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Consultants in Quantitative Process and Environmental Measurements

Final Report

PM10/PM2.5 Monitoring at Harrison Park, Berkeley, California

July, 2001 to January, 2003

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1. INTRODUCTION

This report presents the final summary report of the PM10, PM2.5, and hexavalent chromium monitoring that was conducted at Harrison Field from July, 2001 to January, 2003. This monitoring arose as part of the CEQA process for developing the fields at Harrison Park, in which it was specified to conduct air monitoring to determine if the air quality was adequate for the type and level of use that would occur. To meet this requirement, the Parks, Recreation, and Waterfront Department for the City of Berkeley contracted with Applied Measurement Science to conduct air monitoring for PM10 and PM2.5 for a period of one year (extended to 19 months due to instrument problems and lost data) to assess the impact of local industry and mobile sources on the air quality at Harrison Park. This study was a follow-up to a short-term (2-day) study in 1997 that assessed a wider range of toxics and criteria pollutants.

As an adjunct to the air monitoring, a risk evaluation would be performed using the collected data, to provide input to parents, young people, and other users of the park so that they could determine their level of participation based on their personal health history. This risk evaluation was performed by Dr. Charles E. Lambert of McDaniel-Lambert, Inc., and is included as an appendix to this report.

This report provides an overall summary and conclusions from the data that has already been posted and provides a health risk evaluation in relation to that data. Throughout the program, data had been posted at the AMS web site:

www.AirMeasurement.com/Berkeley.html.

Data files have been available for download at that site in addition to the City of Berkeley web site, at the Parks, Recreation and Waterfront Department page:

http://www.ci.berkeley.ca.us/parks/parkspages/HarrisonAirQuality.html.

In addition, the full data set is included in this report as a CD due to its large size.

The PM10 and PM2.5 monitoring were the primary objectives of this program. However, due to the discovery of hexavalent chromium contamination at the skate board park at the southeast corner of the park after the primary monitoring had commenced, additional monitoring for hexavalent chromium was conducted to determine if any concern should arise to inhalation from that pathway. The results of that monitoring effort is included in the appendix.

2. TECHNICAL APPROACH

2.1 Study Design

The study design consisted of the straightforward collection of PM10 and PM2.5 concentrations at a single point at Harrison Field for a one-year period. The method used was to be defensible for state and local regulatory agencies, and applicable for any risk evaluation purpose. Local meteorological data was also to be collected that would be representative of this site.

Based on these criteria, the MetOne, Inc. (Grants Pass, OR) Beta Attenuation Monitor (BAM) Model 1020 was selected as the monitor for PM10, and the ES-640 Laser Diode Monitor for PM2.5. Following equipment problems with the ES-640, it was replaced with a second BAM 1020 for PM2.5. Details relating to these instrumental issues will be discussed below.

For all parameters—PM10, PM2.5, and wind speed/wind direction—semi-real-time (on an hourly average basis) concentrations were collected. The hourly data would be used to determine diurnal patterns for pollutant concentrations and could be used to ascertain potential sources along with 24-hour and longer averages.

The hexavalent chromium testing is described in Appendix 2.

2.2 Site Location and Description

Harrison Park is located at the end of Harrison Street in West Berkeley, at the intersection of Harrison and 4th Streets. The park includes several play fields, the city homeless shelter, a skate park, and the park utility building that contains restrooms and storage, etc. Figure 1 shows the placement of the park in the general West Berkeley area.

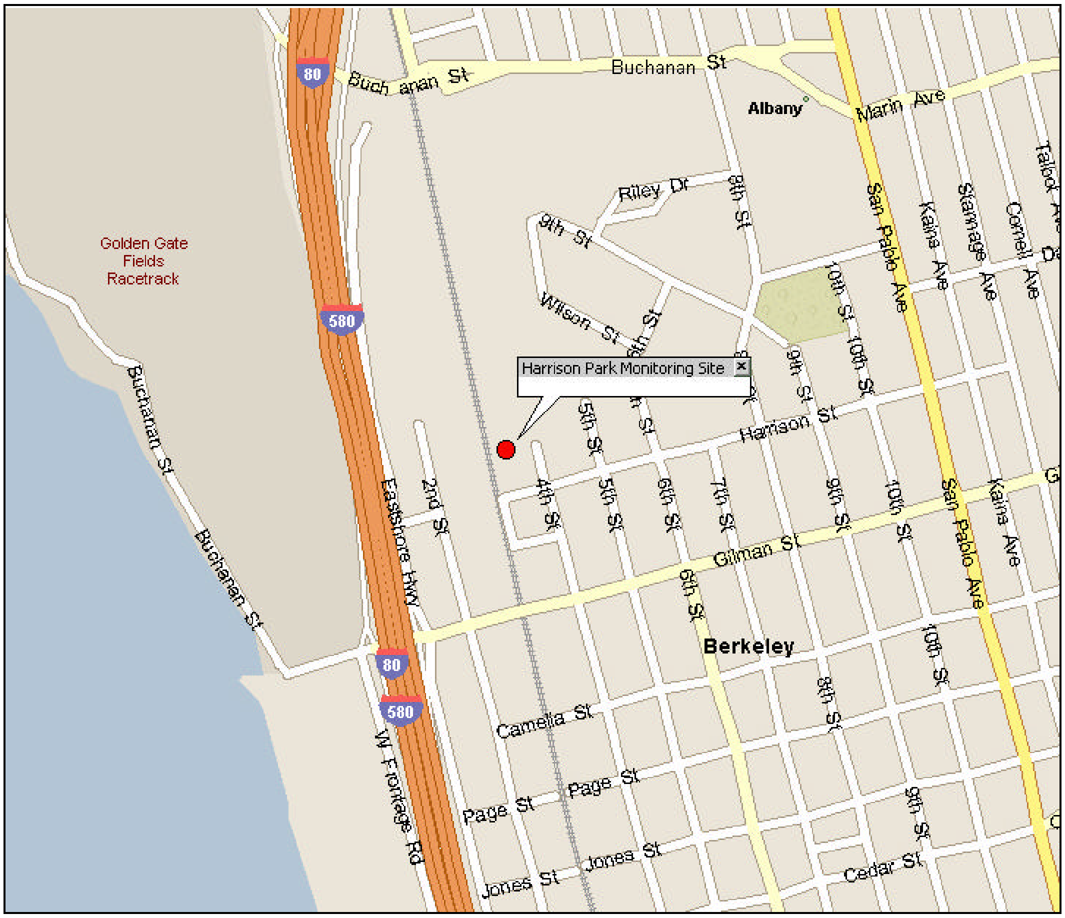


Figure 1. Site Location

Figure 2 shows a close-up of the area. This figure shows the proximity of the Transfer Station to the monitoring site. Two key areas of concern were the diesel trucks, which are parked along the eastern fence line of the Transfer Station, and the unloading areas at the transfer station itself. A lesser potential source was the driveway areas throughout the site that have been observed to have substantial dust generation. The rail tracks occupy the space between the western edge of the fields and the Transfer Station

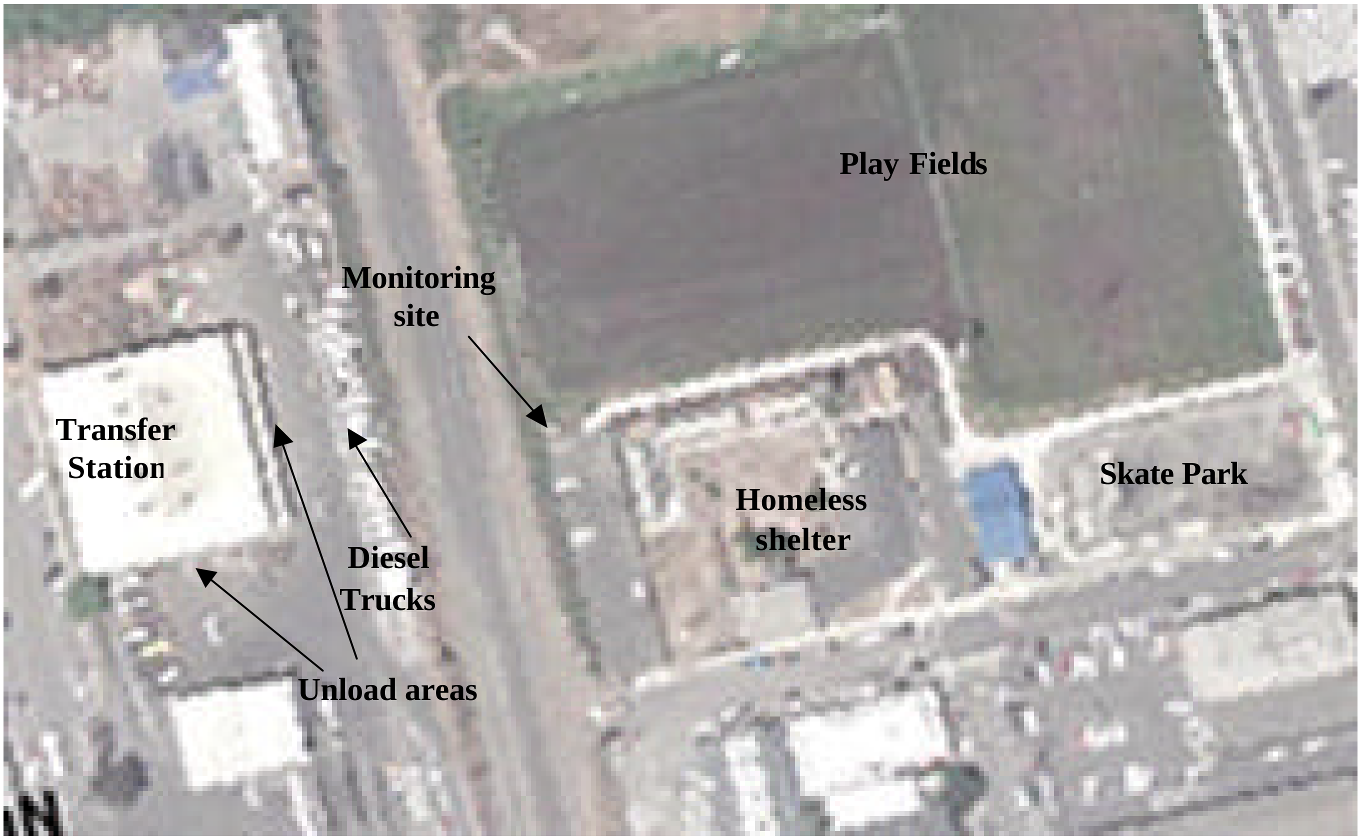


Figure 2. Close up of Harrison Park Area

Figure 3 shows an aerial photo of the larger area surrounding Harrison Park. The area to the south of the park is emphasized due to the dominant S to SW wind direction—other northerly sources are not only more distant but are not in line from the wind direction data. Inset into this photo is the wind rose for the study period showing the dominant wind origins.

The area to the south of the park included other potential, but more distant sources that might impact the air quality at the park. These sources include Gilman Avenue, Interstate Route 80, and Pacific Steel and Foundry. Some questions had arisen regarding the possible contributions from the Berkeley Recycling Center on Gilman and Second, but testing at that site proved a minimal impact to the surrounding area from their operations and provided valuable information regarding the general background concentrations in the area.

2.3 Monitor Siting

The specific monitoring location at the park was selected on the basis of several criteria. First, a worse case location--e.g., a location close to the western side of the park--was selected so that there would be a built-in conservatism in all data collected.

Standard EPA siting criteria were applied as much as possible. These criteria include guidance for where to place the monitoring site as well as probe height and configuration. However, the specific purpose of this study precluded adherence to standard siting criteria, such as placing the sampler away from nearby sources that might impact the data collection. Such a nearby source was the city Transfer Station, which is located approximately 30 yards from the monitoring shelter. In addition, the monitoring equipment was approximately 10 yards from an active railroad, with passing trains approximately once per hour.

Another key aspect in monitoring set up was the placement of the instrument inlets at a height of 15 feet above the ground. This height was in conformance with EPA siting criteria and was designed to capture a "neighborhood" area of representativeness. Any lower level, such as at breathing level, would tend to capture emissions generated locally such as drive-by dust or play-oriented dust, which would obscure the true purpose of the monitoring. Breathing zone height testing is generally reserved for personal sampling, such as in occupational settings and is not indicated for ambient air monitoring.

Figure 3. Harrison Park Neighborhood

Figures 4 to 9 show the surroundings at the monitor site. Figures 8 and 9 show the city Transfer Station with and without its full complement of haul trucks. In Figure 8, the east side of the Transfer Station is seen where other haul trucks and small trucks discharge their loads. During the dry summer months, distinct plumes of dust were seen emanating from this area as loads were discharged. These plumes were easily detected as large peaks in the hourly data. More detail on these plumes will be presented below.

Figure 4. South View from Monitoring Site

Figure 5. East View from Monitoring Site

Figure 6. North View from Monitoring Site.

Figure 7. Northwest View from Monitoring Site

Figure 8. West View from Monitoring Site—Transfer Station

Figure 9. Transfer Station Haul Trucks

2.4 Monitoring Equipment

Three configurations of equipment were used throughout the monitoring project. The first configuration consisted of the MetOne, Inc. BAM1020 (beta attenuation monitor) equipped with a PM10 virtual impactor inlet, and a MetOne, Inc. ES-640 Laser Dust Monitor (LDM) equipped with a cyclone PM2.5 inlet. The BAM was selected for PM10 since it is an EPA Federal Reference Method equivalent, which provides method defensibility. Since PM2.5 was considered a secondary parameter, cost savings could be achieved by using the less expensive ES-640, although its limitations were recognized as a non-equivalent method.

The second configuration was to replace the LDM with a second BAM for PM2.5. This change in configuration was made in January, 2002 due to continuing problems with the LDM instrument. Although the instrument had been newly refurbished and upgraded by the factory, it never provided the data quality that was needed for this program. This became evident soon after start of the program and was manifested by large incongruities between its data and the PM10 BAM data. After two return trips to the factory for examination and adjustment, it was determined that the LDM was unsatisfactory for this program, and the acquisition of a new BAM for PM2.5 was initiated. This culminated with installation of a new BAM 1020 and the start of PM2.5 monitoring on January 15, 2002. Due to the loss of the initial six months of PM2.5 data, it was decided to extend the end of the monitoring period from June 30, 2002 to January 15, 2003, thereby making a full year of monitoring data.

The third configuration was the change from a metered flow rate on the PM10 BAM 1020 to volumetric flow control. This occurred in September, 2002.

The use of the BAM technology was consistent with state of the art air monitoring technology. The BAM is an EPA- and California Air Resources Board-approved continuous PM10 monitor. Much of the EPA and CARB continuous monitoring for these parameters is currently conducted using the BAM.

The BAM is based on the attenuation of beta particles by particulate matter collected on a quartz fiber tape. The specific attenuation of the beta particle flux by the material collected on the tape is proportional to its mass.

The air flow into the monitor is controlled by either a metered mass flow or volumetrically via external temperature and atmospheric pressure sensors. For the metered flow, the flow is set by a calibrated valve and is intended to not vary from that setting. For volumetric flow control, continuous calculations are performed to ensure a 16.7 liters per minute flow rate that is specified for accurate size separation of the particulate matter through the PM10 virtual impactor inlet. The PM10 BAM operated under metered flow from inception to September, 2003, at which point it was converted to volumetric flow control.. The PM2.5 system was always under volumetric control, which is specified for that parameter due to its sensitivity to current conditions.

This mass detected by the beta attenuation is divided by the volume of air collected during the hour period (1 cubic meter) to yield the mass per actual volume. Subsequently, the hourly values are averaged into 24-hour periods, which then can be combined into longer term averages.

The BAMs were placed in a wooden shelter constructed specifically for the monitoring. The shelter was air conditioned during the summer months, and in the winter was warmed by the heat from the air pumps. Between the pump heat and the air conditioner, the shelter maintained a temperature within the instrument's specifications.

Figure 10 shows a photo of an BAMs in the instrument shelter

Figure 10. BAM PM10 and PM2.5 Monitoring Instruments

Figure 11 shows the entire instrument shelter with inlets and meteorological sensor. The photo shows the extra inlet and control box for an EBAM instrument during a comparison test. The two inlets on the left and right are the PM10 and PM2.5 inlets.

Figure 11. Instrument Shelter

The meteorological sensors for wind speed and wind direction were an integrated sonic anemometer and wind direction sensor from MetOne, Inc. Instead of using the usual mechanical means to measure these two parameters, a sonic anemometer uses sound waves and the effect of moving air on the speed to detect a wind speed and the direction it is coming from. Functionally, the sonic sensor set was identical to the mechanical version and provided equivalent data.

2.4.1 *Instrument Quality Assurance*

Throughout the monitoring program, the instruments were frequently checked for standard quality assurance indicators. There were three primary indicators of instrument performance: detector span checks, flow checks, and leak checks. In addition, standard instrument maintenance included tape changes and inlet cleaning.

For detector span checks that assess the accuracy of detector response, the instrument has a built-in function for hourly calibration checks. This function is automatically part of the measurement cycle.

The primary external quality assurance check is for flow rate. Although the flow controller has a high degree of accuracy (±1%), it can drift over time. Therefore, a flow check should be performed.

Two kinds of flow checks were performed. The first consisted of checking that the flow rate that is being registered by the instrument is the correct flow (16.7 liters per minute). This can be done without affecting the normal run of the instrument. This kind of check was performed once every approximately two weeks when data was downloaded.

The second type of calibration involves measuring the flow with an external calibration device and comparison to what is being shown in the instrument. This type of calibration was performed approximately every two months.

The specification for metered flow is that the flow rate would be±1% of the set point. This specification was met for all check until the summer of 2002, after nearly a year of operation. At approximately that same time frame, the PM2.5 flow controller started to show deviations. Several tests were conducted during June, 2002 to determine the comparison between the metered and volumetric instruments. One outcome of these tests was the decision to convert to volumetric flow control for the PM10 BAM. This was accomplished in September, 2002.

A final measure of instrument performance consisted of an external agency audit. This was conducted by the Bay Area Air Quality Management District audit group. On December 18, 2002, both instruments were audited, with both instruments showing performance within BAAQMD and EPA specifications. The report is included as Appendix 3.

2.4.2. *Instrument Maintenance*

Instrument maintenance consisted of periodic replacement of the filter tape and cleaning of the PM10 virtual impactor and the PM2.5 virtual impactor/cyclone combination. The tape change is mandated approximately every two months under normal operation. There were a few instances of the tape running out and a replacement not made until later. In addition, there were 2-3 instances of the tape breaking or coming loose from its base.

Inlet cleaning was conducted approximately every quarter in conformance with specifications.

3. RESULTS AND DISCUSSION

The 19 months of monitoring for PM10 and 12 months for PM2.5 produced a large amount of data. Table 1 contains an overall summary of the data, including major statistical indicators. In addition, the completeness of the hourly data of the program is shown, an indicator for total fraction of data capture.

This table shows that the completeness for the PM10 was 86%—11,891 hours out of 13,556 hours., and 78% for PM2.5—6,827 out of 8,329 hours. The completeness standard for EPA compliance monitoring is 75%, which was exceeded by both instruments.

Parameter	PM10 Avg./ Hour	PM10 Avg./ 24-hr	PM10 Avg./ Month	PM2.5 Avg./ Hour	PM2.5 Avg./ 24-hr	PM2.5Avg./ Month
Avg.	0.045	0.045	0.046	0.021	0.021	0.022
Max	0.481	0.119	0.067	0.125	0.090	0.040
Count	11891	481	19	6827	281	13
Completeness	86%	-	-	78%	-	-

PM10/2.5 Avg./Hr=Average of all hourly values.
PM10/2.5 Avg./24-hr=Average of all 24-hr averages
PM10/2.5 Avg./Month=Average of all monthly averages of 24-hr averages.
All concentration data in mg/m3.

Table 1. Overall Summary of Data

3.1 Monitoring Data Summaries

Due to the massive amounts of hourly data that was collected during the study period (nearly 12,000 hourly PM10 values, and nearly 7,000 hourly PM2.5 values) little presentation will be made of that data. In addition, specific events that are documented by the hourly data are of little consequence in terms of the long-term health impact to persons in the area.

The focus will be on average concentrations, primarily 24-hour averages, along with monthly and annual concentrations. The hourly data was mostly used in elucidating any diurnal trends in the data, and the longer term averages were used in the health evaluation and comparison to state and federal air quality standards.

3.1.1 State and Federal Air Quality Standards

The basis for judging the health impact of the data collected are the State of California and the Federal ambient air quality standards. These standards are based on health impacts for large populations and are the basis for routine air quality monitoring.

The two standards that were used to assess the data were the California 24-hour PM10 standard of 50 ug/m3, and the Federal 24-hour PM2.5 standard of 65 ug/m3.

It should be noted that the PM2.5 standards have not been formally promulgated by the State of California. The foot note to this table—taken directly from the California EPA website—cites expected action to promulgate a revised standard. However, during the program, no standard existed other than the Federal level, which was 65 ug/m3. Therefore, the PM2.5 data was compared against this standard in the data files.

Table 2 shows the Federal and State ambient air quality standards.

Ambient Air Quality Standards						
Pollutant	Averaging Time	California Standards [1]		Federal Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Respirable Particulate Matter (PM10)	24 Hour	50 $\mu g/m^3$	Gravimetric or Beta Attenuation*	150 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^{3*}$		50 $\mu g/m^3$		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		65 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 $\mu g/m^{3*}$	Gravimetric or Beta Attenuation*	15 $\mu g/m^3$		

* On June 20, 2002, the Air Resources Board approved staff's recommendation to revise the PM10 annual average standard to 20 $\mu g/m^3$ and to establish an annual average standard for PM2.5 of 12 $\mu g/m^3$. These standards will take effect upon final approval by the Office of Administrative Law, which is expected in February 2003. Information regarding these revisions can be found at http://www.arb.ca.gov/research/aaqs/std-rs/std-rs.htm.

