Sonoma Technology, Inc.
Innovative Environmental Solutions

Ninth Annual Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School: A Nine-Year Summary November 22, 2007–November 21, 2016





Prepared for
Planning Department, City of Los Angeles
and
Los Angeles County Department of Regional Planning
Los Angeles, California

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Ninth Annual Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School: A Nine-Year Summary November 22, 2007–November 21, 2016

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On the cover (clockwise from upper left): monitoring trailer and meteorological tower at Van Gogh School, DeltaCal NIST-traceable reference meter for auditing flow and temperature, Aethalometer with Beta Attenuation Monitor and data acquisition system, monitoring trailer and meteorological tower at South Berm, and Sunshine Canyon Landfill.

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Executive Summary

Continuous monitoring of meteorological and air quality parameters began at the Sunshine Canyon Landfill (Landfill site) and at Van Gogh Elementary School (Community site) in the nearby community of Granada Hills in fall 2007. Ambient concentrations of particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) are determined by integrated hourly measurements employing a beta attenuation monitor (BAM). Wind speed and wind direction are measured as 1-minute averages, and black carbon (BC)—a surrogate for diesel particulate matter (DPM)—is measured by an Aethalometer as 5-minute averages. STI began monitoring at the Landfill North site on December 11, 2015, measuring PM_{10}, BC, and wind speed and direction, analogous to the Landfill site. The site was planned to run for a minimum of one year, at which time its utility would be assessed and a decision would be made whether to keep the site for the duration of the existing monitoring contract.

All data are reported as hourly averages. The collected data undergo quarterly validation and are evaluated for completeness. BC values are compensated for filter tape saturation effects, which bias instrument measurements low when BC concentrations are high. PM_{10} concentrations are compared with federal and state PM_{10} standards and with the historical, regional, and annual ambient PM_{10} concentrations. BC concentrations are compared with regional concentrations. The PM_{10} and BC data undergo further analysis to characterize the impact of landfill operations on ambient air quality on a neighborhood scale. The validated hourly data and a summary of the analytical results and field operations are reported to the Planning Department of the City of Los Angeles, and to the Los Angeles County Department of Regional Planning, quarterly and annually.

This Ninth Annual Report includes data summaries, accompanied by analysis and interpretation, drawn from nine complete years of continuous monitoring of PM_{10}, BC, and meteorological data at the Landfill and Community monitoring sites, and from one year of data at the Landfill North site. This represents an extensive repository of data with high temporal resolution. These annual data sets, characterized by high data quality, increase the level of confidence for inferences made from comparisons with standards, comparisons between the monitoring sites, observed seasonal or annual trends, and comparisons with regional observations reported by South Coast Air Quality Management District (SCAQMD) monitoring sites in the South Coast Air Basin (SoCAB). Baseline-year data, collected between November 22, 2001, and November 21, 2002, at the Landfill and Community monitoring sites, can provide additional historical perspective. This annual report uses the available data to characterize ambient PM_{10} and BC concentrations on a neighborhood scale and in the context of the SoCAB, and to continue to evaluate the impact of landfill operations on air quality in the community. Of note for this report is the availability of the Landfill North site data and the opportunity to obtain a more direct measure of landfill contributions to PM_{10} and BC concentrations at the Landfill and Community sites.

On average, PM_{10} and BC concentrations have continued their downward or constant trends. As in past years, PM_{10} exceedances occur more frequently at the Landfill site than at the Community site and tend to occur when winds are high (Landfill) or there are elevated regional PM_{10} concentrations (Community).

On average, regional influences on PM_{10} and BC concentrations remain large compared to landfill impacts. The observed patterns in seasonal or monthly average PM_{10} concentrations, within years, are similar among the Landfill site, the Community site, downtown Los Angeles (North Main Street), Burbank (West Palm), and Santa Clarita. However, the neighborhood-scale impacts of the landfill are apparent during discrete time periods, which are typically characterized by high wind speeds from the northwest (upwind of the landfill site). For BC, in previous reports, BC concentrations at the Landfill and Community sites were significantly lower than those measured in the SCAQMD's Multiple Air Toxics Exposure Study (MATES IV), a study performed July 2012 to July 2013. The BC concentrations in the current period at the Landfill and Community sites are lower than those observed in that time period.

To estimate the landfill contributions to PM_{10} and BC concentrations at the Landfill and Community sites, we developed a method that has been applied annually. Basically, under the appropriate wind directions, we used non-working day/hour concentrations and working day/hour concentrations to estimate background and the greatest impacts from the landfill, respectively. For this ninth year, we had the opportunity to obtain a more direct measure of landfill contributions at the Landfill site using data from the North Landfill site. With winds from the northwest and from the south on working days/hours, the concentration differences between the North Landfill and Landfill sites represent landfill operation impacts. This direct method for landfill operation impacts shows significantly higher PM_{10} contributions, 20 to 25 $\mu g/m^3$, than were estimated using the previous method (about 9 $\mu g/m^3$ in the ninth year). While the PM_{10} impacts are higher than previously estimated at the Landfill site, the BC differences between the Landfill and Landfill North sites are small (about 0.1 $\mu g/m^3$) and about the same as using the more imprecise estimation method. This finding suggests a small localized BC contribution from activities at the landfill to the downwind landfill monitor. Also of note, these BC concentrations from landfill activities are quite low.

