611	54.6110	61.6000	1.13*
NA	54.4281	.0000	.4682	21.4149	.0000	.4188	76.7300	114.0000	1.49
K	190.4983	.0000	.0000	.0000	.8838	2.8669	194.2490	25.2000	7.71*
COEFF	1.1571	******	.5871	5.7198	1.0325	.8217		*AVG:	3.14
TSP	15551.	-969.	27.	187.	442.	895.		TOTAL PREDICTED TSP:	16132.
% TSP	96.4	-6.0	.2	1.2	2.7	5.5			

AVERAGE FIT FOR NIAGARA FRONTIER STUDY 6 SAMPLES (NG/M3)

ELEMENT	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S	MISSING
PB	.2754	.0000	.0545	-.1971	138.3632	.0582	138.5541	117.8000	1.18	
BR	.1742	.0000	.0000	-.0080	95.4706	.0388	95.6756	174.5167	1.82	
ZN	2.0231	4.3246	.2100	-.4694	7.1949	.1279	13.4112	12.7433	1.05	
NI	.7888	.0000	1.3634	-.0006	.0844	.1279	2.3619	4.5567	1.93*	
FE	899.1608	93.0025	.4090	-.1924	51.1944	38.7677	1082.3420	1539.0000	1.42	
MN	11.2395	2.8831	.0213	-.0183	.2767	38.7677	53.1700	33.2167	1.60*	
CR	1.4049	.0000	.0038	-.0122	.0000	.0698	1.4603	1.0293	1.11*	
V	1.8545	.0000	2.7269	-.0005	.0000	.1279	4.7088	4.6983	1.00	
CA	118.0149	12.9738	2.2906	-.5632	56.7289	1938.3844	2127.8294	2173.6667	1.02	
S	5.6198	.0093	.0000	.0000	.0000	58.1515	63.7806	600.3333	9.41	
SI	5619.7551	.9300	.0000	-.2197	.0000	445.8284	6066.2939	4730.0000	1.28	
AL	1404.9388	.4650	.1254	-.4365	.0000	77.5354	1482.6281	881.6667	1.68	
CL	4.7768	.0000	.0000	-1.0795	41.5090	.9692	46.1754	217.0000	4.71*	
NA	78.6766	.0000	.6317	-.6102	.0000	2.5199	81.2680	209.6667	2.58	
K	275.3680	.0000	.0000	.0000	2.7673	17.2516	295.3869	60.6667	4.87*	

*AVG: 2.84

MAJOR ELEMENT	SI	FE	V	ZN	PB	CA
EST. % WEIGHT	.250	.387	.070	.088	.100	.360
TSP	22479.	240.	39.	-5.	1384.	5384.
% TOTAL TSP	76.1	.8	.1	-.0	4.7	18.2

TOTAL PREDICTED TSP: 29521.

(SOURCE STRENGTH COEFFICIENT)*(MARKER ELEMENT CONCCENTRATION)

SAMPLE	SOIL	STEEL	OIL	REFUSE	AUTO	LIMING
SITE 1 AVG-	6124.469	-81.804	2.867	12.655	183.743	1627.988
SITE 2 AVG-	6653.355	10.113	2.932	-3.202	168.331	1935.402
SITE 3 AVG-	5760.968	-46.575	2.007	.769	140.815	1656.218
SITE 4 AVG-	5638.969	551.686	3.288	-20.664	148.522	2965.364
SITE 5 AVG-	5653.107	499.632	3.394	-9.448	144.576	3123.215
SITE 6 AVG-	3887.721	-375.038	1.873	16.473	44.191	322.120

APPENDIX G

The following information represents the CEB computer results for the fine particulates. The resolution in this appendix was performed for seven source categories and includes an analysis of the project's overall average values for each chemical component for each site. Additionally, the CEB program calculates a combined average fit for all sites and provides composite data for predicted source strength coefficients when multiplied by the respective marker element concentration.