Table 2. Ambient Air Quality Standards

These standards are usually used to assess data that are collected over long-term periods—a determination of compliance to the standard generally requires three years of monitoring. In addition, it should be noted that these standards apply to monitor sites that comply with the usual EPA siting guidance, as noted above. Therefore, while these standards will be used as a comparison, a strict application is not indicated based on the intent of the standards. More information relating to the interpretation of the standard in regards to health standards is found in the Health Evaluation found in Appendix 4.

The monthly exceedances of the standards were included in each month’s data report. A summary of these data are included in Table 3. This table shows that a total of 35 PM10 exceedances occurred in the six months of 2001 and 135 for the 12 months of 2002, which is more than double the rate of 2001.

Figure 12 shows the bar chart of the monthly averages and the PM10 exceedances for each month. The data also shows an increase in overall concentrations over time. It is not clear why this occurred.

Month	PM10 Ave	PM10 Exc.	PM2.5 Avg.	PM2.5 Exc.
July-01	0.044	10	--	--
August-01	0.032	3	--	--
September-01	0.039	6	--	--
October-01	0.046	10	--	--
November-01	0.038	5	--	--
December-01	0.026	1	--	--
January-02	0.036	5	0.017	0
February-02	0.043	12	0.018	0
March-02	0.038	2	0.010	0
April-02	0.067	15	0.018	0
May-02	0.054	11	0.015	0
June-02	0.048	11	0.020	0
July-02	0.039	4	0.020	0
August-02	0.046	7	0.021	0
September-02	0.046	9	0.025	0
October-02	0.065	23	0.022	0
November-02	0.065	14	0.028	2
December-02	0.065	11	0.040	9
January-03	0.042	5	0.025	1
Total Exc: 2001	-	70	-	-
Total Exc: 2002	-	135	-	11

Table 3. Monthly Summary of Exceedances

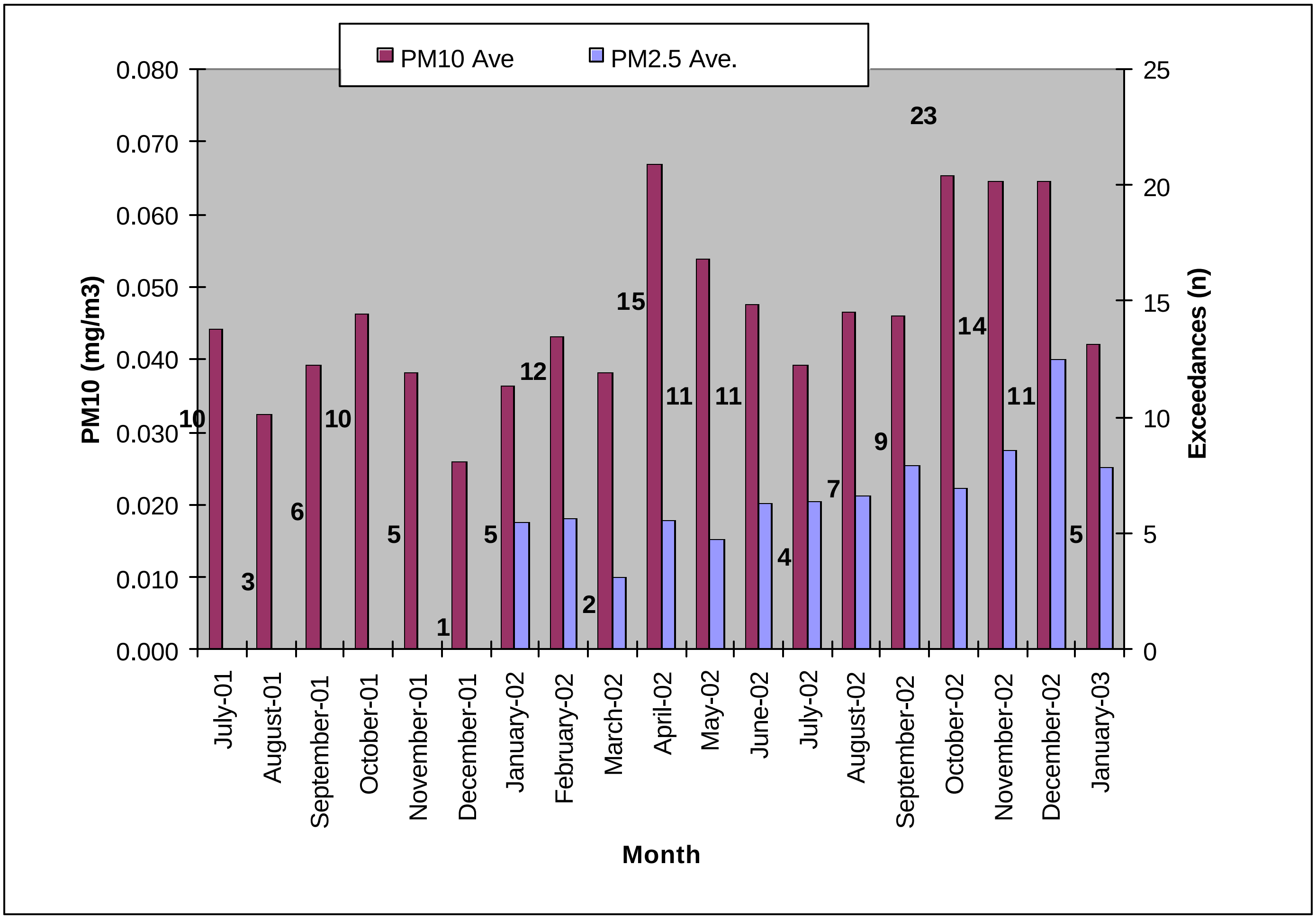


Figure 12. Plot of monthly averages and exceedances

3.1.1 Monthly Data Summaries

Table 4 lists the monthly averages for the study period. The data in this table also includes the exceedance of the24-hour California ambient air quality standard. As noted above, the 2001 data does not include the PM2.5 data due to instrument problems.

Table 4. Monthly Summary Statistics

Monthly Statistics		
Concentration Values are in mg/m3 **Ave=Average of daily 24-hr averages; Max= Maximum daily average; Min=Minimum daily average: Exceedances=Number of exceedances during month of California standard.**		
Parameter	**PM10**	**PM2.5**
July-01		
Ave	0.044	NA
Max	0.086	
Min	0.017	
Exceedances	10	
August-01		
Ave	0.032	NA
Max	0.061	
Min	0.011	
Exceedances	3	
September-01		
Ave	0.039	NA
Max	0.063	
Min	0.017	
Exceedances	6	
October-01		
Ave	0.046	NA
Max	0.071	
Min	0.025	
Exceedances	10	
November-01		
Ave	0.038	NA
Max	0.077	
Min	0.016	
Exceedances	5	
December-01		
Ave	0.026	NA
Max	0.051	
Min	0.015	
Exceedances	1	
January-02		
Ave	0.036	0.017
Max	0.069	0.035
Min	0.017	0.006
Exceedances	5	0
February-02		
Ave	0.043	0.018

Monthly Statistics		
Concentration Values are in mg/m3 **Ave=Average of daily 24-hr averages; Max= Maximum daily average; Min=Minimum daily average: Exceedances=Number of exceedances during month of California standard.**		
Parameter	**PM10**	**PM2.5**
Max	0.072	0.035
Min	0.020	0.004
Exceedances	12	0
March-02		
Ave	0.038	0.011
Max	0.087	0.023
Min	0.023	0.005
Exceedances	2	0
April-02		
Ave	0.067	0.011
Max	0.077	0.021
Min	0.033	0.002
Exceedances	15	0
May-02		
Ave	0.054	0.016
Max	0.081	0.023
Min	0.024	0.009
Exceedances	11	0
June-02		
Ave	0.048	0.020
Max	0.115	0.030
Min	0.023	0.006
Exceedances	11	0
July-02		
Ave	0.039	0.020
Max	0.063	0.027
Min	0.011	0.012
Exceedances	4	0
August-02		
Ave	0.048	0.025
Max	0.073	0.038
Min	0.016	0.005
Exceedances	7	0
September-02		
Ave	0.046	0.025
Max	0.081	0.033
Min	0.020	0.017
Exceedances	9	0
October-02		
Ave	0.065	0.022

Monthly Statistics		
Concentration Values are in mg/m3 **Ave=Average of daily 24-hr averages; Max= Maximum daily average; Min=Minimum daily average: Exceedances=Number of exceedances during month of California standard.**		
Parameter	**PM10**	**PM2.5**
Max	0.098	0.043
Min	0.039	0.013
Exceedances	23	0
November-02		
Ave	0.065	0.028
Max	0.110	0.071
Min	0.030	0.011
Exceedances	14	2
December-02		
Ave	0.065	0.040
Max	0.119	0.090
Min	0.022	0.006
Exceedances	11	9
January-03		
Ave	0.042	0.025
Max	0.070	0.050
Min	0.025	0.010
Exceedances	6	1

3.1.3. Background Data

The collection of background data was not an explicit part of this program, but would be useful in understanding the context of the data for the area. A recent monitoring program over several months at the nearby Berkeley Recycling Center (located at the corner of Gilman and 2nd Avenue) can assist in understanding background concentrations. The report for this program is included in the appendix for reference. The primary challenge to a realistic background concentration is in replicating a similar mix of nearby sources, particularly the mobile sources along I-80. The Recycling Center monitoring met this goal well.

The Recycling Center program consisted of two EBAM (portable versions of the BAM instrument) monitors placed at upwind and downwind locations on the lot. The upwind site was near the corner of Gilman Avenue and 2nd Avenue. This site was well-situated to capture the heavy traffic along Gilman and emissions from Pacific Refining, from which it was kitty-corner.

The downwind site was located at the north end of the recycling center lot.

Data was collected intermittently over the period of July to December, 2002. The overall results showed that the recycling center operations contributed approximately 5 ug/m3 to the background concentration.

Table 5 contains the overall summary of the recycling center background data.

Background	Recycling Center	Harrison Park
39 ug/m3	43.7 ug/m3	45 ug/m3

Table 5. Summary from Recycling Center Study

The value of 39 ug/m3 can be considered an upper bound to the background level at Harrison Park. During low activity periods, the hourly concentration may be lower, but on a 24-hour average basis, this value is representative of concentrations at that site.

For Harrison Park it would be considered an upper bound for the background because the Park is a approximately one hundred yards from the recycling center and more from the other sources, and therefore the effect of the BRC and other sources would be lessened somewhat by the distance from the recycling center and other sources through normal dispersion processes.

The contributors to the background to Harrison Park would include the BRC as well as the I-80 corridor and the industrial operations in West Berkeley that are upwind of the site. Other area sources would include the train corridor, much of which is disturbed soil prone to wind erosion. This relatively high background level shows the impact of the highways and industrial sources in the area, which will be further considered in the section comparing Harrison Park data to other monitoring sites in the Bay Area.

3.2 Meteorological Data

Wind speed and wind direction data were collected on an hourly basis. As with the other data, there were some gaps in the wind data, but overall the data is complete enough to provide an accurate picture of the wind direction

3.2.1 Wind Rose

Figure 13 shows the wind rose for the entire study period, taken from the hourly wind speed and wind direction readings. A wind rose shows the direction that the wind is coming from. The size of each element indicates the fraction that is from that direction, and the color indicates the wind speed. This diagram shows that the majority of the wind data comes from the south to south-west-west directions at fairly consistent velocities.

Figure 13A shows a different representation of part of the wind rose data—the frequency of the various wind directions. It shows that the dominant directions are from 161 to 249 degrees, for a total of 49 percent of the time.

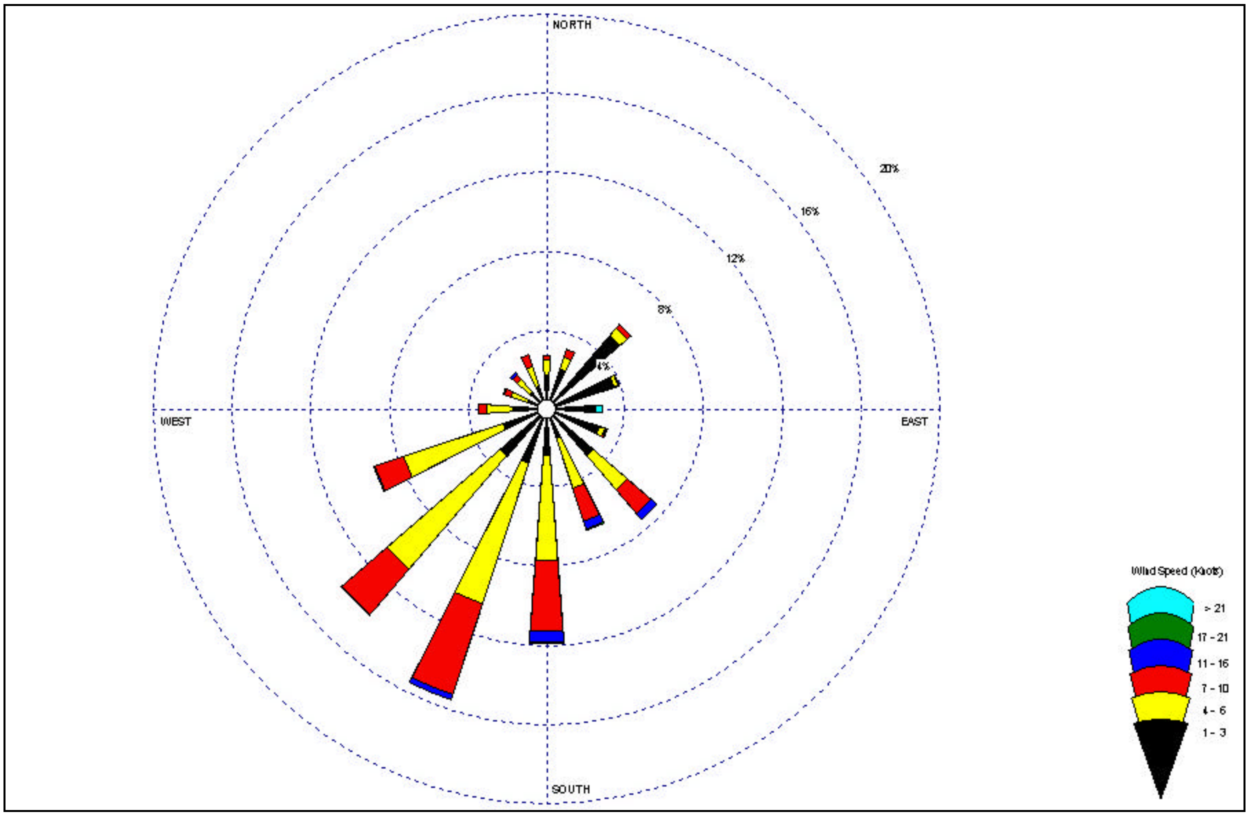


Figure 13. Wind Rose for Harrison Park

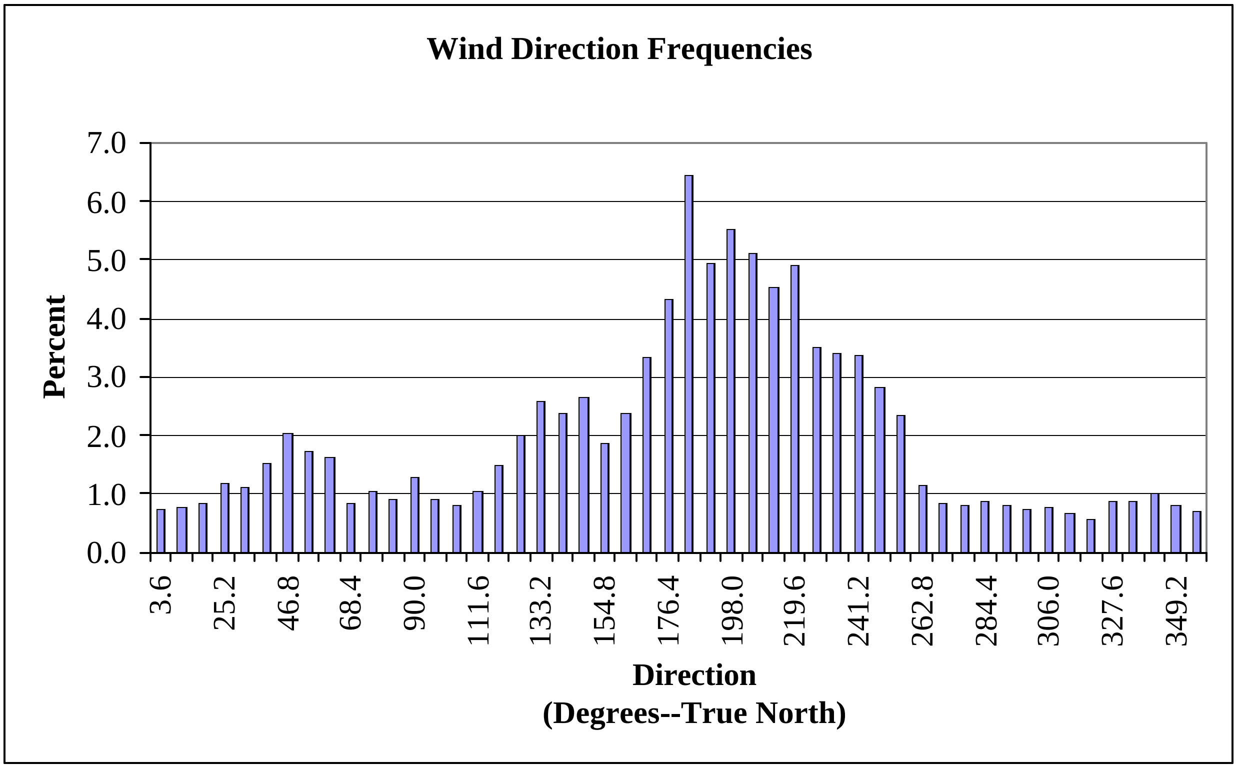


Figure 13A. Wind Direction Frequencies

The opposite of a wind rose is a wind vector plot, which shows the direction the wind is going towards.   It takes the same wind direction and speed frequency data and shows where the wind would be blowing towards.

Figure 14 shows an overlay plot of the wind vector for the study period, with the origin at the Transfer Station, assuming it to be the major source of emissions in the area. This plot shows that the range of wind directions includes a substantial portion towards the fields at Harrison, and impacted directly the monitor site for a large fraction of the time. This type plot is simplistic in terms of the direction and width of a plume that might be emitted from the Transfer Station, but is illustrative of the general trends that are possible.

For example, non-point or area sources such as occurs from discharging trucks or wind-blown dust are much less well-defined than point sources and their plumes would tend to be wide and more dispersed from the start. Thus the impacted area from many plumes from the Transfer Station would encompass a broader area not fully represented as the simple wind rose diagram would suggest.

The wind rose and wind vector plots also apply to sources further upwind such as the other industrial and mobile sources previously mentioned. It is the strength of that source that determines its impact to a receptor, assuming a consistent wind direction and speed. Therefore, as will be seen when more of the hourly data is examined, the proximity of the transfer station along with the wind vector suggests it to be a major source of the measured concentrations.

Figure 14. Wind Vector Overlay

Figure 15 contains a diurnal plot of the wind direction and speed over the course of a day. This data is the average over the 19 months of data. It shows the changes that occur during the transition from early morning hours to the predominant daytime direction, moving more westerly. The wind speed shows a typical diurnal pattern of lower speeds during the night than the day.

The primary conclusion to be gained from this data is that the wind speed and direction are fairly consistent during the daytime hours when the major nearby sources are in operation.

The diurnal patterns of the wind speed and direction are represented in Figure 15, which shows that the wind displays a typical daytime/nighttime pattern of calmer winds at night and higher winds during the day. The wind direction shifts in this pattern also, from 160 (South-South-East) during the night to approximately 225 degrees (South-South-West) during the day, a shift of approximately 60 degrees. However, these changes do not affect the impact from the generally south direction where the majority of the stationary and industrial sources are.

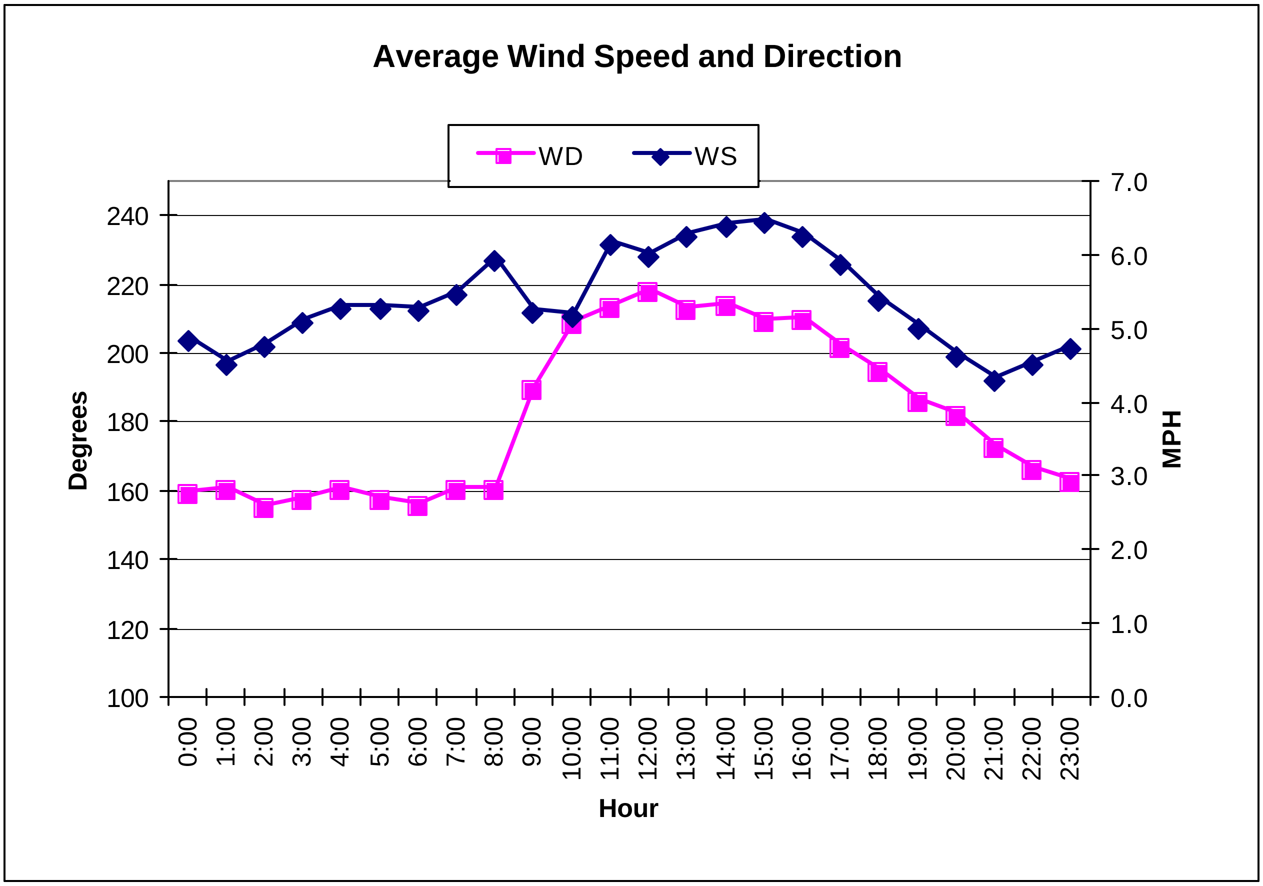


Figure 15. Diurnal Pattern for Wind Speed and Direction

3.3 Monitoring Data Details

The detail of daily monitoring data is overwhelming. A total of 481 days of monitoring was conducted, so a detailed examination of any number of days would encumber the overall conclusions to be gained. However, it is instructive to examine a “typical” day and a “:typical” month to show the peaks and valleys that occurred.