Importantly, because the PM_{10} and BC concentrations at the Community site were lower than those at the Landfill (and Landfill North) site regardless of wind sectors, the data show that the higher concentrations at the Landfill sites did not reach the Community site. Thus, both methods, the imprecise estimation method used to date, and the more precise method using the North Landfill site data, give the same results showing no evidence of landfill PM_{10} or BC impacts at the Community site. However, the direct measure provides much more precise quantification of the landfill impacts at the Landfill sites. The Landfill North site is useful for tracking more precisely the landfill operation PM_{10} and BC impacts within landfill boundaries. Using the North Landfill site also provides more confidence in the finding of no Landfill impacts at the Community site.

1. Introduction

Two air quality monitoring sites were established by operators of the Sunshine Canyon Landfill in 2001. One monitoring site is on a high-elevation ridge on the southern edge of the Sunshine Canyon Landfill (Landfill site). The second site is at Van Gogh Elementary School in the nearby community of Granada Hills (Community site). These sites were established to monitor particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), black carbon (BC) as a surrogate for diesel particulate matter (DPM), wind direction, and wind speed, in fulfillment of the stipulations set forth in the City of Los Angeles' Conditions of Approval for the expansion of the Sunshine Canyon Landfill in the City of Los Angeles (Section C.10.a of Ordinance No. 172,933). In 2009, the County of Los Angeles Department of Regional Planning and Public Works adopted conditions (County Condition 81) very similar to the City's conditions, governing ambient air quality monitoring for the County portion of the landfill.

The original Conditions of Approval also required sampling of landfill gas (LFG) on four occasions throughout each year at each of the locations. The LFG sampling requirement was subsequently eliminated as part of the routine monitoring contract. From April 2010 through December 2012, BFI/Republic operated the Sunshine Canyon Landfill under a Stipulated Order for Abatement (SOA) issued by the South Coast Air Quality Management District (SCAQMD) Hearing Board (a quasi-judicial body separate from SCAQMD). The SOA included many operational provisions, and one of the subsequent amendments to the SOA required BFI/Republic to move to one-in-six day sampling of volatile organic compounds (VOCs) for a minimum of one year. As a result of this requirement for more frequent sampling of VOCs, the four LFG samples are no longer required as part of the City and County Conditions of Approval. Although the formal SOA has been lifted, the landfill operator still adheres to some of its stipulations, such as those limiting landfill activities under certain wind conditions.

1.1 Baseline Year and Continuous Monitoring

A baseline year of continuous monitoring of PM_{10}, BC, and meteorology occurred between November 22, 2001, and November 21, 2002, and a report of the baseline year results was produced by ENVIRON International Corporation.[1] A baseline study of LFG was conducted in 2003 and served as the basis for the establishment of an LFG monitoring protocol.[2] Between the time that the baseline studies were completed and November 2007, when continuous monitoring began, ambient sampling for PM_{10}, BC, and LFG was planned at a nominal frequency of four times each year by ENVIRON International Corporation. Data from those years are not included in this report.

Beginning in 2007, ambient monitoring of particulate matter (and LFGs in some years) at the Landfill and Community sites became the responsibility of Sonoma Technology, Inc. (STI).

[1] ENVIRON International Corporation (2003) Results of the baseline ambient air monitoring program for the Sunshine Canyon Landfill. Final report prepared for Browning-Ferris Industries of California, Inc., by ENVIRON International Corporation, Contract No. 03-9660A, June 6.
[2] ENVIRON International Corporation (2003) Proposed landfill gas baseline ambient air monitoring protocol for the Sunshine Canyon Landfill. Report prepared for Browning-Ferris Industries of California, Inc., by ENVIRON International Corporation, Contract No. 03-9660A, March 27.

STI's technical approach to monitor PM_{10} and BC was based on continuous monitoring (hourly, year-round), whereas previous monitoring was limited to four events per year. Continuous year-round monitoring of PM_{10} and BC allows greater potential for evaluation of times when air flows from the landfill to the Community receptor site, as well as for evaluation of diurnal trends, day-of-week differences, seasonal differences, and annual trends in pollutant concentrations in comparison with regional monitors operated by the SCAQMD and the California Air Resources Board (CARB).