SITE 1 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0359	.0000	.2811	.2124	109.4310	601.4227	.0060	711.4401	682.0000	1.04
BR	.0550	.0000	.0543	.0000	2.2866	210.4979	.0040	212.8978	921.0000	4.33
ZN	.6387	16.6216	.5429	.8893	163.3299	13.2313	.0131	195.2668	171.0000	1.14
NI	.2484	.0000	.0000	6.6366	.2123	.3669	.0131	7.4773	7.0000	1.07*
FE	283.8452	357.4541	24.2355	1.4601	3.9199	8.4199	3.9798	683.3145	684.0000	1.00
MN	3.5481	11.0811	.3102	.0372	.8003	1.2028	3.9793	20.9595	29.9000	1.43*
CR	.4435	.0000	.1939	.0411	.5063	.0000	.0072	1.1920	1.3500	1.13*
V	.5854	.0000	.3005	13.2732	.0229	.0000	.0131	14.1952	14.0000	1.01
CA	37.2547	49.8649	7.2766	1.9910	4.8999	8.4199	198.9387	308.6397	309.0000	1.00
S	1.7740	.0357	.0000	.0000	.0000	.0000	5.9697	7.7794	5110.0000	*****
SI	1774.0326	3.5745	.0000	.0000	76.4384	.0000	45.7674	1899.8130	1830.0000	1.04
AL	443.5082	1.7873	96.9418	8.0967	8.1665	.0000	7.9595	566.4600	558.0000	1.02
CL	1.5079	.0000	.1551	.0000	9.7998	46.9110	.0995	58.4733	74.2000	1.27*
NA	24.3365	.0000	1.5511	8.6276	97.9979	.0000	.2587	133.2717	192.0000	1.44
K	86.9276	.0000	9.5972	.0000	.0000	12.0285	1.7710	110.3243	308.0000	2.79*
COEFF	.9694	.5226	.1737	.9481	.9551	.8819	.6440		*AVG:	1.54
TSP	7096.	924.	729.	190.	1856.	6014.	553.		TOTAL PREDICTED TSP:	17361.
% TSP	40.9	5.3	4.2	1.1	10.7	34.6	3.2			

SITE 2 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.1009	.0000	.1643	.1252	14.8773	689.2680	.0059	704.5415	678.0000	1.04
BR	.0638	.0000	.0317	.0000	.3109	241.2438	.0040	241.6542	796.0000	3.29
ZN	.7410	28.3320	.3172	.5241	22.2049	15.1639	.0131	67.2961	58.6000	1.15
NI	.2882	.0000	.0000	3.9111	.0289	.4205	.0131	4.6617	4.7500	1.02*
FE	329.3181	609.2910	14.1625	.8604	.5329	9.6498	3.9598	967.7745	972.0000	1.00
MN	4.1165	18.8880	.1813	.0219	.1088	1.3785	3.9598	28.6548	45.1000	1.57*
CR	.5146	.0000	.1133	.0242	.0688	.0000	.0071	.7281	1.3700	1.88*
V	.6792	.0000	.1756	7.8223	.0031	.0000	.0131	8.6933	8.5000	1.02
CA	43.2230	84.9961	4.2487	1.1733	.6661	9.6498	197.9894	341.9465	343.0000	1.00
S	2.0582	.0609	.0000	.0000	.0000	.0000	5.9397	8.0588	4970.0000	*****
SI	2058.2380	6.0929	.0000	.0000	10.3919	.0000	45.5376	2120.2603	1910.0000	1.11
AL	514.5595	3.0465	56.6499	4.7716	1.1102	.0000	7.9196	588.0573	564.0000	1.04
CL	1.7495	.0000	.0906	.0000	1.3323	53.7629	.0990	57.0343	150.0000	2.63*
NA	28.8153	.0000	.9064	5.0845	13.3229	.0000	.2574	48.3865	164.0000	3.39
K	100.8537	.0000	5.6083	.0000	.0000	13.7854	1.7621	122.0095	336.0000	2.75*
COEFF	1.0776	.6268	.1004	.9203	.3789	1.0166	.5772		*AVG:	1.97
TSP	8233.	1574.	426.	112.	252.	6893.	550.	TOTAL PREDICTED TSP:		18040.
% TSP	45.6	8.7	2.4	.6	1.4	38.2	3.0			

SITE 3 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0714	.0000	.2443	.1025	16.0335	558.7690	.0058	575.2264	552.0000	1.04
BR	.0452	.0000	.0472	.0000	.3350	195.5691	.0039	196.0003	636.0000	3.24
ZN	.5243	17.4500	.4718	.4292	23.9306	12.2929	.0127	55.1116	49.5000	1.11
NI	.2039	.0000	.0000	3.2026	.0311	.3408	.0127	3.7912	5.0900	1.34*
FE	233.0396	375.2698	21.0607	.7046	.5743	7.8228	3.8508	642.3226	644.0000	1.00
MN	2.9130	11.6334	.2696	.0179	.1173	1.1175	3.8508	19.9194	22.8000	1.14*
CR	.3041	.0000	.1685	.0199	.0742	.0000	.0069	.6336	1.2700	2.00*
V	.4806	.0000	.2612	6.4052	.0034	.0000	.0127	7.1631	7.0400	1.02
CA	30.5864	52.3501	6.3182	.9608	.7179	7.8228	192.5387	291.2949	292.0000	1.00
S	1.4565	.0375	.0000	.0000	.0000	.0000	5.7762	7.2702	4470.0000	*****
SI	1456.4975	3.7527	.0000	.0000	11.1995	.0000	44.2839	1515.7336	1410.0000	1.07
AL	364.1244	1.8763	84.2430	3.9072	1.1965	.0000	7.7015	463.0490	449.0000	1.03
CL	1.2380	.0000	.1348	.0000	1.4358	43.5840	.0963	46.4889	54.0000	1.16*
NA	20.3910	.0000	1.3479	4.1634	14.3584	.0000	.2503	40.5109	200.0000	4.94
K	71.3084	.0000	8.3401	.0000	.0000	11.1754	1.7136	92.5974	312.0000	3.37*
COEFF	1.0330	.5827	.1876	.9098	.4834	1.0123	.6594		*AVG:	1.80
TSP	5826.	970.	633.	92.	272.	5588.	535.		TOTAL PREDICTED TSP:	13915.
% TSP	41.9	7.0	4.6	.7	2.0	40.2	3.8			