3.3.1 Example Daily Pattern

Figure 16 shows three days of particulate matter data in April, 2002—Monday to Wednesday, April 1-3, 2002. There is no significance to the days other than they seem to represent a typical work day period.

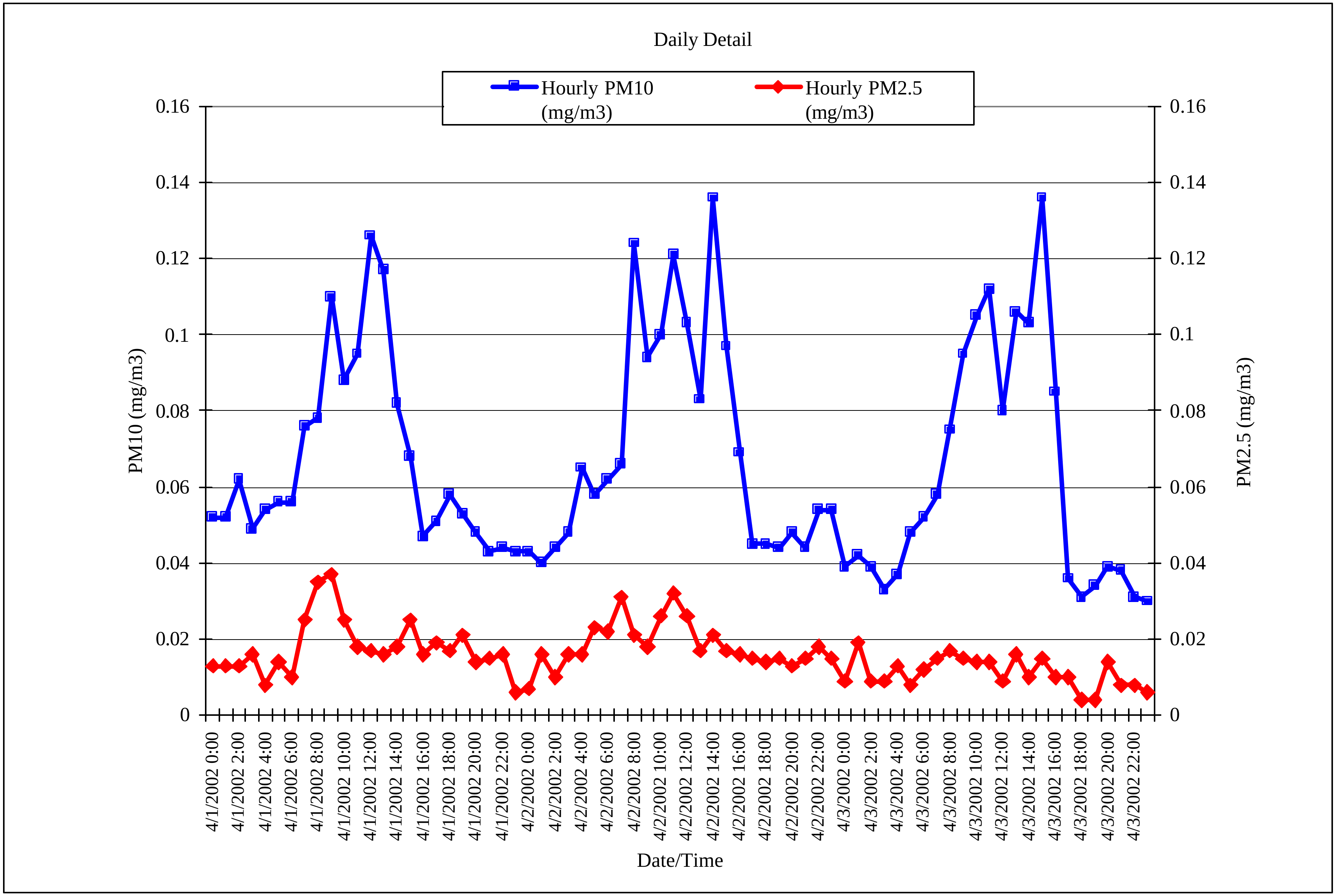


Figure 16. Daily PM Data Detail

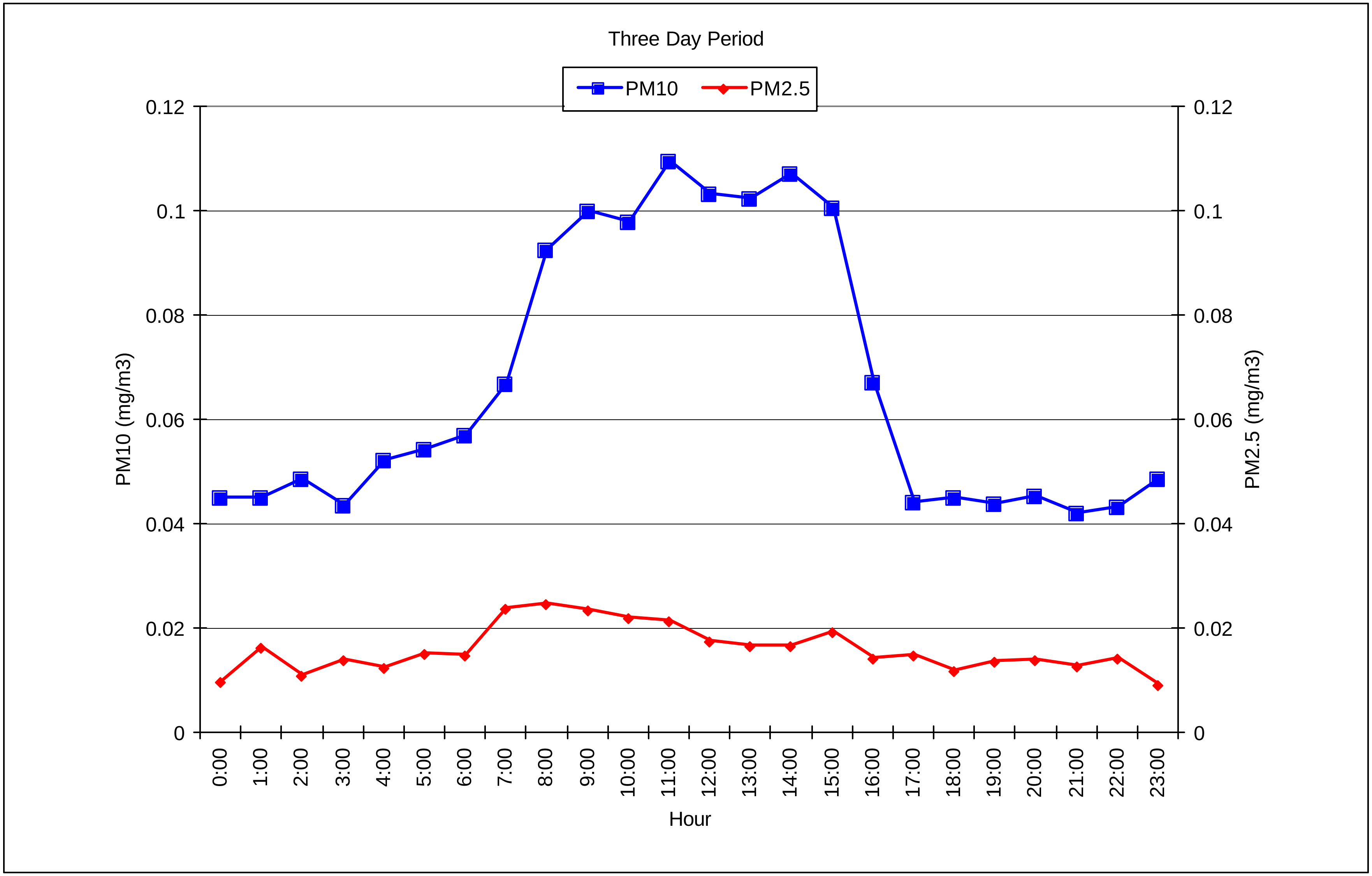


Figure 17. Three Day Period Diurnal Pattern

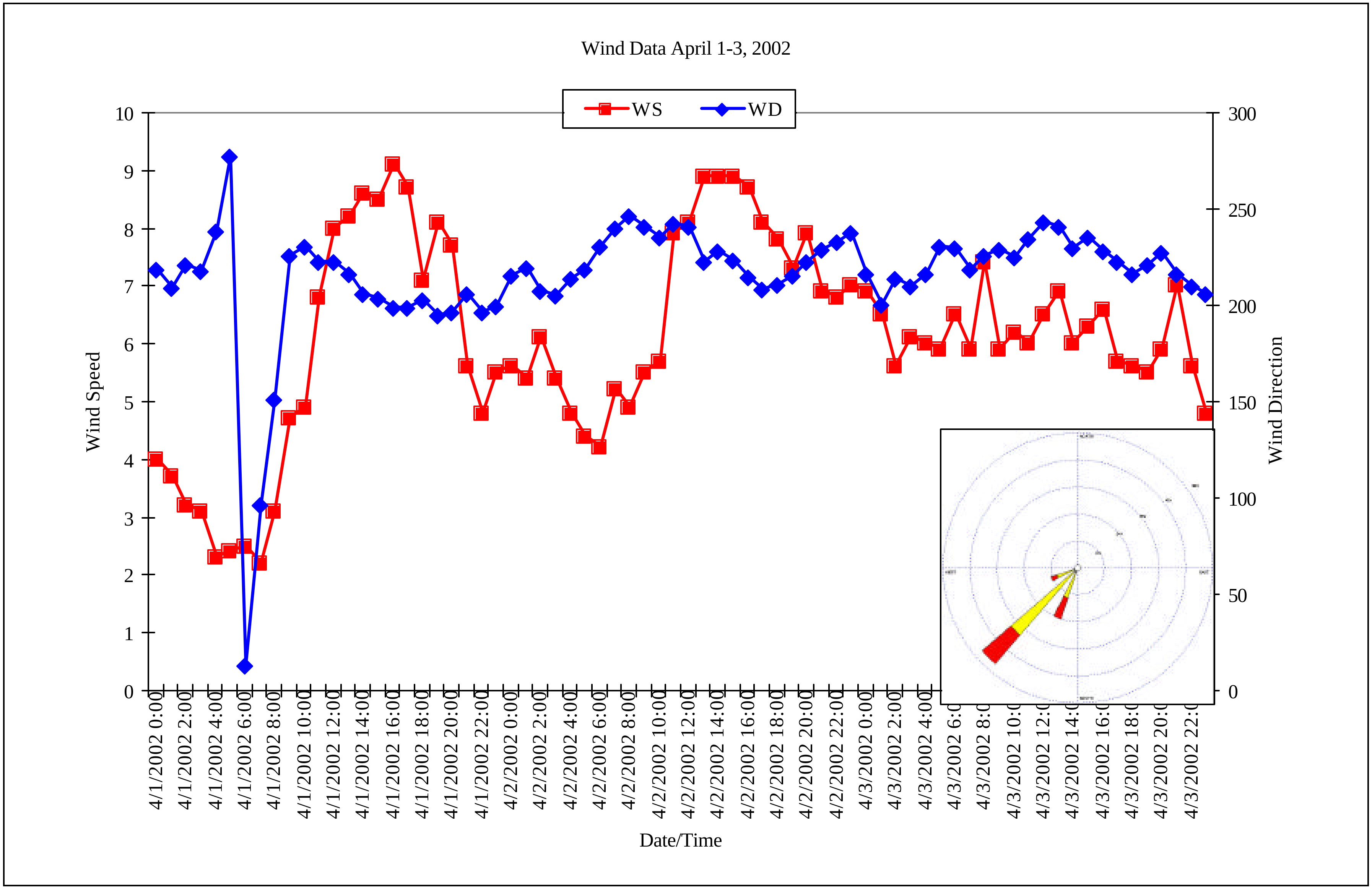


Figure 18 Daily Wind Data Detail

Figure 17 shows the hourly data averaged to show the diurnal pattern for those three days., and Figure 18 shows the daily wind data for this same time period.

These plots are instructive for several reasons. First, the curve in Figure 16 shows the daily pattern of high values that occurs during the daytime hours. The concentrations can reach up to almost 140 ug/m3 for short periods of time. It shows that these high values do not correspond to the morning or evening rush hours and instead most frequently appear just during the hours from 7 AM to 3 PM. Figure 17 shows the average of these three days, indicating the regularity of this pattern.

The PM10 data show the greatest dynamic range—from the normal background levels around 40 ug/m3 to the peaks around 120 to 140 ug/m3. The PM2.5 values do not display this same type of dramatic peaks and valleys. There were a few peaks that did occur for a few hours at a time, but they were only a factor of 1.5 times the general background level, not the factor of 3 times or more that is seen in the PM10 data.

The data summarized in Figure 18 shows that the wind speed and direction did not vary significantly over this same time period. There was one several hour period on April 1 in which the wind direction did change dramatically, but an examination of the PM10 data for that time period did not indicate any change in concentration, suggesting again that the overall background level stays fairly constant around 40 ug/m3.

An examination of many of monitored days shows the same pattern. It should be noted that these three days are work days when the Transfer Station was in operation. As will be shown in Section 3.3.3.3, the day of week profile demonstrates that Sundays have a substantially different profile of concentrations over the hours of the day.

3.3.2 Example Monthly Pattern

Figure 19 shows the detailed plot of the month of April, 2002. As with the daily detail, the peaks and valleys in concentration can be seen, with a few even higher peaks in PM10 concentration from time to time than was seen in the first three days examined above. High concentration peaks above 100 ug/m3 were not uncommon.

The data from a monthly data compilation were also compiled into bar charts showing the concentrations of daily PM10 and PM2.5 concentrations relative to the California and Federal air quality standards.

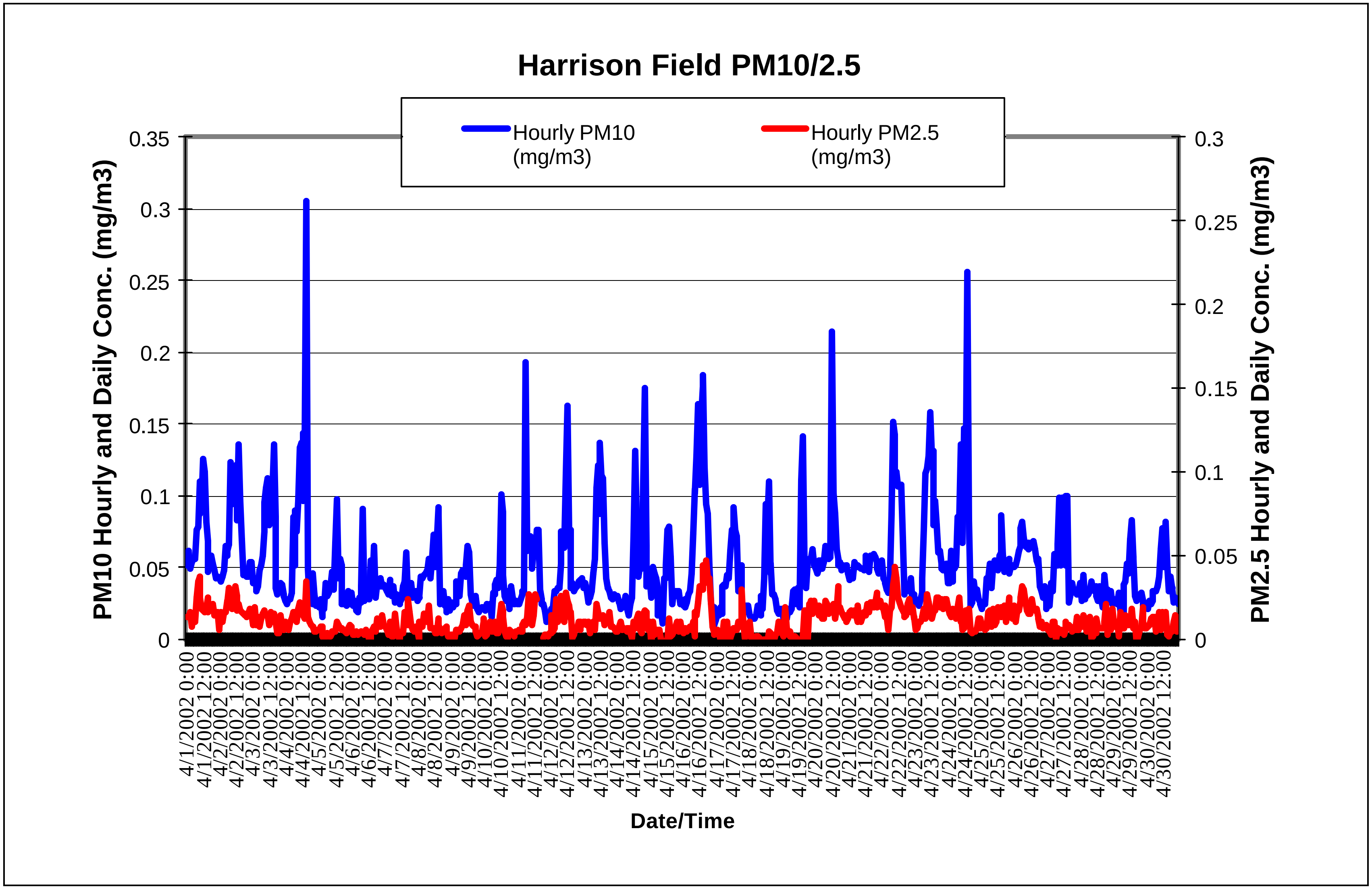


Figure 19. Month of April, 2002 Data

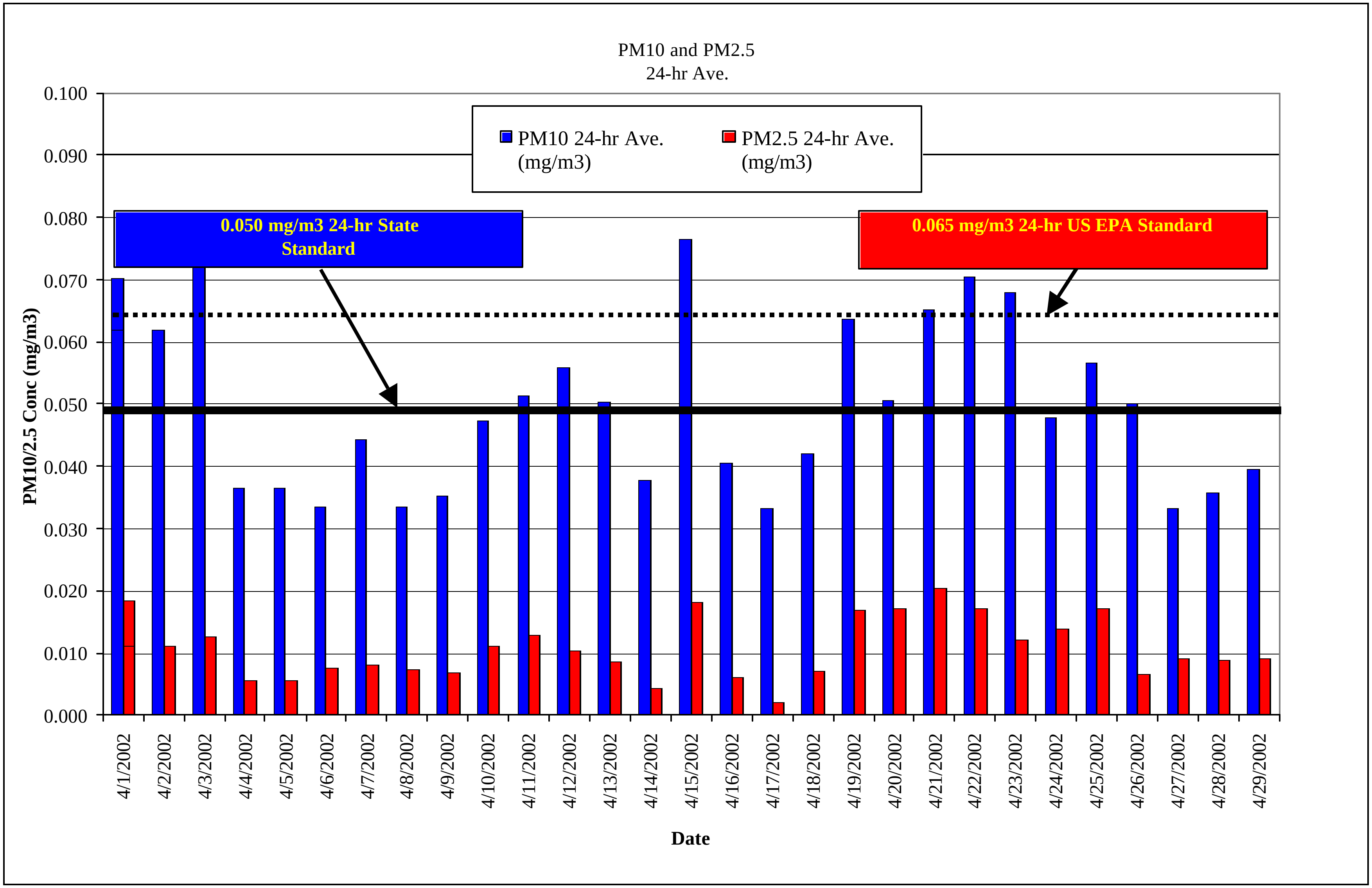


Figure 20. Example Monthly Comparison Plot—April, 2002

3.3.3 PM10 Diurnal Patterns

3.3.3.1 Average Daily Pattern

The daily pattern of PM10 concentrations shows a similar pattern as shown for the short three day period above. Figure 21 shows the average over the 24 hours for the entire study period. This includes all days of the week. The increase in concentration for the period from approximately 8 AM to 5 PM is evident. The larger errors bars (which are the 95% confidence limit to the average concentrations) for the daytime hours reflects the much greater variation in concentration due to the high and low concentrations registered on typical days.