On December 11, 2015, STI began monitoring at the Landfill North site, measuring PM_{10}, BC, and wind speed and direction as at the Landfill site. The site was planned to run for a minimum of one year, at which time its utility would be assessed and a decision would be made whether to keep the site for the duration of the existing monitoring contract. The goal for this site is to assess the utility of measurements at the upwind location for determining with high confidence the impact of landfill-based emissions of PM_{10} and diesel particulate matter on air quality in the nearby communities.

November 22, 2016, marked the completion of nine full years of continuous monitoring of PM_{10}, BC, and meteorology at the two main monitoring locations. Data capture rates and the quality of the captured data have generally been very high. A few discrete events have interrupted data capture at one or both sites; for example, the Sayre Fire in late 2008 took out power at the Landfill monitoring site for several weeks. In addition, monitoring equipment upgrades in 2010 caused some loss of data because instruments were temporarily removed. There was significant loss of PM_{10} data during the fourth quarter of Year 9 because the BAM instruments were removed from the field and sent to the manufacturer for maintenance. This is the first time this project has experienced such a large period of data loss. Even with these interruptions, however, data completeness statistics for the nine years indicate average data capture rates of approximately 96% at the Landfill site and approximately 97% at the Community site (see Section 2). On average, less than 6% of all captured data at the Landfill and Community sites were judged as invalid.

1.2 Report Overview

In this report, the high-quality, high-time-resolution data captured over the nine years between November 2007 and November 2016 at the Landfill and Community sites, and data for the last year captured at the Landfill North site, are analyzed and summarized to offer a realistic characterization of ambient air quality concentrations at the Landfill and the Granada Hills community, and to provide perspective on air quality at the landfill and the local community in the context of the greater South Coast Air Basin (SoCAB).

- Section 2 of this report discusses data completeness.
- Section 3 covers PM_{10} exceedances.
- Section 4 discusses regional comparisons of PM_{10}. No regional comparisons of BC were done in Year 9 because the MATES data set used for comparison is only available every few years. The data in Year 9 would not change the conclusions from the previous comparison (shown in **Appendix A**).
- Section 5 describes the effects of wind direction and work activity levels on PM_{10} and BC concentrations at the Landfill and Community monitoring sites.

- Section 6 discusses the landfill's impact on ambient PM_{10} and BC concentrations.
- Section 7 describes routine field operations and recent upgrades to site infrastructure.
- Additional analyses are provided in **Appendix B**.

Regulatory standards for pollutants are commonly used to judge the compliance status of air districts and air basins. Currently, the only federal health-based standard for PM_{10} is the daily (24-hr) average concentration of 150 $\mu g/m^3$. The State of California's PM_{10} 24-hr standard (50 $\mu g/m^3$) is more stringent than the federal standard. (The previously existing federal annual standard of 50 $\mu g/m^3$ was revoked because of the lack of substantial evidence of health effects attributable to long-term exposures.) In this report, the 24-hr federal standard of 150 $\mu g/m^3$ is used as a benchmark metric for evaluating the specific monitoring locations in relation to each other and to the federal standard.

Regional comparisons of ambient PM_{10} concentrations are used to place the Landfill and Community monitors within the larger context of regional concentrations. For these comparisons, three of the closest regional monitoring sites, operated by the SCAQMD, were chosen: downtown Los Angeles (North Main Street); Burbank (West Palm), and Santa Clarita. **Figure 1-1** shows the relative locations of the sites.

Ambient concentrations of BC as a surrogate for DPM continue to receive increased interest statewide, nationally, and globally. SCAQMD has shown that DPM is one of the primary toxics of concern in the SoCAB. To place the Landfill and Community monitors within the larger context of regional concentrations, four of the closest regional monitoring sites from the Multiple Air Toxics Exposure Study (MATES IV) air toxics study (summer 2012–summer 2013),[3] also operated by the SCAQMD, were selected: Burbank (approximately the same location as the Burbank PM_{10} site), Central LA (approximately the same location as the Los Angeles PM_{10} site), Huntington Park, and Pico Rivera. Note that this regional comparison spans only the one-year study period of the MATES IV study (Appendix A).

[3] Information at http://www.aqmd.gov/home/library/air-quality-data-studies/health-studies/mates-iv.