SITE 4 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0741	.0000	.5301	.0887	34.3048	742.7571	.0144	777.7691	740.0000	1.05
BR	.0469	.0000	.1024	.0000	.7108	259.9650	.0096	260.8406	641.0000	2.46
ZN	.5441	70.8569	1.0236	.3714	51.2012	16.3407	.0317	140.3694	123.0000	1.14
NI	.2116	.0000	.0000	2.7717	.0606	.4531	.0317	3.5346	5.8100	1.64*
FE	241.8069	1523.8034	45.6943	.6098	1.2288	10.3986	9.5949	1833.1367	1840.0000	1.00
MN	3.0226	47.2379	.5849	.0155	.2509	1.4855	9.5949	62.1922	69.9000	1.12*
CR	.3778	.0000	.3656	.0172	.1587	.0000	.0173	.9366	1.8900	2.02*
V	.4987	.0000	.5666	5.5435	.0072	.0000	.0317	6.6477	6.5900	1.01
CA	31.7372	212.5706	13.7083	.8315	1.5360	10.3986	479.7433	750.5255	753.0000	1.00
S	1.5113	.1524	.0000	.0000	.0000	.0000	14.3923	16.0560	5250.0000	*****
SI	1511.2933	15.2380	.0000	.0000	23.9622	.0000	110.3410	1660.8345	1590.0000	1.04
AL	377.8233	7.6190	182.7773	3.3815	2.5601	.0000	19.1897	593.3509	581.0000	1.02
CL	1.2846	.0000	.2924	.0000	3.0721	57.9351	.2399	62.8240	280.0000	4.46*
NA	21.1581	.0000	2.9244	3.6033	30.7207	.0000	.6237	59.0302	401.0000	6.79
K	74.0534	.0000	18.0949	.0000	.0000	14.8551	4.2697	111.2732	847.0000	7.61*
COEFF	.9505	.8282	.3146	.8412	.4163	1.0037	.6371		*AVG:	3.37
TSP	6045.	3937.	1374.	79.	582.	7428.	1333.		TOTAL PREDICTED TSP:	20778.
% TSP	29.1	19.0	6.6	.4	2.8	35.7	6.4			

SITE 5 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0591	.0000	.0354	.1446	32.1150	832.0005	.0099	864.9645	823.0000	1.05
BR	.0374	.0000	.1227	.0000	.0711	291.2002	.0066	292.0379	645.0000	2.21
ZN	.4341	75.4981	1.2271	.0057	47.9328	18.3040	.0217	144.0235	124.0000	1.16
NI	.1638	.0000	.0000	4.5203	.0623	.5075	.0217	5.2806	7.3000	1.38*
FE	192.9408	1623.6150	54.7800	.9945	1.1504	11.6480	6.5698	1891.6985	1900.0000	1.00
MN	2.4118	50.3321	.7012	.0253	.2349	1.6640	6.5698	61.9390	53.3000	1.16*
CR	.3015	.0000	.4382	.0280	.1486	.0000	.0118	.9282	1.3600	1.47*
V	.3979	.0000	.6793	9.0406	.0067	.0000	.0217	10.1462	10.0000	1.01
CA	25.3235	226.4943	16.4340	1.3561	1.4380	11.6480	328.4895	611.1834	613.0000	1.00
S	1.2059	.1624	.0000	.0000	.0000	.0000	9.8547	11.2229	4930.0000	*****
SI	1205.8799	16.2362	.0000	.0000	22.4326	.0000	75.5526	1320.1012	1270.0000	1.04
AL	301.4700	8.1181	219.1201	5.5148	2.3966	.0000	13.1396	549.7591	538.0000	1.02
CL	1.0250	.0000	.3506	.0000	2.8766	64.8960	.1642	69.3118	443.0000	6.39*
NA	16.8823	.0000	3.5059	5.8764	28.7597	.0000	.4270	55.4514	361.0000	6.51
K	59.0881	.0000	21.6929	.0000	.0000	16.6400	2.9236	100.3446	1220.0000	12.16*
COEFF	.9495	.8545	.4073	.9041	.3866	1.0109	.5359		*AVG:	4.51
TSP	4824.	4195.	1048.	129.	545.	8320.	912.	TOTAL PREDICTED TSP:		20573.
% TSP	23.4	20.4	5.0	.6	2.6	40.4	4.4			