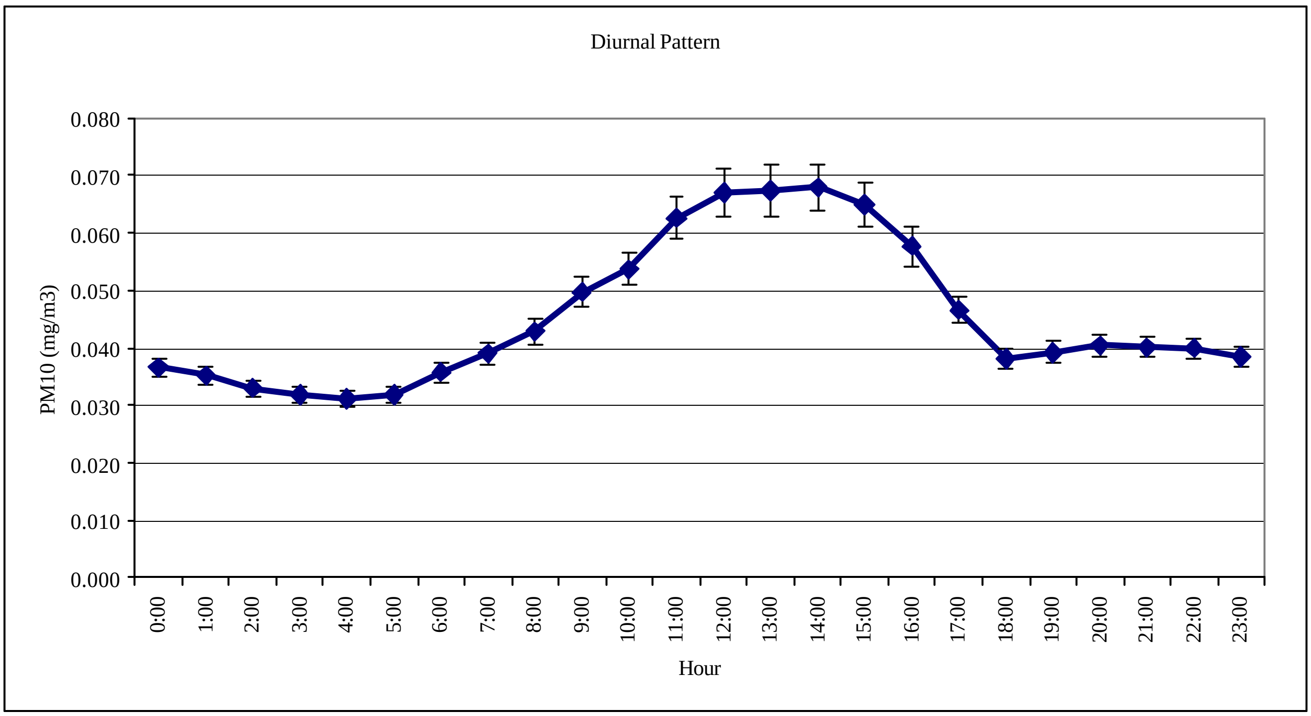


Figure 21. Diurnal Pattern for PM10

A comparison of this plot to the data from the Berkeley Recycling Center (BRC) in Figure 22 shows that a local source appears to cause the increase during the day, as there is no similar "hump" during the daytime hours. The heading BRC-UP indicates the upwind location at the corner of Gilman and 2nd, and the heading BRC-DN indicates the downwind location at the north end of the lot.

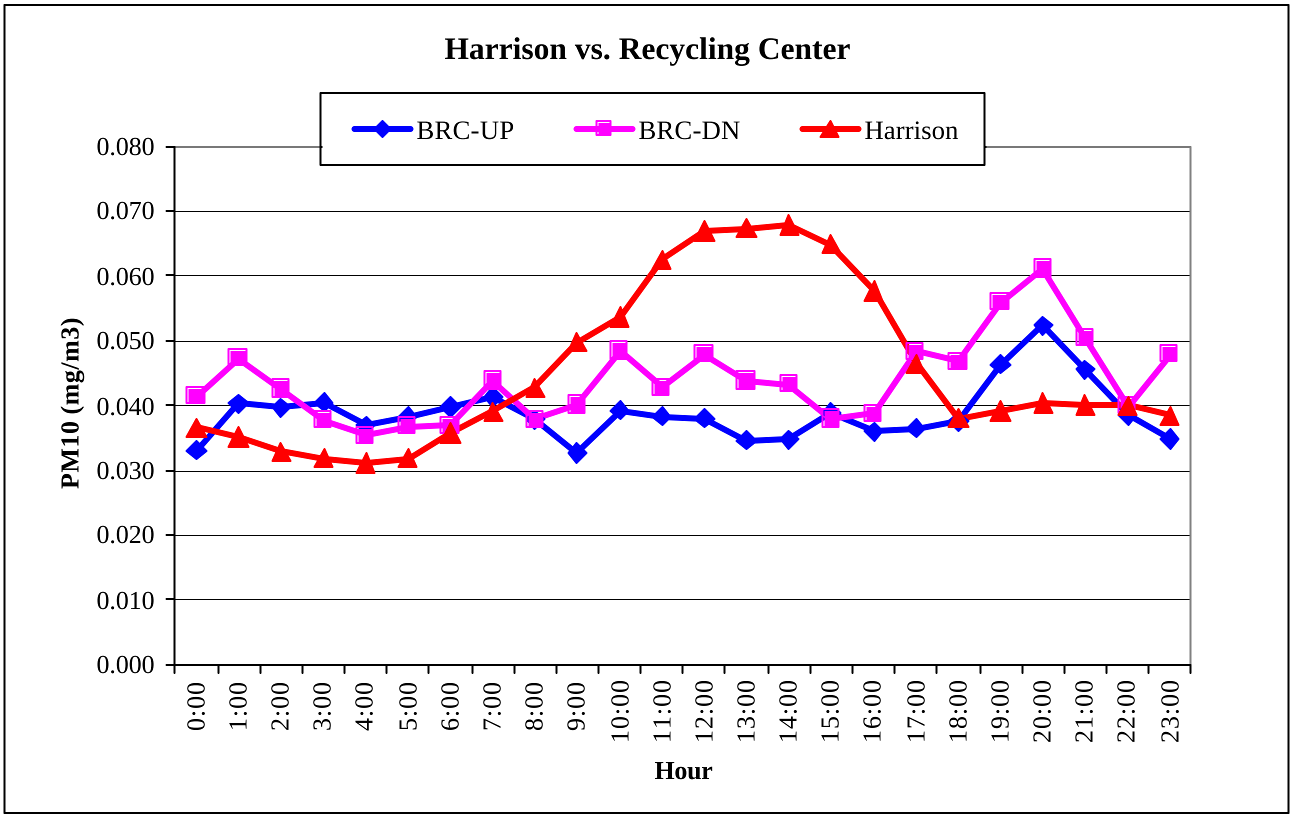


Figure 22. Comparison of Harrison vs. Berkeley Recycling Center

The non-work hours for the BRC show a higher concentration than at Harrison (significant because of the lack of influence by the Transfer Station), mostly likely due to their proximity to Gilman and I-80. This difference is on the order of 6 ug/m3. In addition, the BRC data show the effect of a periodic nearby emission at around 8 PM. That emission does not appear to affect Harrison Park, as there is no corresponding sharp concentration spike at that time, just a slight increase that is too slight to be conclusively linked to the BRC event.

3.3.3.2 Day of Week Pattern

The day of the week pattern shows that Sunday has the lowest concentration—37 ug/m3, which is similar to the background level. The Sunday concentration level is significant in that there is no activity at the Transfer Station on that day and traffic on I-80 and Gilman is lower, thus this represents the generally lowest level that might be expected to be found consistently at the Park.

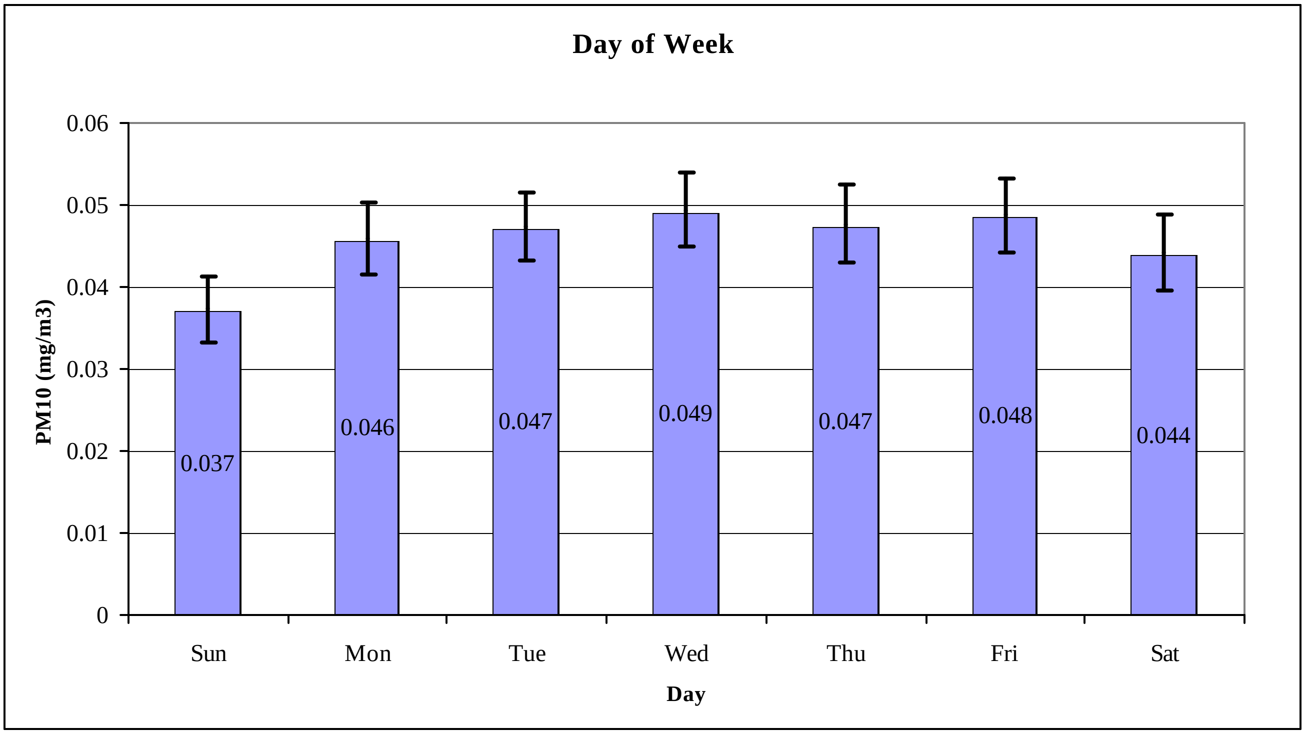


Figure 23. Day of Week Concentrations

The day of week dependence is further elucidated by examining the diurnal pattern of Saturday vs. Sunday. Figure 24 shows how the concentrations of PM10 on Sunday only slight increase during the day, while the Saturday concentrations display the same large hump during work hours.

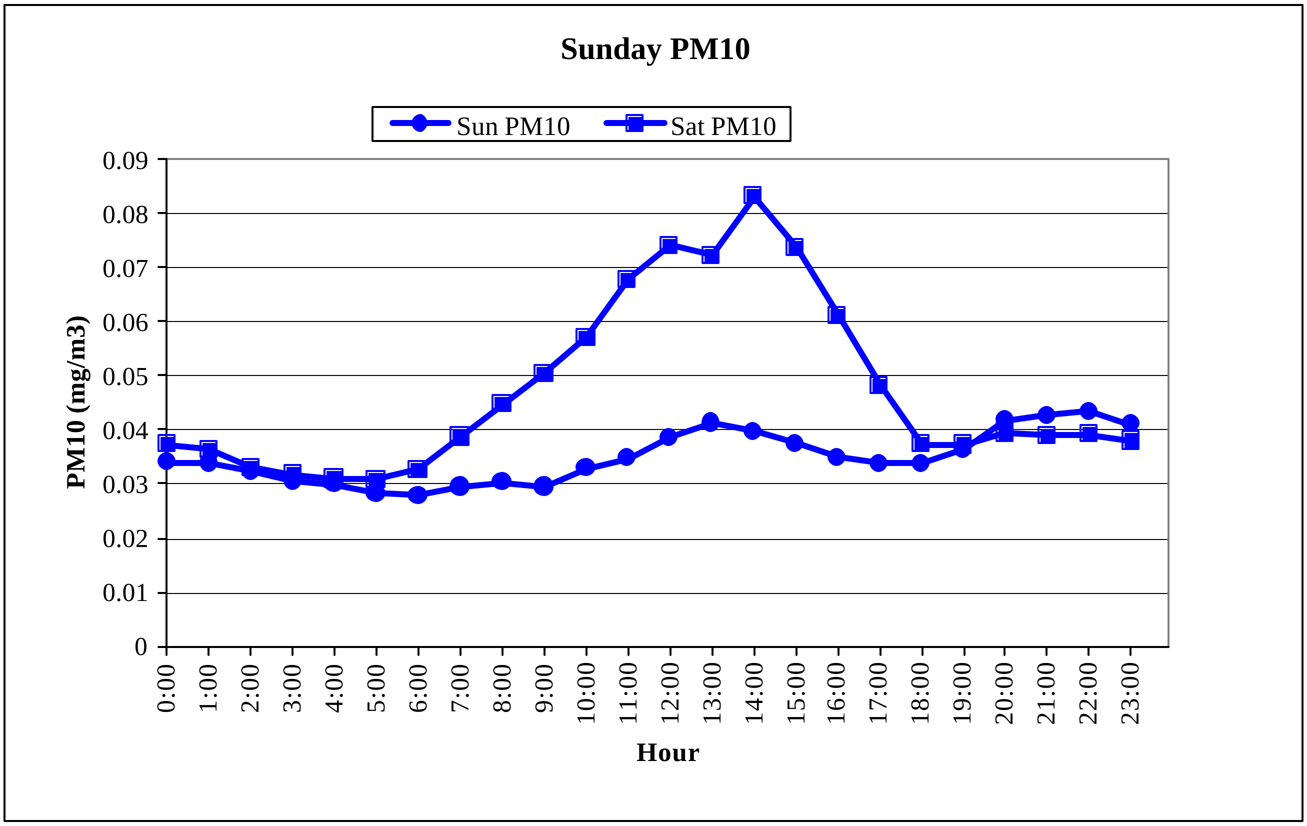


Figure 24. Saturday and Sunday Diurnal Patterns

3.3.4 PM2.5 Diurnal Patterns

The PM2.5 concentration data are useful to compare against what was seen for PM10, as the processes for formation of each size fraction are different. A simplistic view is that PM10 is generally formed by physical processes such as abrasion and erosion, while PM2.5 is formed by chemical processes such as atmospheric chemical reactions and combustion. Therefore, the two fractions may not correlate completely at all times. While PM2.5 is a subset of PM10, the "coarse" fraction (between PM2.5 and PM10) may dominate and any distinction between the two subsets will likely be blurred or lost.

For Harrison Park, the PM2.5 processes that may be of interest are exhaust from the nearby highway sources and the nearly truck sources at the Transfer Station. The examination of daily and weekly patterns assists in evaluation of these possible impacts.

3.3.4.1 Average Daily Pattern

Figure 25 shows a plot of the diurnal pattern of the hourly PM2.5 concentrations collected for the 12 month period the PM2.5 BAM was in operation.

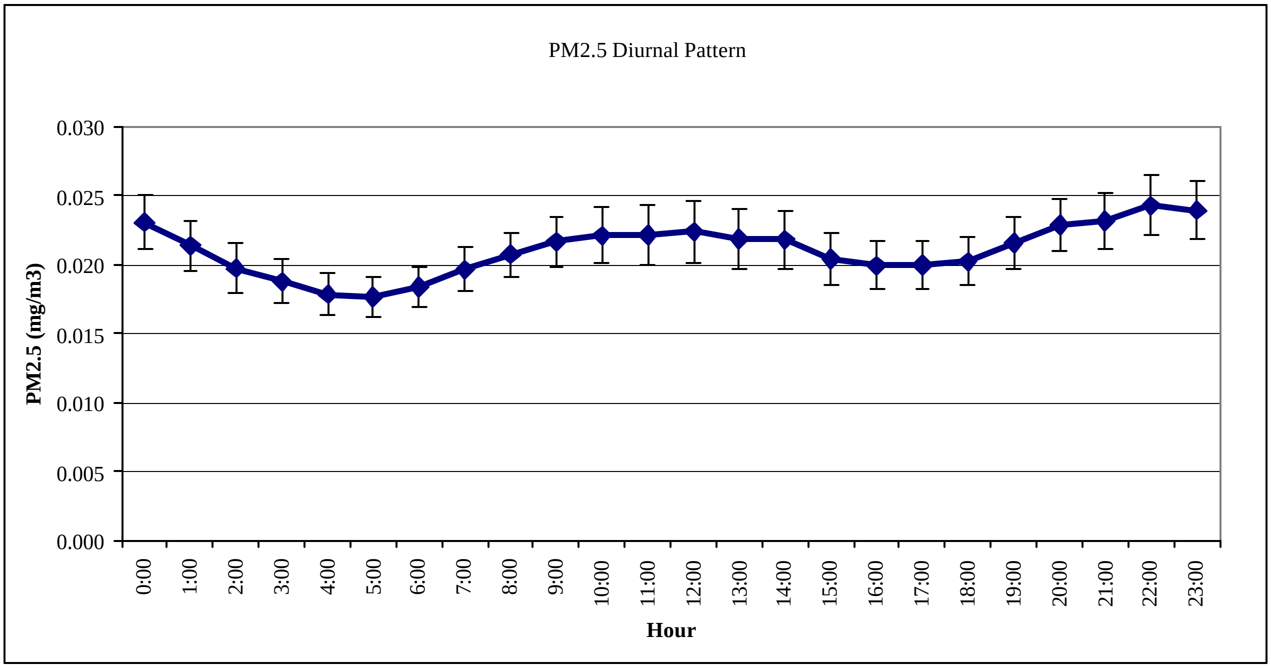


Figure 25. PM2.5 Diurnal Pattern

This data shows that there is no corresponding peak in concentration during the daytime work hours as was seen in the PM10 data. There is a slight increase during the daytime, but it is actually mirrored by an increase in the late evening and early morning hours. The 95% confidence intervals do increase during the day, indicating more variation in the hourly concentrations, but that may also be due to the typical meteorological variations that occur during the daytime hours.

There is no peak during the morning and afternoon rush hours, indicating that the direct influence of the highways is muted due to the distance from the Park. This is also indicated in the previous examination of the detailed daily and monthly data.

These data suggest that there may only be a slight effect from the nearby sources—the diesel exhaust from the Transfer Station haul trucks.

3.3.4.2 Day of Week Pattern

Figure 26 shows the day of week dependence for PM2.5. There is no strong trend to be shown, with only 2-3 ug/m3 difference between the days. The difference between Saturdays, at 18 ug/m3 and Wednesdays at 23 ug/m3, may be significant, but is likely due to lessened highway influence. The data for Sundays, at 19 ug/m3, may lead to a similar conclusion. However, there is no strong dependence showing nearby sources to be an issue.