SITE 6 AVG-FINE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.0653	.0000	.1519	.0591	12.2382	189.2250	.0014	201.7410	192.0000	1.05
BR	.0413	.0000	.0293	.0000	.2557	66.2287	.0010	66.5561	187.0000	2.81
ZN	.4801	-3.2110	.2934	.2476	18.2659	4.1629	.0032	20.2421	19.2000	1.05
NI	.1867	.0000	.0000	1.8476	.0237	.1154	.0032	2.1766	4.4400	2.04*
FE	213.3705	-69.0544	13.0972	.4065	.4384	2.6491	.9617	161.8690	162.0000	1.00
MN	2.6671	-2.1407	.1676	.0103	.0895	.3784	.9617	2.1341	9.3500	4.38*
CR	.3334	.0000	.1048	.0115	.0566	.0000	.0017	.5080	.8380	1.65*
V	.4401	.0000	.1624	3.6951	.0026	.0000	.0032	4.3033	4.2400	1.01
CA	28.0049	-9.6331	3.9292	.5543	.5480	2.6491	48.0848	74.1371	74.2000	1.00
S	1.3336	-.0069	.0000	.0000	.0000	.0000	1.4425	2.7692	3300.0000	*****
SI	1333.5659	-.6905	.0000	.0000	8.5485	.0000	11.0595	1352.4833	1240.0000	1.09
AL	333.3915	-.3453	52.3888	2.2540	.9133	.0000	1.9234	390.5257	377.0000	1.04
CL	1.1335	.0000	.0838	.0000	1.0960	14.7595	.0240	17.0969	40.4000	2.36*
NA	18.6699	.0000	.8382	2.4018	10.9596	.0000	.0625	32.9320	134.0000	4.07
K	65.3447	.0000	5.1865	.0000	.0000	3.7845	.4280	74.7437	169.0000	2.26*
COEFF	1.0755	-.4263	.1390	.8715	.9514	.9855	.6480		*AVG:	2.54
TSP	5334.	-178.	394.	53.	208.	1892.	134.		TOTAL PREDICTED TSP:	7836.
% TSP	68.1	-2.3	5.0	.7	2.6	24.1	1.7			

AVERAGE FIT FOR NIAGARA FRONTIER STUDY 6 SAMPLES (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S	MISSING
PB	.0763	.0000	.3345	.1221	36.5000	602.2404	.0072	639.2804	611.1667	1.05	
BR	.0433	.0000	.0646	.0000	.7627	210.7841	.0048	211.6645	637.6667	3.01	
ZN	.5604	34.2579	.0460	.5112	54.4776	13.2493	.0159	103.7183	90.8333	1.14	
NI	.2179	.0000	.0000	3.6150	.0708	.3674	.0159	4.4870	5.7333	1.28*	
FE	249.0535	736.7298	28.8384	.8393	1.3075	8.4314	4.8194	1030.0193	1033.6667	1.00	
MN	3.1132	22.8386	.3691	.0214	.2669	1.2045	4.8194	32.6332	38.3917	1.18*	
CR	.3891	.0000	.2307	.0237	.1689	.0000	.0087	.8211	1.3463	1.64*	
V	.5137	.0000	.3576	7.6300	.0076	.0000	.0159	8.5248	8.3950	1.02	
CA	32.6883	102.7738	8.6515	1.1445	1.6343	8.4314	240.9724	396.2962	397.3667	1.00	
S	1.5566	.0737	.0000	.0000	.0000	.0000	7.2292	8.8594	4671.6667	*****	
SI	1556.5845	7.3673	.0000	.0000	25.4955	.0000	55.4237	1644.8710	1541.6667	1.07	
AL	389.1461	3.0836	115.3535	4.6543	2.7239	.0000	9.6389	525.2003	511.1667	1.03	
CL	1.3231	.0000	.1846	.0000	3.2687	46.9747	.1205	51.8716	173.6000	3.35*	
NA	21.7922	.0000	1.8457	4.9595	32.0865	.0000	.3133	61.5971	242.0000	3.93	
K	76.2726	.0000	11.4200	.0000	.0000	12.0448	2.1447	101.8821	532.0000	5.22*	

*AVG: 2.53

MAJOR ELEMENT	SI	FE	AL	V	ZN	PB	CA
EST. % WEIGHT	.250	.387	.133	.070	.088	.100	.360
TSP	6226.	1904.	867.	109.	619.	6022.	669.
% TOTAL TSP	37.9	11.6	5.3	.7	3.8	36.7	4.1

TOTAL PREDICTED TSP: 16417.