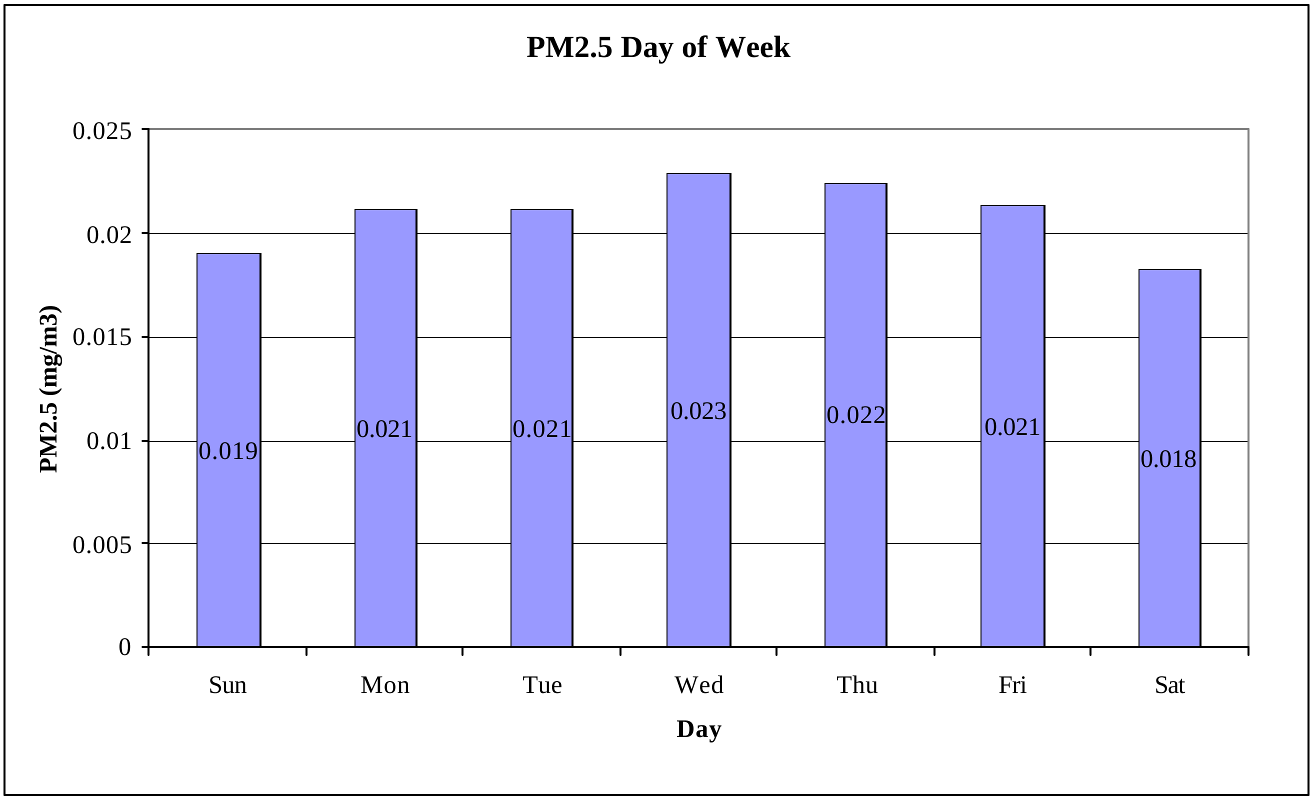


Figure 26. PM2.5 Day of Week Dependence

3.3.5. Sources of Particulate Matter Impacting the Park

There are several nearby and distant sources that potentially impact the air quality at Harrison Park:

Stationary Sources

- Transfer Station
- Berkeley Recycling Center
- Pacific Refining and Foundry
- Precision Technical Coatings

Mobile Sources

- I-80
- Gilman Avenue
- Nearby city streets

Since all of these sources are upwind to Harrison Park, they affect the air quality in general. However, the magnitude of that impact and the ability to discern one source from the others is uncertain except for the Transfer Station. No direct data is available for any particular source other than the Berkeley Recycling Center, and the evidence from that source suggests its downwind fence line influence is on the order of 5 ug/m3. However, that influence is likely diluted by the distance the plume must be transported before impacting the monitoring site at Harrison Park.

The data, do however, conclusively link daytime operations from the Transfer Station to increased levels of PM10 at the monitoring site. There appears to be little impact from PM2.5 from the Transfer Station operations, based on the PM2.5 data. Figure 27 shows the superimposed PM10 and PM2.5 diurnal patterns. It clearly shows that there is no correlation between the two parameters and that the PM10 dominates during the work day of the Transfer Station. Coupled with the directional influence of the meteorology, it shows conclusively that the Transfer Station is the primary source for the high concentrations seen at the monitoring site in Harrison Park.

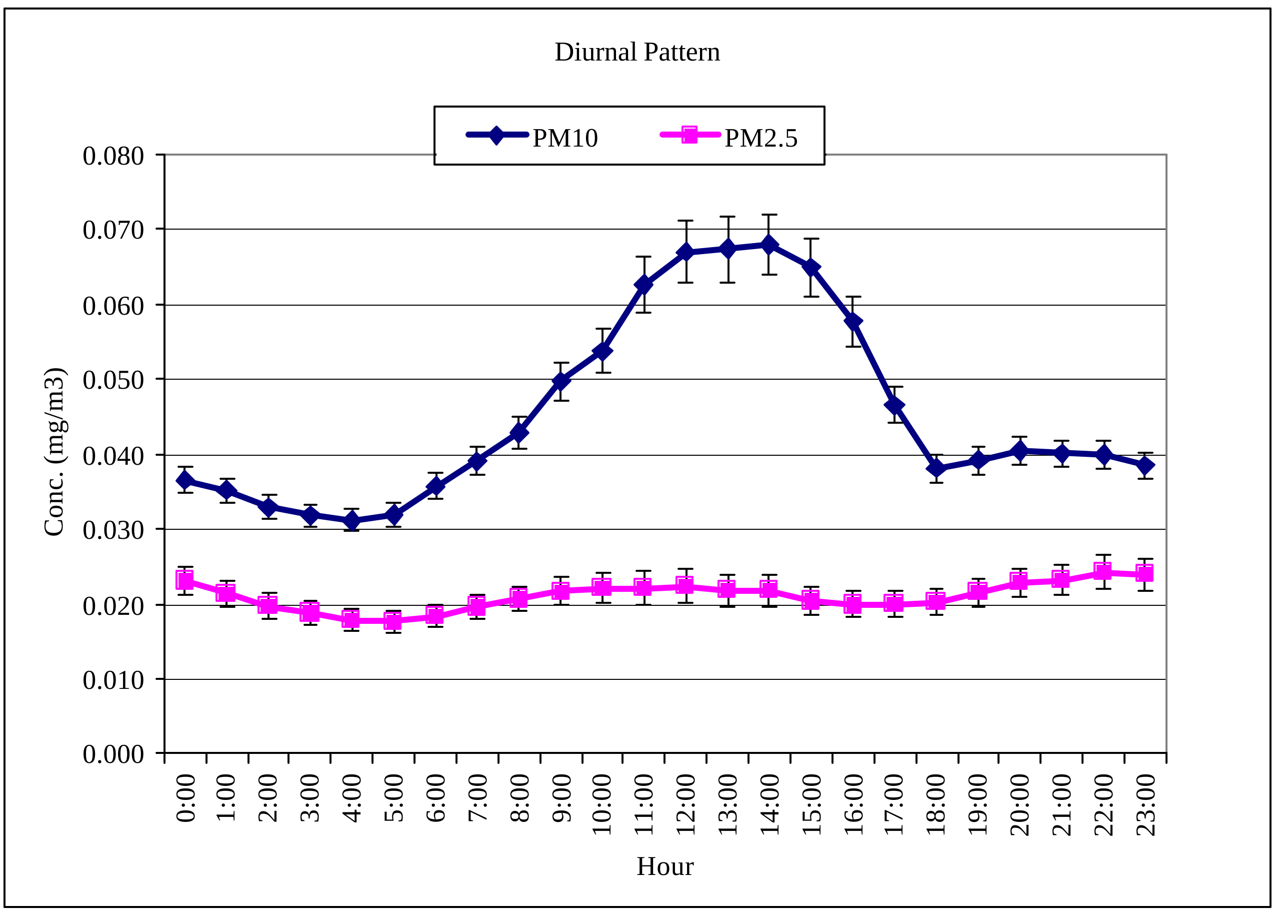


Figure 27. PM10 and PM2.5 Diurnal Patterns

Based on the available data, the impact from the Transfer Station to the monitoring site appears to be approximately 16 ug/m3. This was obtained by comparing the background level of 39 ug/m3 with the daytime (7 AM to 5 PM) average of 55 ug/m3.

3.3.6 Park Usage Patterns

As determined by the Parks, Recreation, and Waterfront Department, the Park usage pattern is generally just a few hours per week. This is based on both field maintenance schedules and use schedules that are organized by city staff.

Usage:

The field is used by children, generally aged 8-16 every weekday from 4:00 to 7:00 and Saturdays from 8-5. Most children are there once or twice a week for 1 1/2-2 hours. At the most a child is there three times a week for 1 1/2-2 hours (two practices and a Saturday game). Adults [very few] are there weekdays from 7-9:30 and Sundays from 9-5. Most adults are there once a week for 2 hours. A small number of adults are there twice a week for two hours.

The fields are shut down June 15th to September 1 there is no summer activity on the fields. The east field is shut down December 1-March 1 there is no activity on this field. The west field is open December 1-March 1 on Sunday mornings from 9-1 for adult play. There are no children on the west field from December 1 to March 1.

3.3.7 Exposure Breakdown

When various time periods are broken down in to averages, it is seen that the averages for the workday are increased over non-work hours and background levels by approximately 16 ug/m3. The concentration for play time, from 4 PM to 7 PM, is 41 ug/m3—only slightly above the background level of 39 ug/m3. The off-hours level of 36 ug/m3 reflects the similar background concentration.

Time Period	PM10 (mg/3)
24-hr Avg.	0.046
Day-Avg.	0.055
Off-hr Avg.	0.036
Play Time	0.041
Background	0.039

Table 5. Exposure Period Breakdowns

3.4 Data Comparison

3.4.1 Bay Area PM10 and PM2.5 Concentrations

Tables 6 and 7 contain the monthly data from the Bay Area Air Quality Management District PM10 and PM2.5 monitoring network. These data put the background and monitoring data from this report in context to nearby communities. The BAAQMD uses EPA federal reference or federal reference equivalent methods, as was done at Harrison Park. Several of the BAAQMD sites utilize the same equipment as was used at Harrison Park for this study. The BAAQMD data sets are comprised of every one in six day monitoring schedule. These data were subsequently averaged (arithmetic average) into a monthly value. Based on standard practice, this frequency is considered representative of overall trends and therefore can be compared with other data sets such as the Harrison data set.

These data show that the concentrations measured at Harrison Park are approximately a factor of two higher for PM10 than most of the area monitoring sites, and a factor of 1.5 higher for PM2.5 than most of the area monitoring sites.

Conclusive reasons for these disparities are beyond the scope of this report, but several factors may come into play. First, the siting of the Harrison Park monitoring site does not conform to the standard siting that is performed for standard ambient air monitoring stations. The proximity to the Transfer Station site, and the proximity to the major highways and surface streets are both factors that would lead to higher than average concentrations. Furthermore, the presence of several moderate to large industrial sources directly upwind contribute to the overall burden of particulate matter in the ambient air.

Standard ambient air monitoring stations avoid these factors and are sited to provide a representativeness for the majority of the population, which do not live in essentially industrial areas. Therefore, it's partially an "apples and oranges" argument—the two situations are not the same.

However, the comparison is valid in terms of comparing what a "typical" Bay Area resident would be exposed to. The concentrations cited in Tables 6 and 7 represent the air that a typical resident would breathe. Therefore, concerned individuals should take appropriate precautions as cited in the health evaluation report contained in the appendix.

PM10	Harrison	FR	LV	PT	CC	BI	RI	SR	NP	SF	RC	SJ	TU	VA	ST
2001															
January	-	0.035	0.047	0.041	0.048	0.037	-	0.035	0.043	0.042	0.038	0.042	0.034	0.041	0.040
February	-	0.015	0.013	0.009	0.013	0.010	-	0.014	0.014	0.016	0.015	0.017	0.012	0.014	0.011
March	-	0.024	0.022	0.016	0.018	0.015	-	0.022	0.020	0.030	0.026	0.028	0.018	0.015	0.018
April	-	0.020	0.016	0.013	0.018	0.016	-	0.019	0.019	0.019	0.017	0.021	0.016	0.012	0.015
May	-	0.028	0.025	0.018	0.019	0.023	-	0.021	0.026	0.035	0.027	0.034	0.023	0.018	0.023
June	-	0.022	0.020	0.012	0.016	0.018	0.023	0.017	0.027	0.030	0.021	0.025	0.020	0.016	0.019
July	0.044	0.020	0.022	0.015	0.016	0.023	0.014	0.015	0.019	0.017	0.018	0.026	0.017	0.013	0.019
August	0.032	0.017	0.018	0.016	0.015	0.022	0.015	0.014	0.022	0.016	0.015	0.025	0.011	0.012	0.019
September	0.039	0.021	0.023	0.019	0.018	0.022	0.017	0.015	0.022	0.020	0.016	0.029	0.030	0.018	0.020
October	0.046	0.028	0.028	0.026	0.021	0.030	0.024	0.023	0.026	0.032	0.024	0.037	0.038	0.022	0.023
November	0.038	0.030	0.034	0.043	0.020	0.038	0.018	0.027	0.026	0.033	0.030	0.038	0.034	0.029	0.025
December	0.026	0.015	0.019	0.014	0.017	0.012	0.015	0.017	0.018	0.021	0.018	0.019	0.016	0.019	0.014
2002															
January	0.036	0.021	0.027	0.022	0.021	0.018	0.020	0.018	0.025	0.024	0.021	0.026	0.020	0.022	0.017
February	0.043	0.019	0.021	0.023	0.019	0.020	0.018	0.018	0.025	0.025	0.018	0.025	0.026	0.022	0.017
March	0.038	0.017	0.019	0.020	0.016	0.012	0.018	0.017	0.020	0.025	0.021	0.023	0.023	0.019	0.016
April	0.067	0.026	0.025	0.025	0.021	0.017	0.024	0.020	0.023	0.026	0.025	0.026	-	0.022	0.018
May	0.054	0.017	0.016	0.015	0.014	0.014	0.015	0.016	0.019	0.022	0.017	-	0.021	0.017	0.014
June	0.048	0.026	0.026	0.024	0.023	0.024	0.027	0.022	0.027	0.028	0.026	-	0.026	0.024	0.022
Jul	0.039	0.026	0.026	0.024	0.023	0.024	0.000	0.022	0.027	0.028	0.026	0.000	0.019	0.024	0.022
Aug	0.046	0.019	0.019	0.018	0.013	0.023	0.000	0.015	0.020	0.017	0.016	0.000	0.019	0.016	0.018
Sep	0.046	0.030	0.033	0.035	0.030	0.032	0.000	0.024	0.027	0.024	0.028	0.000	0.027	0.024	0.020
Oct	0.065	0.019	0.021	0.019	0.015	0.029	0.000	0.017	0.023	0.016	0.018	0.000	0.027	0.014	0.016
Nov	0.065	0.023	0.024	0.023	0.020	0.035	0.000	0.022	0.028	0.026	0.020	0.000	0.022	0.020	0.019
Dec	0.065	0.031	0.040	0.040	0.038	0.040	0.000	0.039	0.043	0.038	0.032	0.000	0.038	0.038	0.031
Avg.	0.047	0.023	0.024	0.022	0.020	0.023	0.013	0.020	0.025	0.025	0.022	0.020	0.023	0.020	0.020

All concentrations in mg/m3

Table 6. BAAQMD PM10 Concentrations

PM2.5	**Harrison**	**FR**	**LV**	**CC**	**SF**	**RC**	**TU**	**VA**	**ST**
2001									
January	-								
February	-		0.013		0.014				
March	-		0.012		0.019				
April	-		0.009		0.011				
May	-		0.012		0.016				
June	-		0.008		0.010				
July	-				0.014				
August	-		0.012		0.013				
September	-		0.013		0.015				
October	-		0.014		0.018				
November	-		0.017		0.019				
December.	-		-		0.011				
2002									
January	0.017	0.018	0.027	0.019	0.018	0.019	0.018	0.028	0.016
February	0.018	0.016	0.017	0.014	0.015	0.014	0.016	0.016	0.013
March	0.010	0.008	0.009	0.007	0.008	0.007	0.008	0.008	0.006
April	0.018	0.010	0.011	0.009	0.011	0.008	0.009	0.008	0.007
May	0.015	0.007	0.007	0.007	0.008	0.006	0.008	0.007	0.006
June	0.020	0.011	0.010	0.010	0.011	0.010	0.009	0.009	0.008
July	0.020	0.008	0.007	0.008	0.008	0.007	0.007	0.008	0.007
August	0.021	0.019	0.019	0.020	0.015	0.018	0.017	0.019	0.011
September	0.025	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.007
October	0.022	0.011	0.010	0.009	0.011	0.010	0.011	0.009	0.007
November	0.028	0.017	0.020	0.029	0.022	0.017	0.019	0.021	0.019
December	0.040	0.020	0.024	0.027	0.023	0.018	0.016	0.027	0.023
Avg.	0.021	0.013	0.014	0.014	0.013	0.012	0.012	0.014	0.011

All concentrations in mg/m3
California PM10 Standard = 0.050 mg/m3 for 24-hour average, 0.020 mg/m3 for annual average.

Table 7. BAAQMD PM2.5 Concentrations

FR=Fremont
LV=Livermore
PT=Pittsburgh
CC=Concord
BI=Bethel Island
RI=Richmond
SR=San Rafael
NP=Napa
SF=San Francisco
RC=Redwood City
SJ=San Jose
TU=San Jose Tully St.
VA=Vallejo
ST=Santa Rosa

3.4.2 California PM10 Concentrations

The California Air Resources Board (CARB) conducts ambient air monitoring throughout the State of California for the same purpose as the BAAQMD—to determine the quality of air that the majority of California residents breathe. Monitoring is conducted to determine compliance with Federal and State air quality standards, as cited earlier in this report.

Table 8 contains the results from PM10 monitoring in the air basins throughout the state. There is no comparable PM2.5 table for PM2.5 as it has not been criteria pollutant for the state in previous years.

AIR BASIN	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
GREAT BASIN VALLEYS	23.4	21.0	20.1	20.0	19.6	13.9	17.4
LAKE COUNTY	10.1	9.6	9.1	7.7			9.6
LAKE TAHOE	23.5	19.3		19.6	19.6	17.4	17.6
MOJAVE DESERT	24.7		25.6	25.2	14.2	27.9	19.3
MOUNTAIN COUNTIES	28.7	21.7	18.8	25.0	22.5	22.5	16.1
NORTH CENTRAL COAST	27.6	29.5	27.7	31.7	25.9	27.6	23.5
NORTH COAST	21.1	23.4	21.6	20.7	19.6	21.2	19.8
NORTHEAST PLATEAU	20.3	12.2	10.7			22.2	17.6
SACRAMENTO VALLEY	30.0	26.3	25.5	25.3	22.8	30.3	24.7
SALTON SEA	45.3	59.6	64.7	70.2	58.6	66.4	73.0
SAN DIEGO	45.2	39.8	28.4	41.9	38.6	47.5	31.6
SAN FRANCISCO BAY AREA	24.8	22.1	22.1	23.7	22.5	25.4	23.7
SAN JOAQUIN VALLEY	44.3	48.9	47.6	42.3	32.1	50.3	45.4
SOUTH CENTRAL COAST	26.0	23.3	26.2	28.4	23.8	28.1	26.2
SOUTH COAST	56.0	51.8	52.0	56.3	43.3	64.9	54.6

Data in ug/m3
California PM10 Standard = 50 ug/m3 for 24-hour average, 20 ug/m3 for annual average.

Table 8. California PM10 Concentrations

These data show that most areas are exposed to lower concentrations of PM10, however, there are a few exceptions. The two main exceptions are the San Joaquin valley and the South Coast.

4. Conclusions

The data presented in this report show that elevated concentrations of PM10 and PM2.5 are present at Harrison Park due to local industrial sources, particularly the City of Berkeley Transfer Station. These concentrations exceed the California air quality standards for a large number of days, 70 in 2001 and 135 in 2002. Both numbers of exceedances would constitute being out of compliance with the standards.

The health evaluation presented in this report suggests that users with impaired health or breathing disorders consider carefully the amount of time that is spent in the area. While the higher concentrations are present during times of the day when most children are not present, the overall concentrations are consistent with possibly unhealthful air quality.

Appendices

1. **Data Files—on CD**

2. **Hexavalent Chromium Sampling**

3. **BAAQMD Audit Report**

4. **Risk Evaluation Report—Dr. Charles E. Lambert**

5. **Berkeley Recycling Center Report**

Appendix 1. Data Files

The enclosed CD contains the monthly data compilations, along with this report. Due to the size of the files and the length of any printed tables, this information has to be presented in electronic format.

Appendix 2. Hexavalent Chromium Sampling

Introduction

Part of the Harrison Park development was the construction of a skateboard park on the southeast corner of the lot. During construction, it was determined that the groundwater in that area was contaminated by hexavalent chromium. Construction was stopped until an appropriate remediation could be determined.

Concern about this contamination and the possible inhalation exposure route to persons in the area lead to the proposal to conduct air sampling in the area.

Technical Approach

The approach that was used to collect data on ambient air concentrations of hexavalent chromium was based the CARB Method MLD039, which stipulates the use of sodium carbonate impregnated cellulose filters that are sampled through a total particulate inlet at 10 L/min for 24 hours. The analysis consists of ion chromatography with post-column derivitization and detection by UV.

The analysis was conducted by Philips Analytical Services of BC, Canada. Of the few laboratories able to do the CARB method, this one has been proven through past use to provide high quality results. The detection limit for this analysis was 20 ng/sample. With a flow rate of 10 liter per minute over a 24-hour period, the concentration that could be detected in air would be 1.4 ng/m3.

The sampling was conducted at the northeast corner of the homeless shelter lot, inside the fence. Figure A-2 shows a photograph of the sampling set up.

Sampling was conducted in accordance with CARB’s 1 in 12 day schedule for hexavalent chromium sampling. Sampling commenced on June 30, 2001 and continued through November 21, 2001. The sampling event for December 3, 2001 failed due to rain on that day that short-circuited the control equipment. After consultation with city staff, it was determined that there was no need to continue given the equipment problems and the lack of any positive results to date. All previous samples had been returned as non-detects.

Table A-2 contains the results of these tests, showing the complete set of non-detects. The quality assurance samples submitted with the field samples—blanks and spikes—showed acceptable results, confirming the validity of the data.

Figure A-2. Hexavalent chromium Sampling Set Up

Date	Detection Limit (ng)	Vol (m3)	Results
6/30/2001	20	14.4	<1.4 ng/m3
7/12/2001	20	14.4	<1.4 ng/m3
7/24/2001	20	14.4	<1.4 ng/m3
8/5/2001	20	14.4	<1.4 ng/m3
8/17/2001	20	14.4	<1.4 ng/m3
8/29/2001	20	14.4	<1.4 ng/m3
9/10/2001	20	14.4	<1.4 ng/m3
9/22/2001	20	14.4	<1.4 ng/m3
10/4/2001	20	14.4	<1.4 ng/m3
10/16/2001	20	14.4	<1.4 ng/m3
10/28/2001	20	14.4	<1.4 ng/m3
11/9/2001	20	14.4	<1.4 ng/m3
11/21/2001	20	14.4	<1.4 ng/m3
12/3/2001	NS	NA	NA
12/15/2001	NS	NA	NA

NS= not sampled
NA=not available

Table A-2. Results from Hexavalent Chromium Sampling

Conclusions

The use of the CARB hexavalent chromium sampling and analysis method showed consistent non-detects over the approximately 6 month sampling period. All QA data was satisfactory, and combined with the field results, this data set shows the ambient air concentration to be less than 1.4 ng/m3.

Appendix 3. BAAQMD Audit

On December 18, 2002, the audit group from the Bay Area Air Quality Management District audited the monitoring equipment in use. The findings showed that the system passed all acceptance criteria and was working satisfactorily. The audit report is included as Figure A-2.

BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

January 30, 2003

Mr. Eric Winegard
Applied Measurement Science
4764 Concord Drive
Fair Oaks, CA 95628

Mr. Winegard:

The Bay Area Air Quality Management District (BAAQMD) performed a site evaluation and instrument audits on two BAM-1020 samplers located in Harrison Park, Berkeley on 18-Dec-02.

PM_{10} and $PM_{2.5}$ BAM sampler audits at Harrison Park, Berkeley were found to be within acceptable limits. All performance flows and design flow criteria limits were met.

Drawings and photos of the site may be obtained in a separate PowerPoint presentation file by request. Siting criteria was generally acceptable and complied with EPA guidelines with one exception. The shelter housing the BAM samplers was not large enough to accommodate placement of the samplers far enough apart to satisfy the EPA minimum of 1 meter between low flow sampler inlets (EPA QA Guidance Document 2.12, §5.1.2). If possible, Bay Area AQMD recommends following EPA siting criteria in any special monitoring studies. (40 CFR, Part 50, App. E).

BAM PM_{10}	***Sampler #***	***Audit Flow l/min.***	***Ind. Sampler Flow l/min.***	***Audit %***	***Design %***
	A2334	16.43	16.7	1.6	
		Design Flow l/min.	***Audit Flow l/min.***		
		16.7	16.43		-1.6
Temperature		Reference = 769	Indicated = 769	Abs. Diff.	0.0
Pressure		Reference = 11.3	Indicated = 10.7	Abs. Diff.	-0.6
BAM $PM_{2.5}$	***Sampler #***	***Audit Flow l/min.***	***Ind. Sampler Flow l/min.***	***Audit %***	***Design %***
	A5376	17.15	16.7	-2.6	
		Design Flow l/min.	***Audit Flow l/min.***		
		16.7	17.15		2.7
Temperature		Reference = 769	Indicated = 769	Abs. Diff.	0.0
Pressure		Reference = 11.8	Indicated = 11.2	Abs. Diff.	-0.6

PM10
Acceptance criteria for flow rate audit is ±7%. Acceptance criteria for design flow rate is ±10%.

PM2.5
Acceptance criteria for flow rate audit is ±4%. Acceptance criteria for design flow rate is ±5%.

Acceptance criteria for temperature is ±2°C. Acceptance criteria for pressure is ±10mmHg.

Please feel free to call Dan Zucker at (510) 243-1444 if you have any questions.

Sincerely,

Mark Stoelting

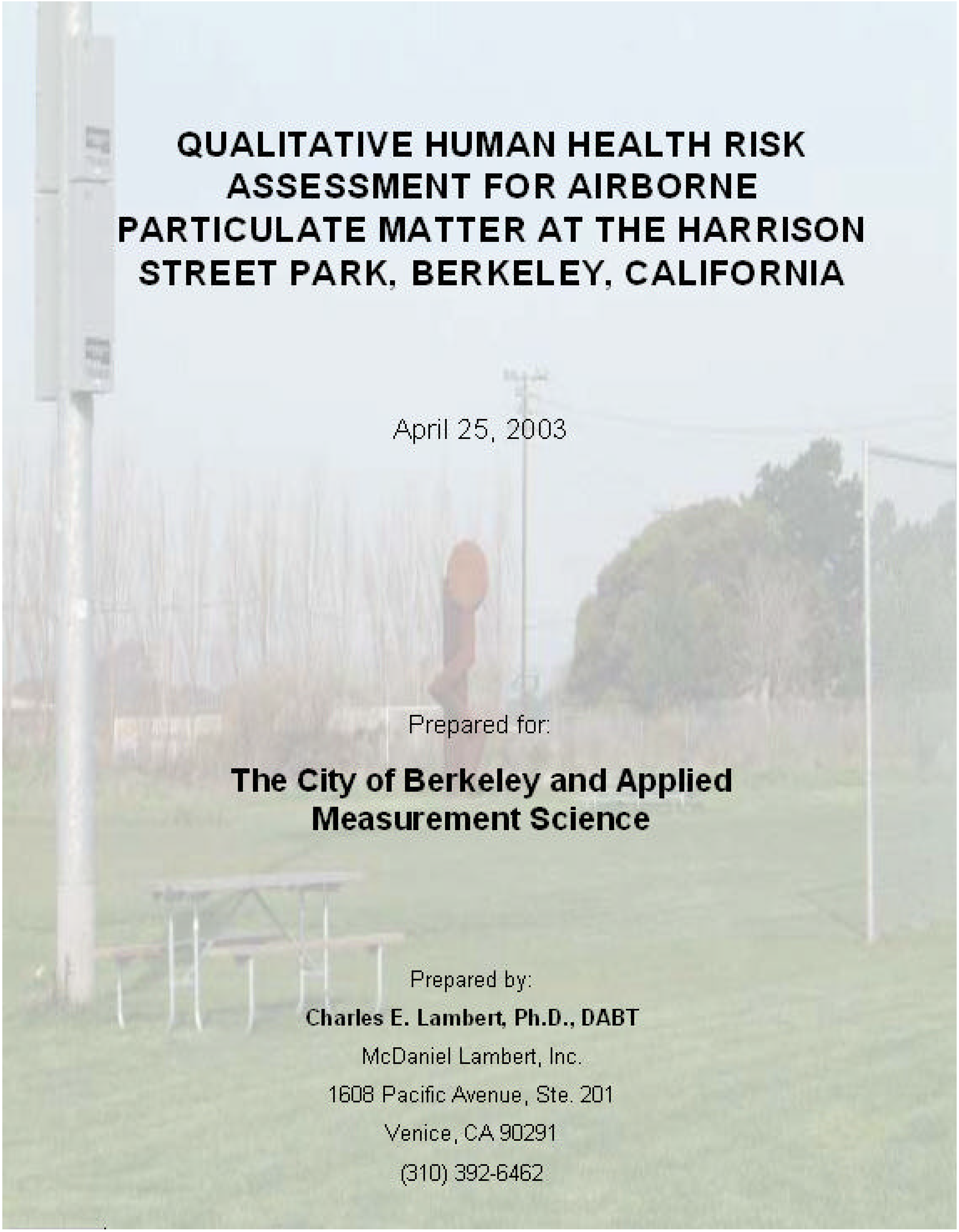
Mark Stoelting

****

Mark Stoelting
Manager of Meteorology/Data Analysis and Quality Assurance (acting)
Bay Area Air Quality Management District
www.baaqmd.gov <http://www.baaqmd.gov>
<mailto:mstoelting@baaqmd.gov>
415-749-4619

Figure A-2. BAAQMD Audit Report

Appendix 4. Risk Evaluation by Dr. Charles E. Lambert



QUALITATIVE HUMAN HEALTH RISK ASSESSMENT FOR AIRBORNE PARTICULATE MATTER AT THE HARRISON STREET PARK, BERKELEY, CALIFORNIA

April 25, 2003

Prepared for:

The City of Berkeley and Applied Measurement Science

Prepared by:

Charles E. Lambert, Ph.D., DABT

McDaniel Lambert, Inc.

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Executive Summary

Based on long-term air monitoring occurring over a 18 month period (from July 2001 to January 2003) at the Harrison Street Park in Berkeley, we conclude that PM10 (particulate matter less than 10 microns in size) concentrations are consistently higher than both State standards and regional background concentrations. The major source of this increased particulate concentration appears to be the City of Berkeley Solid Waste Transfer Station. These elevated concentrations are probably not a significant health risk for healthy individuals (adults or children) who spend a few hours a week at the Park. However, a number of epidemiology studies have shown that persons (particularly children) with preexisting respiratory illnesses are more sensitive to increased particulate concentrations as seen at the Park.

We would therefore recommend that the current health hazard communication posting (the Notice) remain in place with one change. This Notice currently advises Park users that "air quality at this site *occasionally* (our emphasis) does not meet State standards. High particulate levels have an adverse health impact on children with respiratory problems. In addition, some health and safety experts suggest that existing state standards are inadequate to protect persons considered at risk. Should you have any questions, contact your doctor." We would recommend changing the word "occasionally" to "often" as this phrasing will better reflect the air monitoring data that shows over 100 daily exceedances of the 24 hour PM10 standard over the course of a year. We would also caution against moving children or adults with preexisting respiratory or cardiac illness into the proposed transitional housing next to the Park. These types of particulate exposures over an extended period of time could exacerbate existing conditions in both children and adults.

1.0 Introduction and Background Information

An 18 month air monitoring study (July 2001 through January 2003)was commissioned by the City of Berkeley to monitor airborne concentrations of particulate matter at the Harrison Street soccer field and park (the Park). The study undertaken was recently completed by Eric Winegar, Ph.D. of Applied Measurement Science. As part of the summary of the Applied Measurement Science air quality study, the City of Berkeley requested a qualitative human health risk assessment to look at potential health impacts from airborne particulate matter on users of the Harrison Street Park as well as on residents of the adjacent Ursula Sherman Village. Applied Measurement Science contracted with Dr. Charles Lambert of McDaniel Lambert Inc. to conduct the qualitative health risk assessment.

1.1 Site Description

The Harrison Street Park is used as a recreational area for Berkeley residents. It is composed of two adjacent soccer fields and a skateboard park. The Park is mostly used in the late afternoon and early evening. Adjacent to the Park is the Ursula Sherman Village, a planned community designed to provide emergency and transitional housing, and social services for community residents. The Park is located in a primarily industrial area consisting of warehousing and manufacturing businesses.

Harrison Street Park

The Park is exposed to potential ambient air pollutants from several local stationary and mobile sources. The stationary sources include, (1) the City of Berkeley Solid Waste Transfer Station directly south west across from the soccer fields; (2) the Recycling Center (0.15 miles south); and (3) the Berkeley Forge Company (0.25 miles south). The prevailing wind direction across the park is from the south to southwest, which is from the direction of the Transfer Station.

Solid Waste Transfer Station

Mobile sources of air pollutants include, (1) freight and passenger trains along the adjacent Union Pacific right-of-way; (2) nearby Interstate 80 (0.20 miles south west); and (3) trucks moving in and out of the transfer station.

Interstate 80 and Recycling Center (both less than a mile from Park)

1.2 Human Populations at the Harrison Park

The users of the Park appear to be primarily soccer players who are at the Park in the late afternoon and early evening. The Park user at most potential risk is therefore a young child playing soccer on a regular basis at the Park. The average time spent by a child soccer player at the Park is approximately 4.5 hours per week and is based on three separate visits of 1.5 hours each (observations of City of Berkeley Staff). However, adjacent to the Park is transitional housing at the Ursula Sherman Village, where an adult population may live for a few months at a time. There are plans to expand the transitional housing, to allow families to stay for longer periods of time, up to two years. The populations of concern in this extended housing scenario would be young children, the elderly, and adults with preexisting respiratory illnesses.

1.3 Previous Air Quality Studies

One of the first air quality assessments in the Park area was conducted in 1997 by Acurex (Acurex 1997). This report was completed before the location was developed into a park and soccer fields. The assessment used both quantitative risk assessment and a qualitative approach to look at potential risk at the site from air pollution. The study concluded, based on a very limited air monitoring program, that the health risk from air pollution was “no more significant than is seen in a typical, densely-populated, urban environment” and that “the small particle value (PM10), although higher than Normal Bay area ranges, is below the current National Ambient Air Quality Standards (NAAQS) and below the EPA’s proposed standard for these materials”.

Information gathered during the first year of the Applied Measurement Science air monitoring study were summarized and interpreted by Environ Corporation (Environ 2002a and b) in two reports prepared for Building Opportunities for Self-Sufficiency (BOSS). The Environ analysis was conducted to aid BOSS, which is planning to further develop the adjacent Ursula Sherman Village, a planned community that provides emergency and transitional housing, and social services for community residents.
In their analysis of the airborne particulate air data, Environ concluded that, “PM10 concentrations at the Harrison Street site appeared to be higher than at other Bay Area locations in 2002. Evaluations of available data clearly point to the West Berkeley Waste Transfer Station as the cause of elevated PM10 concentrations at the site.”

Air monitoring equipment in Park across from Transfer Station

Ursula Sherman Village

The results of Applied Measurement Science’s air monitoring program show that air quality at the Park, particularly PM10 concentration, is impacted by activities at the Transfer Station. This conclusion is in agreement with earlier conclusions reached by both Environ and Acurex. Based on these preliminary findings, a “Notice” was posted at the Park advising users that “air quality at this site occasionally does not meet State standards. High particulate levels have an adverse health impact on children with respiratory problems. In addition, some health and safety experts suggest that existing state standards are inadequate to protect persons considered at risk. Should you have any questions, contact your doctor.”

Notice posted at Harrison Street Park *View of Soccer Fields*

2.0 Qualitative Health Risk Assessment

2.1 Air Quality Data Summary

The PM10 and PM2.5 data for the Park and other nearby locations provided by Applied Measurement Sciences are summarized and presented in the following Table:

Location	**PM10 Annual Arithmetic Average (ug/m^3)***	**PM2.5 Annual Arithmetic Average (ug/m^3)***
Harrison Park	46	21
Recycling Center	38	NA
Area Background	34	NA

*Annual arithmetic average as is specified in the Federal Standard
NA – none available

Using the above data set a qualitative risk assessment was conducted comparing PM10 annual averages with data from across the State, regulatory PM standard, and information from the health effects literature to draw conclusions about the safety of current users of the site. In the Table below, a summary of PM10 data from the California Air Resources Board database for various Bay Area locations as well as some locations in Southern California is provided for comparison purposes.

Location (2001 Data)	**PM10 Annual Arithmetic Average (ug/m^3)**	**PM10 Maximum (ug/m^3)**	**Exceedances of State 24-hour Standard (# of Days)**
Harrison*	46	119	~105
Concord	20.3	106	12
Fremont	23.3	58	18
Livermore	24.6	109	18
San Jose	28.9	77	24
San Rafael	20.4	79	12
Los Angeles	44.2	97	119
Burbank	40.9	86	83

*Harrison data is for the 19 month period 2001 through 2002 except exceedances which are approximated for one year

As can be seen from both of the above tables the annual average PM10 concentration measured at the Park is significantly higher than local area background, other Bay Area communities, and is similar to concentrations seen in the more impacted areas of Southern California.

2.2 Information from the Particulate Health Effects Literature

PM10 is a heterogenous mix consisting of both fine particles (PM2.5 or particles less than 2.5 microns in diameter) and coarse particles (2.5 to 10 microns in diameter). PM10 comes from a number of different sources, but the two major contributors are from combustion sources (e.g. fuel combustion, residential fireplaces, and agricultural burning) and from the transformation of gaseous pollutants (e.g. sulfur dioxide, nitrogen dioxides, and volatile organic compounds) in the atmosphere. Other sources of the coarser particles include windblown dust, unpaved roads, crushing and handling operations.

Acute health effects from PM10 inhalation include an aggravation of bronchitis in adults and children with preexisting respiratory illness, small but significant changes in lung functioning in children, and immediate additional deaths of the elderly and of people with preexisting heart or lung disease if pollution levels are extremely high (e.g. London Fog of 1952) (Atkinson *et al* 1999; Peters *et al* 1999; McConnell *et al* 1999; Bremner *et al* 1999). Asthmatics and those with allergies may also react to PM10 inhalation, particularly to sulfate particulates (Thurston 2000). Chronic exposure to PM10 may cause damage to lung tissues, contributing to chronic respiratory disease, cancer, and premature illness and death (Schwartz 2000). Symptoms of chronic obstructive pulmonary disease are correlated with ambient air particulate concentrations. Children in areas of higher particulate pollution seem to suffer from increased upper respiratory illnesses (e.g. colds, coughs) than do children in less polluted areas. There is some evidence to suggest that children in general may be more susceptible to the health effects of PM10 because of increased exposure (e.g. time outdoors, higher respiration rates) and other conditions (e.g. higher asthma rates, developing lungs) (Norris *et al* 1999; Thurston 2000; OEHHA/CARB 2000) .

2.3 California Ambient Air Quality Standard

The present California Ambient Air Quality Standard (CAAQS) for PM10 is 50 ug/m^3 for a sample gathered over a 24 hour period. The CAAQS for an annual arithmetic mean of 24 hour samples is 30 ug/m^3 (a new standard of 20 ug/m^3 is pending). The PM10 standards are often exceeded in various areas of the State, particularly Southern California. The CAAQ PM10 standards are set at these levels to "prevent excess deaths from short-term exposures and of exacerbation of symptoms in sensitive patients with respiratory disease. Prevention of excess seasonal declines in pulmonary function, especially in children". However, there is increasing epidemiological evidence that the threshold for health effects for sensitive populations (elderly with preexisting conditions, children) from PM10 may be below the current State standards of 30 ug/m^3 (annual average) and 50 ug/m^3 (24-hour average). There is currently no CAAQS for PM2.5, although a proposed annual arithmetic mean of 12 ug/m^3 is pending.

Annual CAAQ Standards	PM10	PM2.5
	30 (20*)	(12*)
Harrison Park Data	46	21

*Pending standard

The above table indicates that both proposed and existing annual CAAQ particulate standards (PM10 and PM2.5) are significantly exceeded at the Harrison Park.

2.4 Discussion and Conclusions

The annual arithmetic concentrations of PM10 measured in the corner of the Park nearest the Transfer Station are high (46 ug/m3). This is evident from both a comparison to local background (34 ug/m3) and other regional background locations (e.g. Livermore at 24.6 ug/m3). The annual average for the Park is even higher than concentrations seen in an area with much worse regional air quality, namely the South Coast Basin (Los Angeles at 44.2 ug/m3). Moreover, the number of exceedances of the 24-hour State Standard at approximately 105 days/year exceed by four-fold the number for any other Bay Area location looked at in this comparison. The annual arithmetic concentrations of both PM10 and PM2.5 at Harrison Park significantly exceed both existing and proposed CAAQ standards. The air quality, from a particulate perspective, is clearly poor at the Park, which has PM10 concentrations similar to some of the more impacted urban areas in the State.

For a healthy child who visits the Park a few times a week, exposure to these PM10 concentrations is probably unlikely to cause health effects above those caused by background air pollution. The concern would be for an asthmatic child or child with other respiratory illness who uses the Park. Studies have shown that these children are more susceptible to elevated PM10 concentrations. If these children were engaging in recreational activities at the Park, with a likely increase in respiration rates, the possibility exists for an acute health episode (such as an asthmatic response) that is precipitated by the increased particulate concentrations at the Park. Similarly, this is probably not an ideal location for long-term housing (> six months) for families proposed by BOSS. If the residents were healthy adults it would probably not be a significant risk. However, adults or children with preexisting respiratory illness would probably be at increased risk of both acute and chronic respiratory illness.

Based on the above discussion and conclusions we would recommend that:

1) The current health hazard communication posting (the Notice) remain in place with one change. This Notice currently advises Park users that “air quality at this site *occasionally* (our emphasis) does not meet State standards. High particulate levels have an adverse health impact on children with respiratory problems. In addition, some health and safety experts suggest that existing state standards are inadequate to protect persons considered at risk. Should you have any questions, contact your doctor.” We would recommend changing the word “occasionally” to “often” as this phrasing better reflects the air monitoring data that show over 100 daily exceedances of the 24 hour PM10 standard over the course of a year.

2) Caution is exercised with regard to moving children or adults with preexisting respiratory or cardiac illness into the proposed transitional housing next to the Park. These types of particulate exposures over an extended period of time could exacerbate existing conditions in both children and adults.

3.0 Questions and Answers About this Report

Is the air at Harrison Park unhealthful to breathe?

The particulate air quality at the Park is poor and it is probably unhealthful to be exposed to it for extended periods of time. Short-term exposure, such as a few hours per week, is unlikely to cause any health effects above those caused by area background particulate concentrations. However, children with preexisting respiratory illness (e.g. asthma) may be at increased risk of an acute health effect, such as an asthmatic response.

My child has asthma. What precautions should she take when playing at the Park?

It is hard to predict what may happen to an individual without knowing the particular health condition of your child. You should consult with your child's personal physician.

I have heard that young children, particularly children who are exercising outside, are more vulnerable to the health effects of particulate matter. Should we continue to let our children exercise and play at the Park?

There are some epidemiological studies that show that otherwise healthy children who live and play outside in areas where there are high concentration of PM10 may be at increased risk for suffering from respiratory health effects. In the Harrison Park situation, typical exposures are short term (a few hours a week). However, this is obviously a choice that each parent must make for themselves.

Are the residents at the homeless shelter at increased risk?

Most of the current adult residents are only at the shelter for brief stays. Unless they are suffering from a preexisting respiratory or cardiac illness that makes them particularly sensitive to increased concentrations of air particulates it is unlikely that their health will be affected.