(SOURCE STRENGTH COEFFICIENT)*(MARKER ELEMENT CONCENTRATION)

SAMPLE	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING
SITE 1 AVG-	1774.033	357.454	96.942	13.273	163.330	601.423	198.989
SITE 2 AVG-	2058.238	609.291	56.650	7.822	22.205	689.268	197.989
SITE 3 AVG-	1456.498	375.270	84.243	6.405	23.931	558.769	192.539
SITE 4 AVG-	1511.293	1523.803	182.777	5.543	51.201	742.757	479.743
SITE 5 AVG-	1205.830	1623.615	219.120	9.041	47.933	832.000	328.490
SITE 6 AVG-	1333.566	-69.054	52.389	3.695	18.266	189.225	48.085

APPENDIX H

The following information represents the CEB computer results for the coarse particulates. The resolution in this appendix was performed for seven source categories and includes an analysis of the project's overall average values for each chemical component for each site. Additionally, the CEB program calculates a combined average fit for all sites and provides composite data for predicted source strength coefficients when multiplied by the respective marker element concentrations.

SITE I AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2390	.0000	-.3384	.0858	-8.4638	199.6705	.0489	191.2421	161.0000	1.19
BR	.1512	.0000	-.0451	.0000	-.3426	137.7726	.0326	137.5088	209.0000	1.52
ZN	1.7563	28.7644	-1.4666	.3305	-20.1518	10.3829	.1076	19.7232	19.9000	1.01
NI	.0830	.0000	.0000	2.1460	-.0262	.1218	.1076	3.0322	4.8000	1.58*
FE	780.5564	618.5885	-310.2350	.6438	-8.2622	73.8781	32.6083	1187.7778	1160.0000	1.02
MN	9.7570	19.1762	-.8743	.0335	-.7859	.3993	32.6083	60.3141	26.9000	2.24*
CR	1.2196	.0000	-.4513	.0060	-.5239	.0000	.0587	.3091	2.3000	7.44*
V	1.6099	.0000	-.9871	4.2920	-.0222	.0000	.1076	5.0002	5.0000	1.00
CA	102.4480	86.2931	-20.5883	3.6053	-24.1822	81.8649	1630.4135	1859.8543	1860.0000	1.00
S	4.8785	.0619	.0000	.0000	.0000	.0000	48.9124	53.8527	689.0000	12.79
SI	4378.4773	6.1859	.0000	.0000	-9.4310	.0000	374.9951	5250.2272	5190.0000	1.01
AL	1219.6193	3.0929	-282.0318	.1974	-18.7412	.0000	65.2165	987.3532	1010.0000	1.02
CL	4.1467	.0000	-.1044	.0000	-46.3491	59.9011	.8152	18.4096	213.0000	11.57*
NA	68.2987	.0000	-4.5125	1.0730	-26.1973	.0000	2.1195	40.7814	282.0000	6.91
K	239.0454	.0000	-31.0235	.0000	.0000	3.9934	14.5107	226.5260	68.2000	3.32*

	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING		
COEFF	.9400	.5333	-.2792	.8584	******	1.2402	.8766	*AVG:	5.23
TSP	19514.	1598.	-2121.	61.	-229.	1997.	4529.	TOTAL PREDICTED TSP:	25350.
% TSP	77.0	6.3	-8.4	.2	-.9	7.9	17.9		

SITE 2 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2467	.0000	-.4294	.0952	-20.7704	188.5704	.0581	167.7706	143.0000	1.17
BR	.1561	.0000	-.0573	.0000	-.8407	130.1136	.0387	129.4104	192.0000	1.48
ZN	1.8128	47.7078	-1.8607	.3663	-49.4534	9.8057	.1277	8.5062	8.5400	1.00
NI	.7050	.0000	.0000	2.3788	-.0643	.1150	.1277	3.2623	5.5000	1.69*
FE	805.6816	1025.9749	-393.6199	.7136	-20.2759	69.7711	38.7016	1526.9471	1480.0000	1.03
MN	10.0710	31.8052	-1.1093	.0371	-1.9287	.3771	38.7016	77.9541	43.8000	1.78*
CR	1.2589	.0000	-.5725	.0067	-1.2858	.0000	.0697	-.5231	1.7600	-3.36*
V	1.6617	.0000	-1.2524	4.7577	-.0544	.0000	.1277	5.2403	5.2400	1.00
CA	105.7457	143.1235	-26.1220	3.9964	-59.3441	77.3139	1935.0788	2179.7922	2180.0000	1.00
S	5.0355	.1026	.0000	.0000	.0000	.0000	58.0524	63.1905	609.0000	9.64
SI	5035.5102	10.2597	.0000	.0000	-23.1442	.0000	445.0681	5467.6939	5400.0000	1.01
AL	1258.8775	5.1299	-357.8362	.2189	-45.9917	.0000	77.4032	937.8015	959.0000	1.02
CL	4.2802	.0000	-.1324	.0000	-113.7428	56.5711	.9675	-52.0563	165.0000	-3.17*
NA	70.4971	.0000	-5.7254	1.1894	-64.2894	.0000	2.5156	4.1874	159.0000	37.97
K	246.7400	.0000	-39.3620	.0000	.0000	3.7714	17.2222	228.3716	66.8000	3.42*
COEFF	.9325	.6932	-.3731	.9080	******	1.3187	.8877		*AVG:	.07
TSP	20142.	2651.	-2690.	68.	-562.	1886.	5375.	TOTAL PREDICTED TSP:		26870.
% TSP	75.0	9.9	-10.0	.3	-2.1	7.0	20.0			

SITE 3 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2158	.0000	-.3985	.0730	-15.6550	158.1428	.0497	142.4299	120.0000	1.19
BR	.1365	.0000	-.0531	.0000	-.0336	109.1185	.0332	108.6015	177.0000	1.63
ZN	1.5856	30.7977	-1.7267	.2811	-37.2690	8.2234	.1094	3.0015	8.0400	1.00
NI	.0166	.0000	.0000	1.8253	-.0484	.0965	.1094	2.5993	4.1500	1.60*
FE	704.7065	791.3481	-365.2668	.5476	-15.2803	58.5128	33.1596	1207.7274	1170.0000	1.03
MN	8.8088	24.5318	-1.0294	.0285	-1.4555	.3163	33.1596	64.3621	26.1000	2.47*
CR	1.1011	.0000	-.5313	.0051	-.9690	.0000	.0597	-.3344	1.2600	-3.77*
V	1.4535	.0000	-1.1622	3.6505	-.0410	.0000	.1094	4.0102	4.0100	1.00
CA	92.4927	110.3931	-24.2404	3.0604	-44.7228	64.8385	1657.9780	1859.8055	1860.0000	1.00
S	4.4044	.0791	.0000	.0000	.0000	.0000	49.7393	54.2229	545.0000	10.05
SI	4404.4158	7.9135	.0000	.0000	-17.4419	.0000	381.3349	4776.2223	4710.0000	1.01
AL	1101.1039	3.9567	-332.0608	.1679	-34.6602	.0000	66.3191	804.8268	825.0000	1.03
CL	3.7438	.0000	-.1229	.0000	-85.7188	47.4428	.8290	-33.8261	241.0000	-7.12*
NA	61.6618	.0000	-5.3130	.9126	-48.4497	.0000	2.1554	10.9671	182.0000	16.60
K	215.8164	.0000	-36.5267	.0000	.0000	3.1629	14.7560	197.2085	44.0000	4.48*
COEFF	.9351	.6754	-.4025	.9104	******	1.3179	.8914		*AVG:	-.47
TSP	17613.	2045.	-2497.	52.	-424.	1581.	4605.	TOTAL PREDICTED TSP:		22981.
% TSP	76.7	8.9	-10.9	.2	-1.8	6.9	20.0			