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Final Report

PM10 Monitoring at the Berkeley Recycling Center Materials Recovery Facility

July, 2002 to January, 2003

Prepared for:

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Project Manager
Community Conservation Centers
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April 15, 2003

1. INTRODUCTION

Due to concerns about its contribution of fugitive PM10 emissions to nearby facilities and exposure of its employees to these emissions, the Community Conservation Center contracted with Applied Measurement Science to conduct PM10 monitoring at the Berkeley Recycling Center at the corner of Gilman and 2nd Street in Berkeley.

The monitoring was to be conducted in two phases, first at “upwind” and “downwind” locations, and secondly inside the sorting building. The upwind/downwind monitoring was intended to provide a measure of the contribution to local PM10 concentrations by facility operations. The sorting building monitoring was intended to assess the potential for high exposure to employees working in the semi-enclosed building around the sorting and packaging operations.

2. TECHNICAL APPROACH

2.1 Study Design

The technical approach used was to collect concurrent hourly PM10 data at upwind and downwind locations using beta attenuation monitor technology. Following that period, the inside location would be monitored. The intended test time period was to collect data for two months at the upwind and downwind locations, and the inside location for three weeks.

2.2 Site Location

The Berkeley Recycling Center is located at the corner of Gilman and 2nd Streets in Berkeley, California. Figure 1 shows the general area. This area is primarily industrial, with the city Transfer Station to the north, and to the south, the Pacific Foundry and Steel Mill. Gilman Street is a major artery for access to and from I-80. Interstate Highway 80 is located approximately 150 yards to the west.

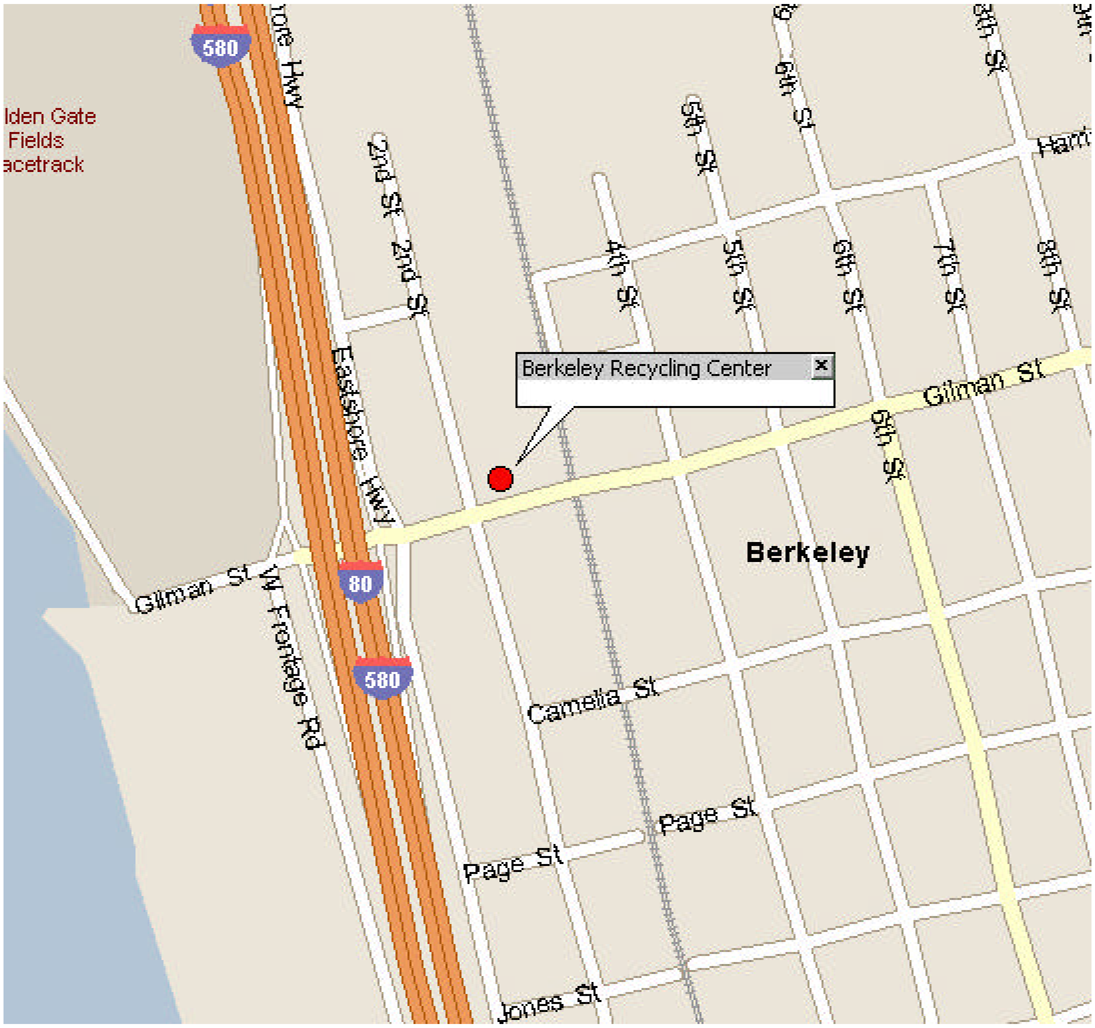

Figure 1. Site Location

The monitoring sites are noted in Figure 2. This figure was obtained from an aerial photo of the area.

The upwind site was located on top of a storage container on the southwest corner of the lot. The instrument inlet was at a height of approximately 12 feet above ground level. This location was designated as "upwind" due to the predominant wind direction as determined from the Harrison Field wind direction data.

The "downwind" site was located on top of a storage container along the north side of the lot, and was designated as such from the same Harrison Field wind data.

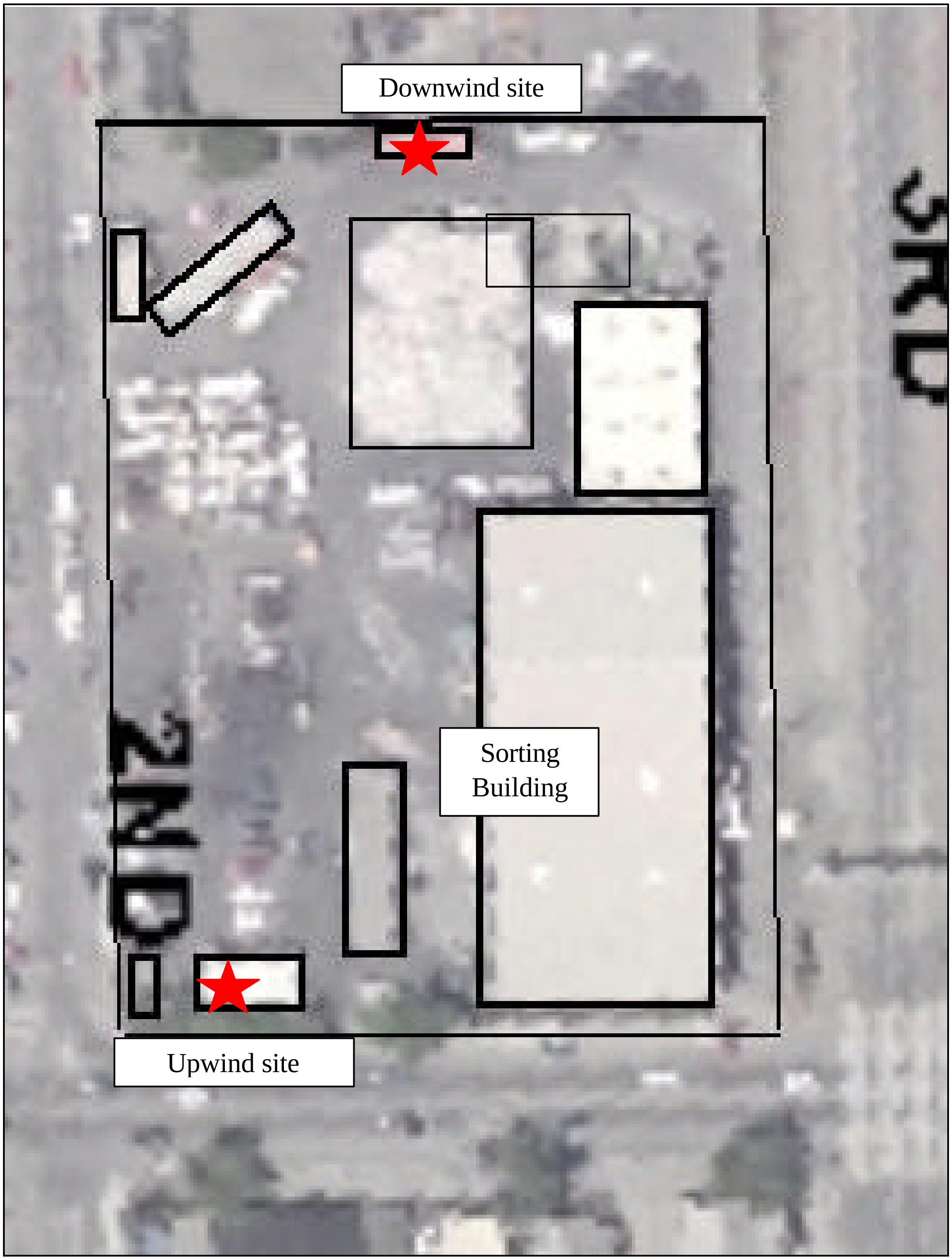

Figure 2. Monitoring Locations

2.3 Monitoring Equipment

The monitoring was conducted using a continuous PM10 monitor, the MetOne, Inc. EBAM (Environmental Beta Attenuation Monitor). The EBAM is a portable version of the EPA- and California Air Resources Board-approved BAM 1020 continuous PM10 monitor. The EBAM is based on the attenuation of beta particles by particulate matter collected on a quartz fiber tape. The specific attenuation of the material collected on the tape is proportional to its mass.

The flow of the monitor is controlled volumetrically via the external temperature sensor and atmospheric pressure. The appropriate calculation is performed to yield a 16.7 liters per minute flow rate that is specified for accurate size separation of the particulate matter through the PM10 virtual impactor inlet.

This mass detected is divided by the volume of air collected during the hour period. Subsequently, the hourly values are averaged into 24-hour periods, which then can be combined into longer term averages.

Following the monitoring, one of the EBAMs was co-located with the BAM1020 at Harrison Park for a cross-calibration test. The BAMs in this case would be considered the more accurate instrument, and having been recently calibrated and audited, were deemed accurate. The results of this comparison showed that the EBAM provided data with a bias of approximately 15% low. Therefore, the concentrations for the EBAMs were adjusted by that amount. All data cited in this report reflects that calibration factor.

Figure 3 shows a photo of an EBAM at the upwind site.

Figure 3. EBAM PM10 Monitoring Instrument at Upwind Site

2.4 Upwind Monitoring

Upwind (concurrent with downwind) monitoring was conducted from late June, 2002 to mid-December, 2002 at the top of the storage shed located at the southwest corner of the facility. The dominant wind direction of Southwest to Northeast was determined from PM10 and meteorological monitoring that has been in operation since June, 2001 at nearby the City of Berkeley's Harrison Park play fields.

2.5 Downwind Monitoring

Downwind (concurrent with upwind) monitoring was conducted at the top of the storage shed located at the middle of the north fence line. This site was selected as the downwind location due to its position at the downwind side of the facility and due to the presence of the storage container to place the equipment. The height of the inlet was approximately 12 feet above ground surface.

2.6 Area Monitoring

Area monitoring was conducted for three weeks in the sorting building. The monitor was placed at the end of the sorting machine platform and run continuously during the period from December 18, 2002 to January 17, 2003. This placement was necessary due to it being the only spot that was not either occupied by material being processed or would be in the way for the forklifts, etc. However, due to its relatively protected indoor location, this site was judged to be adequate for being representative of area concentrations.

Hourly PM10 data was collected in the same manner as the upwind and downwind monitoring.

2.7 Meteorological Data Collection

Local meteorological data from the Harrison Field air monitoring that was concurrently in operation during the CCC monitoring was used to establish the upwind/downwind wind pattern.

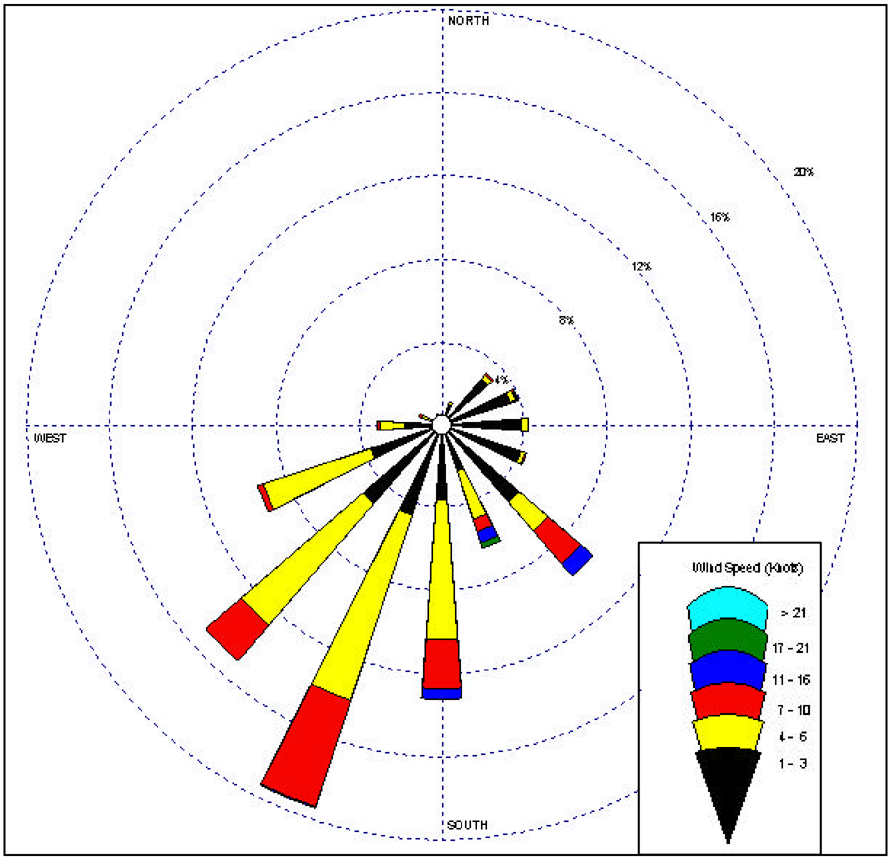

Figure 4. Wind Rose for Study Period: July to December, 2002.

This plot shows that the dominant pattern is for wind to come from the south to southwest direction, establishing the southwest monitoring location as upwind and the north location as downwind.

2.8 Monitoring Period

Monitoring was conducted at the upwind and downwind locations from July 1, 2002 to December 18, 2002. However, during that period, there were several instrument malfunctions due to pump failure. The EBAM is a relatively new instrument, and evidently some elements were not sufficiently tested. The sampling pump was replaced twice on each instrument, once being returned to the factory and once with an on-site replacement. The second pump was replaced by a new version that was promised to be more robust than the first type. This indeed turned out to be the case, as the final part of the monitoring period, data was collected without mishap.

In addition to the pump outages, there were several power problems related to the use of an extension cord that crossed a portion of the work area. When that cord was shifted to another building, those power outages stopped.

While the two sites were not contemporaneous for the entire study period, the number of days at each location plus the relatively constant wind directions suggests that the use of overall averages is valid. The examination of a subset of data that consisted of both monitors for more than 30 days mirrors the overall trends, thereby lending support to the overall method of combining data.

3. RESULTS

3.1 Upwind and Downwind PM10 Results

Hourly PM10 concentration values show that the site produced sporadic spikes in concentrations of up to 0.350 mg/m3—a substantial hourly concentration. However, combined with the dominant lower values, the overall concentrations average to more reasonable values. As the discussion below notes in relation to diurnal patterns, the overall facility contribution to background PM10 is 0.005 mg/m3.

Figure 5 shows the upwind and downwind concentrations over the entire study period. The gaps in the data due to instrument difficulties are evident.

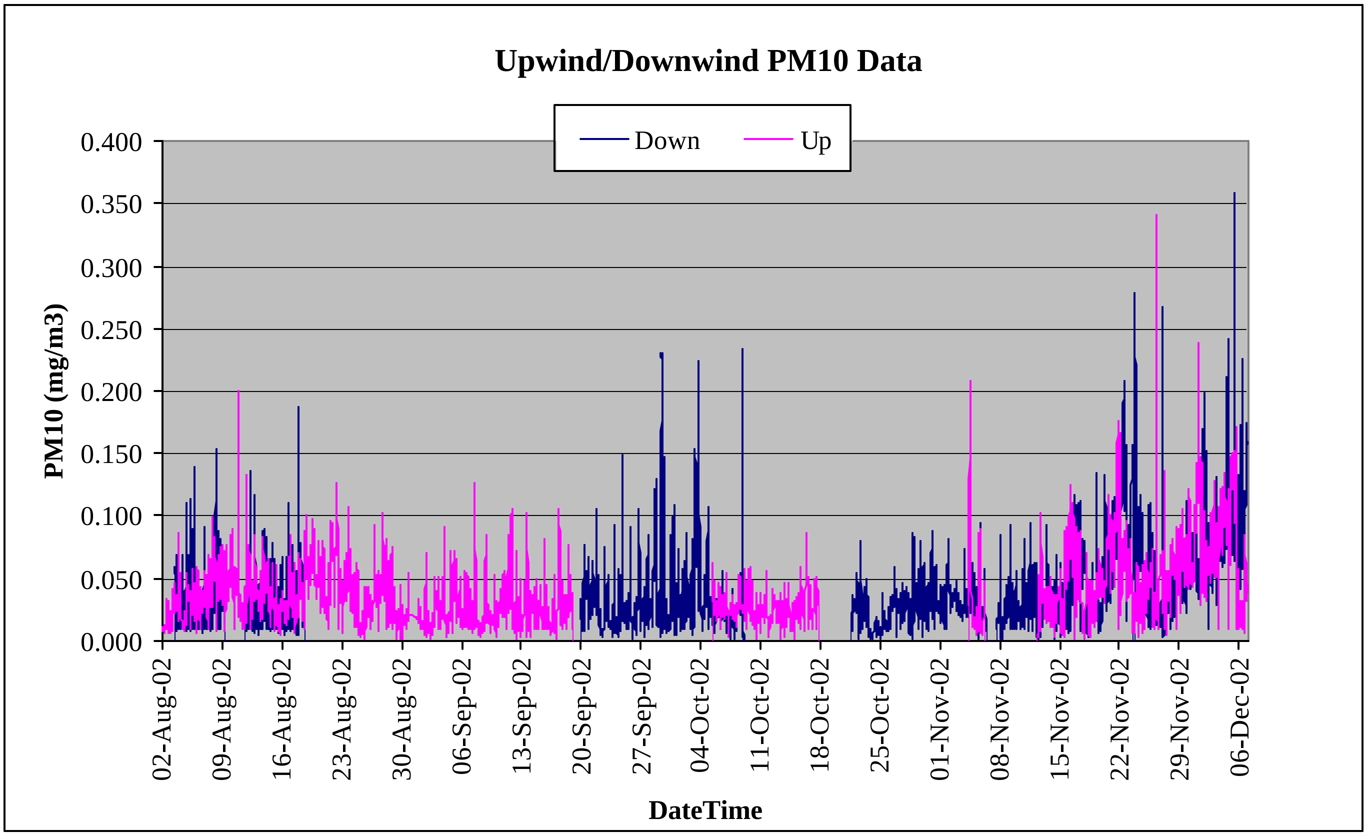

Figure 5. Upwind and Downwind Concentrations

Both upwind and downwind concentrations peaked at high values several times higher than the average, suggesting that facility operations were not the sole source for spikes. It is likely that the nearby industrial sites contributed sporadic high values, in addition to regular high values, as discussed below. In addition, mobile sources such as idling trucks nearby on 2nd street could directly impact the relatively small area bounded by the monitors.

Localized sources were certainly a cause for many of the spike values. There are several facility operations that potentially could cause short-term pulses of high dust concentrations. The specific correlation of activities with high concentrations cannot be made from this data set, but overall the activities do not appear to be major impact to the area concentrations.

Overall, the upwind concentrations were lower than the downwind concentrations by just a few micrograms per cubic meter. The data showed that the recycling center contributed just a few micrograms per cubic meter PM10 at the downwind location. The average PM10 concentration at the upwind site was 0.039 mg/m3 and at the downwind site was 0.044 mg/m3. During work hours (8AM to 5 PM), the concentrations were 0.037 mg/m3 at the upwind site, and 0.043 mg/m3 at the downwind site. During the off-hours (non-work hours), the concentrations were 0.040 mg/m3 at the upwind site and 0.045 mg/m3 at the downwind site.

The diurnal pattern is useful to examine to determine hourly trends across the entire study period. Figure 6 shows the upwind and downwind concentrations on a hourly basis averaged over the entire study period.