SITE 4 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2122	.0000	-.3451	.0956	-34.3372	174.0538	.0891	139.7085	120.0000	1.16
BR	.1342	.0000	-.0460	.0000	-1.3898	120.0971	.0594	118.8549	184.0000	1.55
ZN	1.5588	87.0568	-1.4953	.3682	-81.7552	9.0508	.1961	14.9802	15.1000	1.01
NI	.0062	.0000	.0000	2.3908	-.1063	.1062	.1961	3.1930	4.7200	1.48*
FE	692.8216	1872.1890	-316.3177	.7173	-33.5196	64.3999	59.4217	2339.7120	2220.0000	1.05
MN	8.6603	58.0379	-.8914	.0373	-3.1885	.3481	59.4217	122.4253	45.4000	2.70*
CR	1.0825	.0000	-.4601	.0067	-2.1256	.0000	.1070	-1.3895	2.4100	-1.73*
V	1.4239	.0000	-1.0065	4.7817	-.0899	.0000	.1961	5.3103	5.3100	1.00
CA	90.9328	261.1704	-20.9920	4.0166	-98.1062	71.3620	2971.0832	3279.4669	3280.0000	1.00
S	4.3301	.1872	.0000	.0000	.0000	.0000	89.1325	93.6499	745.0000	7.96
SI	4330.1348	18.7219	.0000	.0000	-38.2614	.0000	683.3491	4993.9444	4930.0000	1.01
AL	1082.5337	9.3609	-287.5616	.2200	-76.0323	.0000	118.8433	847.3641	867.0000	1.02
CL	3.6806	.0000	-.1064	.0000	-188.0369	52.2161	1.4855	-130.7610	323.0000	-2.47*
NA	60.6219	.0000	-4.6010	1.1954	-106.2817	.0000	3.8624	-45.2030	311.0000	-6.88
K	212.1766	.0000	-31.6318	.0000	.0000	3.4811	26.4426	210.4685	67.8000	3.10*
COEFF	.8783	.8433	-.3317	.9005	******	1.4504	.9058		*AVG:	.61
TSP	17321.	4838.	-2162.	68.	-929.	1741.	8253.	TOTAL PREDICTED TSP:		29129.
% TSP	59.5	16.6	-7.4	.2	-3.2	6.0	28.3			

SITE 5 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.2040	.0000	-.1621	.0890	-44.6017	183.6246	.0927	139.2465	120.0000	1.16
BR	.1290	.0000	-.0216	.0000	-1.8053	126.7010	.0618	125.0649	200.0000	1.60
ZN	1.4986	117.0556	-.7024	.3428	-106.1945	9.5485	.2039	21.7525	22.0000	1.01
NI	.5828	.0000	.0000	2.2262	-.1381	.1120	.2039	2.9868	5.0500	1.69*
FE	666.0485	2517.3252	-143.5849	.6678	-43.5398	57.9411	61.7820	3121.6400	2920.0000	1.07
MN	8.3256	78.0371	-.4187	.0347	-4.1416	.3672	61.7820	143.9804	51.2000	2.81*
CR	1.0407	.0000	-.2161	.0062	-2.7611	.0000	.1112	-1.8190	1.5900	-.87*
V	1.3737	.0000	-.4728	4.4523	-.1168	.0000	.2039	5.4403	5.4400	1.00
CA	87.4189	351.1669	-9.8606	3.7399	-127.4335	75.2861	3089.1014	3469.4191	3470.0000	1.00
S	4.1628	.2517	.0000	.0000	.0000	.0000	92.6730	97.0876	724.0000	7.46
SI	4162.8029	25.1733	.0000	.0000	-49.6990	.0000	710.4933	4848.7704	4790.0000	1.01
AL	1040.7007	12.5866	-135.0771	.2048	-98.7609	.0000	123.5641	943.2181	967.0000	1.03
CL	3.5384	.0000	-.0500	.0000	-244.2475	55.0874	1.5446	-184.1271	302.0000	-1.64*
NA	58.2792	.0000	-2.1612	1.1131	-138.0529	.0000	4.0158	-76.8060	210.0000	-2.73
K	203.9773	.0000	-14.8535	.0000	.0000	3.6725	27.4930	220.2844	92.0000	2.39*
COEFF	.8691	.8021	-.1397	.8184	******	1.5302	.8902		*AVG:	.38
TSP	16651.	6505.	-1016.	64.	-1207.	1836.	8581.	TOTAL PREDICTED TSP:		31414.
% TSP	53.0	20.7	-3.2	.2	-3.8	5.8	27.3			

SITE 6 AVG-COARSE

PREDICTED CONTRIBUTION TO THE ATMOSPHERE (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S
PB	.1662	.0000	-.2881	.0578	.2577	51.5236	.0095	51.7267	42.8000	1.21
BR	.1052	.0000	-.0384	.0000	.0104	35.5513	.0063	35.6348	85.1000	2.39
ZN	1.2213	-.0446	-1.2483	.2225	.6135	2.6792	.0208	2.8645	2.8800	1.01
NI	.4750	.0000	.0000	1.4448	.0008	.0314	.0208	1.9728	3.1200	1.58*
FE	542.8207	-13.8618	-264.0711	.4334	.2515	19.0637	6.3180	290.9545	284.0000	1.02
MN	6.7853	-.4297	-.7442	.0225	.0239	.1030	6.3180	12.0788	5.9000	2.05*
CR	.8482	.0000	-.3841	.0040	.0160	.0000	.0114	.4954	.4560	1.09*
V	1.1196	.0000	-.8402	2.8895	.0007	.0000	.0208	3.1904	3.1900	1.00
CA	71.2452	-1.9337	-17.5247	2.4272	.7362	21.1247	315.8981	391.9730	392.0000	1.00
S	3.3926	-.0014	.0000	.0000	.0000	.0000	9.4769	12.8682	290.0000	22.54
SI	3392.6291	-.1386	.0000	.0000	.2871	.0000	72.6566	3465.4342	3360.0000	1.03
AL	848.1573	-.0693	-240.0646	.1329	.5706	.0000	12.6359	621.3628	662.0000	1.07
CL	2.8837	.0000	-.0888	.0000	1.4111	15.4571	.1579	19.8211	61.6000	3.11*
NA	47.4968	.0000	-3.8410	.7224	.7976	.0000	.4107	45.5864	114.0000	2.50
K	166.2388	.0000	-26.4071	.0000	.0000	1.0305	2.8115	143.6787	25.2000	5.70*
COEFF	1.0097	-.0488	-.3626	.9058	.2130	1.2038	.8059		*AVG:	2.70
TSP	13571.	-36.	-1805.	41.	7.	515.	877.	TOTAL PREDICTED TSP:		13171.
% TSP	103.0	-.3	-13.7	.3	.1	3.9	6.7			

AVERAGE FIT FOR NIAGARA FRONTIER STUDY 6 SAMPLES (NG/M3)

ELEMENT	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING	PREDICTED	OBSERVED	L/S	MISSING
PB	.2140	.0000	-.3269	.0827	-20.5947	159.2643	.0580	138.6974	117.8000	1.18	
BR	.1354	.0000	-.0436	.0000	-.8336	109.8924	.0387	109.1892	174.5167	1.60	
ZN	1.5722	52.7896	-1.4167	.3186	-49.0351	8.2817	.1276	12.6380	12.7433	1.01	
NI	.6114	.0000	.0000	2.0686	-.0637	.0972	.1276	2.8411	4.5567	1.60*	
FE	698.7725	1135.2606	-299.6826	.6206	-20.1044	58.9278	38.6652	1612.4598	1539.0000	1.05	
MN	8.7347	35.1931	-.8446	.0323	-1.9124	.3185	38.6652	80.1868	33.2167	2.41*	
CR	1.0918	.0000	-.4359	.0058	-1.2749	.0000	.0696	-.5436	1.6293	-3.00*	
V	1.4412	.0000	-.9535	4.1373	-.0539	.0000	.1276	4.6986	4.6983	1.00	
CA	91.7139	158.3689	-19.8880	3.4753	-58.8421	65.2984	1933.2588	2173.3852	2173.6667	1.00	
S	4.3673	.1135	.0000	.0000	.0000	.0000	57.9978	62.4786	600.3333	9.61	
SI	4367.3283	11.3526	.0000	.0000	-22.9484	.0000	444.6495	4800.3821	4730.0000	1.01	
AL	1091.8321	5.6763	-272.4387	.1903	-45.6026	.0000	77.3304	856.9877	881.6667	1.03	
CL	3.7122	.0000	-.1008	.0000	-112.7807	47.7793	.9666	-60.4233	217.6000	-3.60*	
NA	61.1426	.0000	-4.3590	1.0343	-63.7456	.0000	2.5132	-3.4145	209.6667	*****	
K	213.9991	.0000	-29.9683	.0000	.0000	3.1853	17.2060	204.4221	60.6667	3.37*	

*AVG: .16

MAJOR ELEMENT	SI	FE	AL	V	ZN	PB	CA
EST. % WEIGHT	.250	.387	.133	.070	.088	.100	.360
TSP	17469.	2933.	-2043.	59.	-557.	1593.	5370.
% TOTAL TSP	70.4	11.8	-8.3	.2	-2.2	6.4	21.6

TOTAL PREDICTED TSP: 24819.

(SOURCE STRENGTH COEFFICIENT)*(MARKER ELEMENT CONCENTRATION)

SAMPLE	SOIL	STEEL	COAL	OIL	REFUSE	AUTO	LIMING
SITE 1 AVG-	4878.477	618.588	-282.032	4.292	-20.152	199.670	1630.413
SITE 2 AVG-	5035.510	1025.975	-357.836	4.758	-49.453	188.570	1935.079
SITE 3 AVG-	4404.416	791.348	-332.061	3.651	-37.269	158.143	1657.978
SITE 4 AVG-	4330.135	1872.189	-287.562	4.782	-81.755	174.054	2971.083
SITE 5 AVG-	4162.803	2517.325	-135.077	4.452	-106.195	183.625	3089.101
SITE 6 AVG-	3392.629	-13.862	-240.065	2.890	.614	51.524	315.898