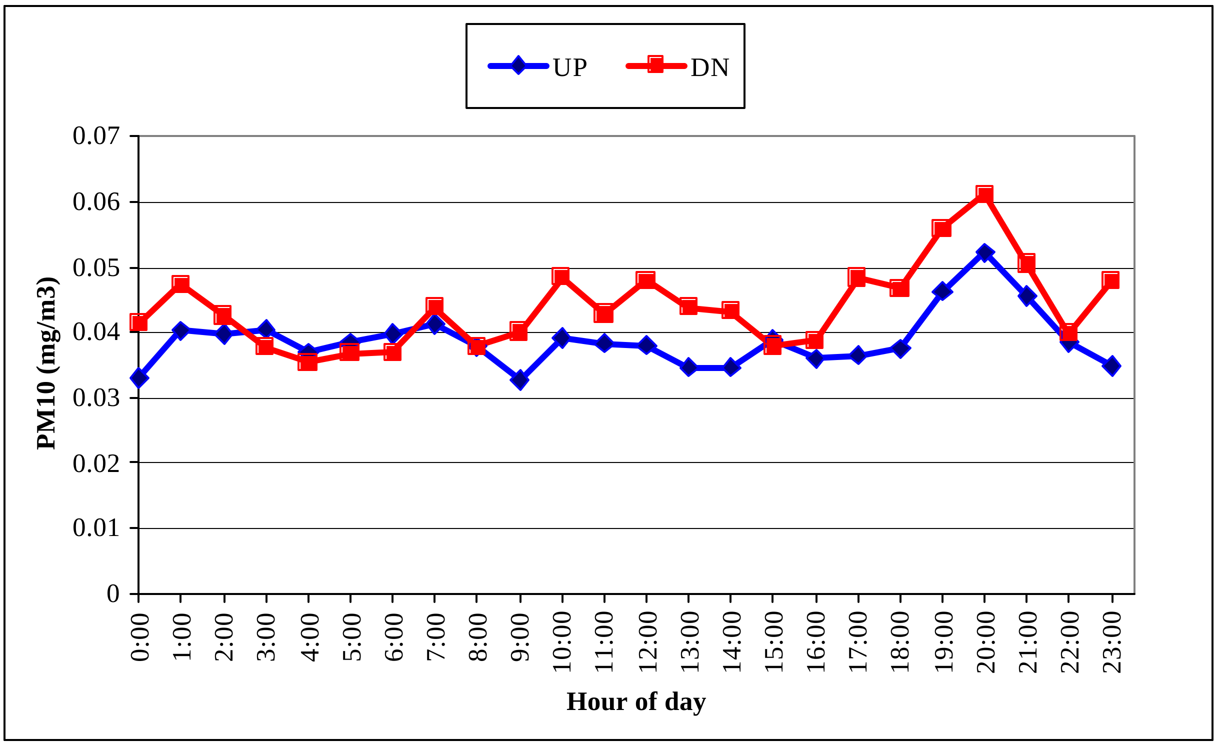

Figure 6. Diurnal Plot

Figure 6 shows hourly data are consistent with these averages. Midnight to 8 AM concentrations are fairly consistent between upwind and downwind, indicating no local sources. The divergence at midnight to 1 AM may be due to localized micrometerological conditions that arise from calmer winds in the middle of the night.

A slight upward tick at 7 AM at both locations indicates morning rush hour traffic. This slight upward trend is only slightly indicated at the afternoon rush and only at the upwind location.

The daytime work hours of 8 AM to 5 PM values show that the downwind concentrations begin to increase around 8-9 AM, and then diminish briefly at the end of the day. The average difference between the upwind and downwind concentrations during the work day was 0.006 mg/m3. This amount—0.006 mg/m3—is the estimate of the contribution of the recycling center to the area PM10 burden.

The downwind concentrations start to rise at around 5 PM and continue until a peak at 8 PM. At that time, both the upwind and downwind concentrations show a peak, although at different magnitudes.

This peak appears to be due to localized industrial activity. The fact that the downwind concentration is higher than upwind indicates an elevated source that impacts the upwind side less than the downwind. The plume appears to impact the upwind location less than the downwind location. This suggests that the emission point is elevated, that the plume is above ambient temperature, and therefore has some loft. The dispersion occurs normally in a Gaussian mode and therefore disperses over a distance. In the evening hours when the winds subside, the plume would be more distinctly formed and dispersion would occur over greater distances. Hence the conclusion that the plume originates at the foundry or steel mill and appears to impact the upwind and downwind locations in the noted manner.

Given the dominant wind direction, this peak must arise from some regular event at the foundry or steel mill. Attempts were made to ascertain what kind of regular schedule would correspond with this peak, but no definitive answers were obtained.

An examination of the weekday concentration trends shows some variation by day of the week, although only three days appear to be substantial—Sunday, Thursday, and Friday. Figure 7 shows these data.

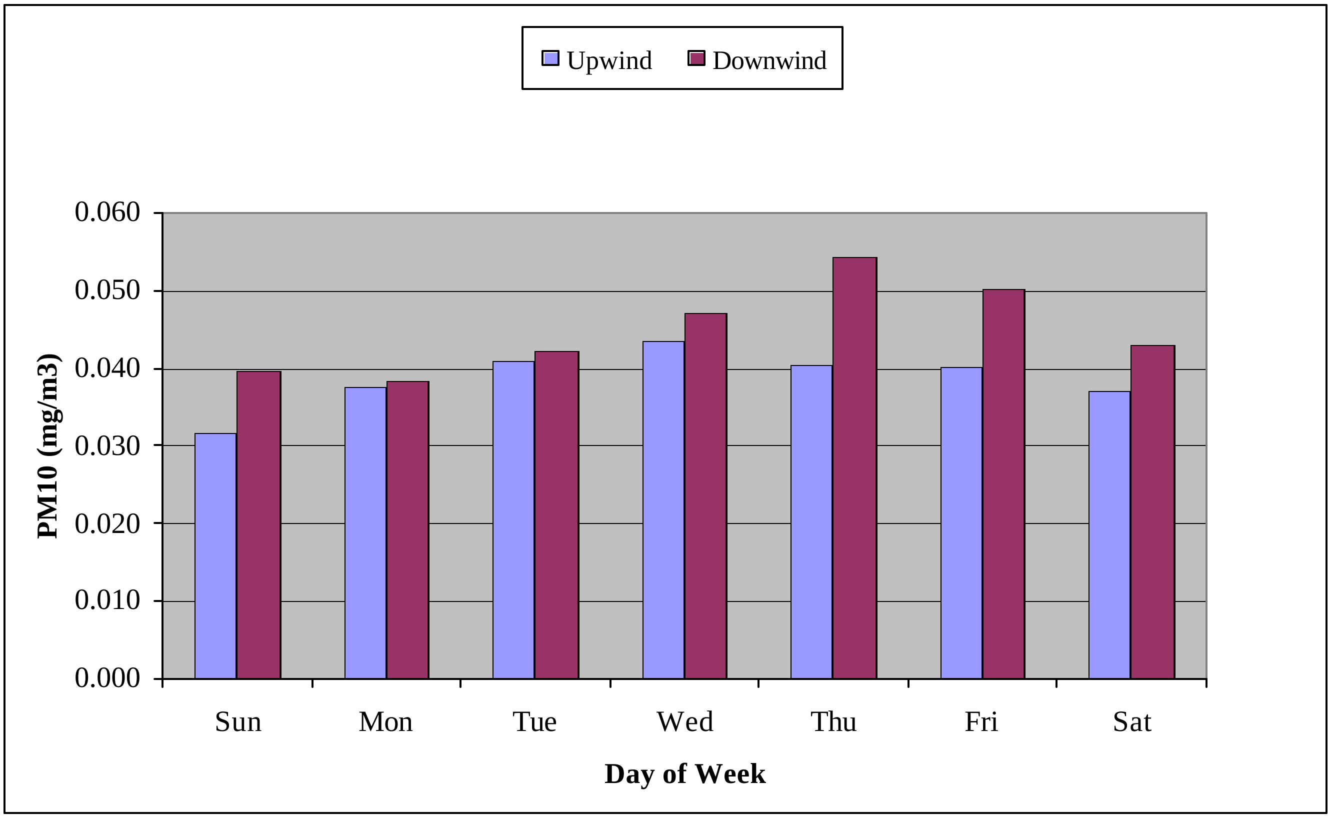

Figure 7. Day of Week Dependence

Overall, the facility operations do not cause an exceedance to any regulatory standards over the long-term since the average concentration is less than both the California and Federal ambient air standards. The California ambient air quality standard for PM10 is 0.050 mg/m3 for 24 hours, and the Federal 24-hour standard is 0.150 mg/m3.

A total of 15 instances of the 24-hour California standard exceedances occurred at the upwind location, and a total of 20 at the downwind location occurred. One 24-hour period at the downwind site exceeded the Federal standard of 0.150 mg/m3.

The relatively high number of exceedances at the upwind site suggests that other upwind sources contributed to both those exceedances and the subsequent downwind exceedances. A daily examination of the exceedances does not shed much light on trends as there are both days with high upwind and low downwind, and vice-versa. The overall trend is more important, showing a minimal facility impact to the area concentrations.

Table 1 contains the 24-hour (midnight to midnight) average concentrations for the upwind and downwind locations. The blanks in the table represent periods of instrument down time.

Table 1. 24-hour Average Concentrations
Concentrations in mg/m3.
UP=upwind, DN=downwind

Date	UP 24-hour	DN 24-hour
8/2/02	0.014	
8/3/02	0.032	0.039
8/4/02	0.024	0.037
8/5/02	0.032	0.044
8/6/02	0.033	0.023
8/7/02	0.044	0.031
8/8/02	0.049	0.048
8/9/02	0.048	0.037
8/10/02	0.052	
8/11/02	0.032	0.040
8/12/02	0.050	0.039
8/13/02	0.036	0.034
8/14/02	0.039	0.035
8/15/02	0.026	0.029
8/16/02	0.033	0.032
8/17/02	0.034	0.041
8/18/02	0.048	0.041
8/19/02	0.061	
8/20/02	0.047	
8/21/02	0.046	
8/22/02	0.058	
8/23/02	0.049	
8/24/02	0.032	
8/25/02	0.016	
8/26/02	0.034	
8/27/02	0.044	
8/28/02	0.042	
8/29/02	0.018	
8/30/02	0.020	
9/1/02	0.018	
9/2/02	0.016	
9/3/02	0.031	
9/4/02	0.022	
9/5/02	0.036	
9/6/02	0.024	
9/7/02	0.027	
9/8/02	0.017	
9/9/02	0.022	
9/10/02	0.025	
9/11/02	0.036	
9/12/02	0.020	
9/13/02	0.026	
9/14/02	0.026	
9/15/02	0.026	
9/16/02	0.018	

Date	UP 24-hour	DN 24-hour
9/17/02	0.028	
9/18/02	0.030	
9/19/02	0.013	
9/20/02		0.038
9/21/02		0.043
9/22/02		0.018
9/23/02		0.022
9/24/02		0.025
9/25/02		0.027
9/26/02		0.028
9/27/02		0.027
9/28/02		0.043
9/29/02		0.042
9/30/02		0.029
10/1/02		0.028
10/2/02		0.032
10/3/02		0.066
10/4/02		0.041
10/5/02	0.034	0.025
10/6/02	0.029	0.024
10/7/02	0.024	0.021
10/8/02	0.027	0.036
10/9/02	0.031	
10/10/02	0.022	
10/11/02	0.025	
10/12/02	0.023	
10/13/02	0.025	
10/14/02	0.020	
10/15/02	0.027	
10/16/02	0.038	
10/17/02	0.030	
10/18/02		
10/19/02		
10/20/02		
10/21/02		0.020
10/22/02		0.028
10/23/02		0.020
10/24/02		0.008
10/25/02		0.012
10/26/02		0.027
10/27/02		0.025
10/28/02		0.030
10/29/02		0.034
10/30/02		0.033
10/31/02		0.035
11/1/02		0.034
11/2/02		0.037
11/3/02		0.031
11/4/02	0.045	0.031
11/5/02	0.022	0.028

Date	UP 24-hour	DN 24-hour
11/6/02	0.028	0.027
11/7/02		0.019
11/8/02		0.023
11/9/02		0.032
11/10/02		0.027
11/11/02		0.031
11/12/02	0.025	0.018
11/13/02	0.029	0.036
11/14/02	0.026	0.028
11/15/02	0.044	0.031
11/16/02	0.072	0.050
11/17/02	0.033	0.067
11/18/02	0.034	0.030
11/19/02	0.038	0.030
11/20/02	0.063	0.052
11/21/02	0.092	0.079
11/22/02	0.078	0.110
11/23/02	0.034	0.088
11/24/02	0.033	0.067
11/25/02	0.045	0.051
11/26/02	0.047	0.037
11/27/02	0.039	0.041
11/28/02	0.060	0.042
11/29/02	0.069	0.062
11/30/02	0.079	0.077
12/1/02	0.108	0.091
12/2/02	0.068	0.083
12/3/02	0.076	0.081
12/4/02	0.097	0.106
12/5/02	0.096	0.093
12/6/02	0.028	0.109
12/7/02	0.036	0.162
12/8/02		0.119
12/9/02		0.128
12/10/02		0.087
12/11/02		0.030
12/12/02		0.034

3.2 Sorting Building PM10 Results

The sorting building was monitored for the period from December 18, 2002 to January 17, 2003. A gap from January 10 to 14 exists, presumably due to a power outage, as there was no equipment malfunction during the entire period.

A total of 30 24-hour periods were monitored. The minimum for the period was 0.009 mg/m3 and the maximum was 0.510 mg/m3. The overall average was 0.054 mg/m3, which includes all 24-

hours of the day. The daytime average was 0.060 mg/m3, and the off-hours average was 0.027 mg/m3.

Figure 8 shows the data over the 30 day monitoring period.

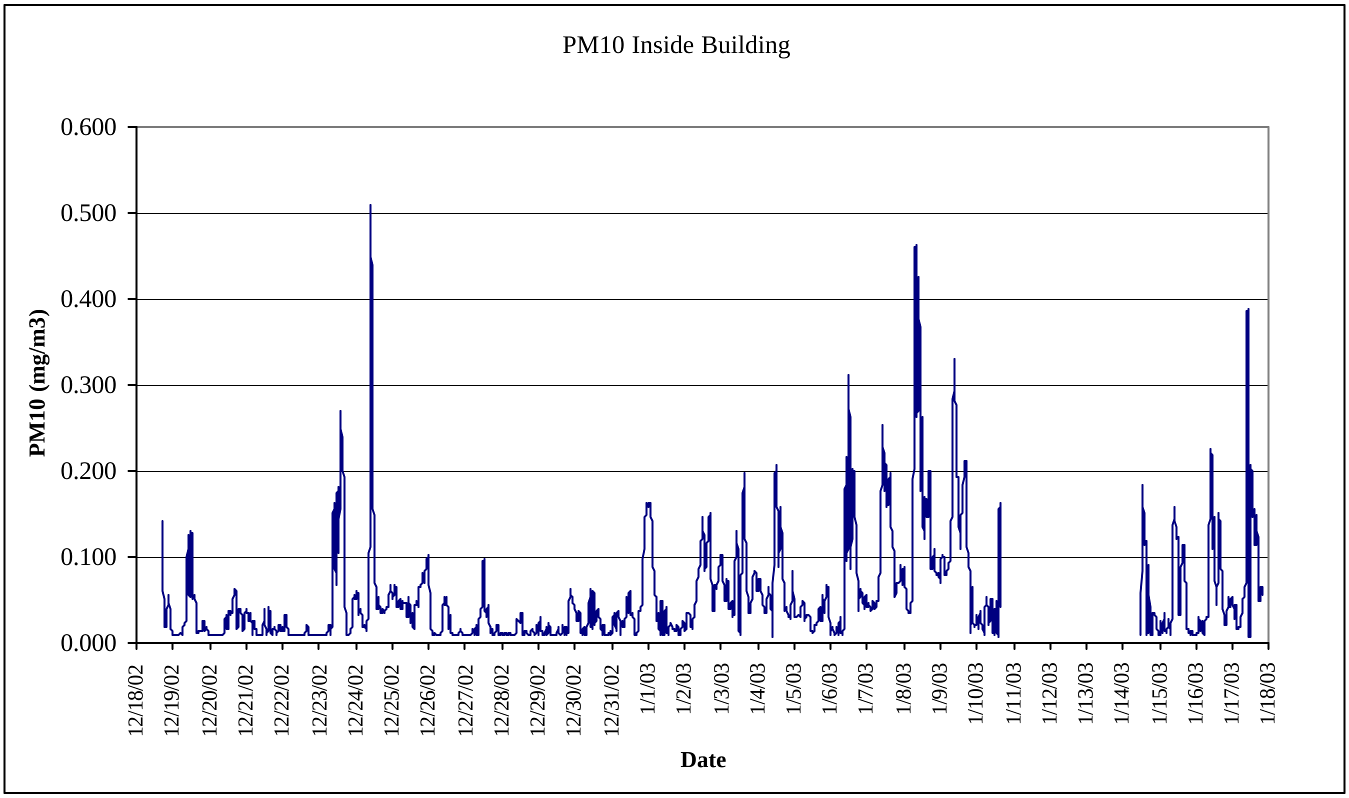

Figure 8. Sorting Building PM10 Concentrations

The periodic nature of the high concentrations is evident. When the hourly values are put into a plot of diurnal patterns, the daily work pattern emerges. Figure 9 shows the average of the hourly values over the day, with spikes at 10 AM, 12 noon, and 2 PM. The off-hour period reflects the ambient concentrations sheltered by the building.

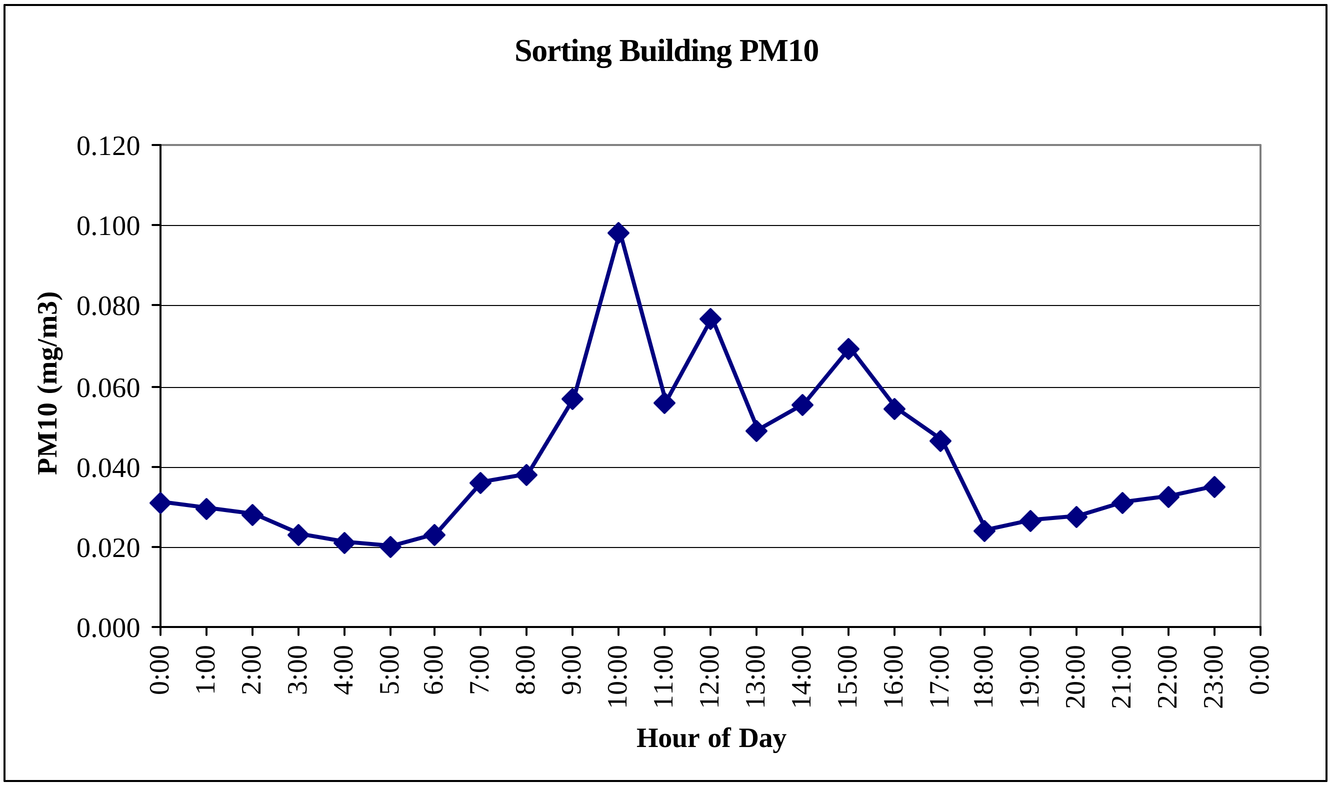

Figure 9. Sorting Building PM10 Diurnal Pattern

3.2.1 Exposure Limits

A comparison to existing worker exposure standards shows that the PM10 concentration values measured did not exceed applicable levels. Two general standards are used for worker exposure: the Occupational Safety and Health Administration (OSHA), and the National Institutes of Occupational Safety and Health (NIOSH). For this sort of dust, NIOSH cites the OSHA standard.

No specific standard exists for dust generated from paper handling procedures. However, a general category of "particulates not otherwise regulated" exists to handle this kind of situation. The OSHA permissible exposure level (PEL) for particulates otherwise not regulated is 15 mg/m3 for total dust and 5 mg/m3 for respirable dust. While the PM10 cutoff of the instrumentation used is slightly different from that used by OSHA, a cutoff of 10 microns is a generally accepted point for respirable dust. Therefore, the PM10 values obtained by the EBAM can be used to compare against this standard. The PEL is defined over an 8-hour integrated work day period, so the work hours average is compared against the standard.

The work-day average for the sorting building was 0.060 mg/m3, a factor of 83 times lower than the standard of 5 mg/m3. The highest hourly concentration detected was 0.510 mg/m3, which is still approximately a factor of 10 lower than the standard. Therefore, it appears that the atmosphere in the sorting building does not pose a health standard for respirable dust from routine operations.

4. Summary and Conclusions

Monitoring for particulate matter of 10 microns aerodynamic diameter was conducted at two locations at upwind and downwind locations of the Berkeley Recycling Center from August to December, 2002. The PM10 monitoring at these upwind and downwind locations have shown that the impact from facility operations during work day is approximately 0.006 mg/m3. Higher spikes from localized transient operations do occur, but when averaged into the predominantly lower concentrations, the average for the upwind location was 0.039 mg/m3, and for the downwind location was 0.044 mg/m3. The value of 0.039 mg/m3 can be considered a general background value for the area, which is bounded by industrial and mobile sources.

Other monitoring was conducted inside the sorting building for the purpose of assessing the worker exposure to dust produced during operations there. The results showed an average of 0.060 mg/m3, a factor of 83 times lower than the applicable OSHA standard. Therefore, the dust in the sorting building does not appear to pose a hazard for workers under routine operations.