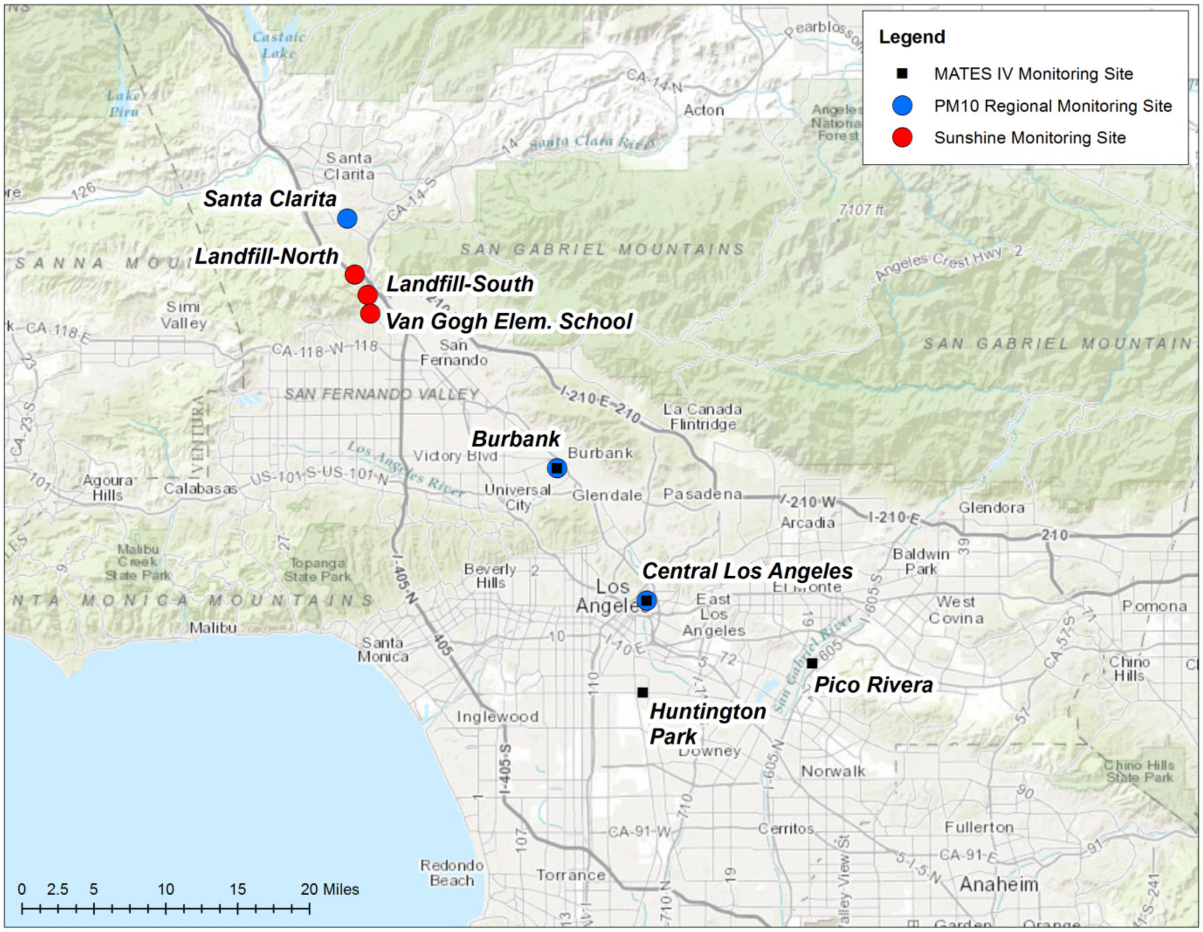


Figure 1-1. Locations of the Landfill and Community monitors in relation to the three SCAQMD PM_{10} sites and four MATES IV BC sites used for regional comparisons. The Landfill site is labeled “Landfill South,” and the Community monitor is labeled “Van Gogh Elem. School.” In MATES IV documentation, the Central Los Angeles site is referred to as “Central LA.”

1.3 Methods and Operations Background

Aethalometers measure BC concentrations via an optical attenuation technique, and are subject to what is known as a tape saturation effect, where the buildup of BC on the tape causes an artifact affecting the accuracy of the measured concentration.[4,5] Instrument response is dampened with heavier loading (i.e., heavier concentrations) of black carbon aerosol. This artifact can bias BC concentrations low. However, mathematical methods to correct the BC concentrations are available and are widely used. To effectively compare BC measured at the

[4] Drinovec L.et al. (2014) The "dual-spot" Aethalometer: an improved measurement of aerosol black carbon with real-time loading compensation. *Atmos. Meas. Tech. Discuss.*, 7(9), 10179-10220, doi: 10.5194/amtd-7-10179-2014. Available at http://www.atmos-meas-tech-discuss.net/7/10179/2014/.

[5] Allen G. (2014) Analysis of spatial and temporal trends of black carbon in Boston. Report prepared by Northeast States for Coordinated Air Use Management (NESCAUM), Boston, MA, January. Available at nescaum.org/documents/analysis-of-spatial-and-temporal-trends-of-black-carbon-in-boston/nescaum-boston-bc-final-rept-2014.pdf/.

Landfill and Community sites to BC measured at the regional MATES IV study sites, BC values from the Landfill and Community sites were compensated for this tape saturation effect. Further discussion of BC concentrations was provided in the Seventh Annual Report.

Meteorological factors and work activity levels are known to have an impact on local and regional pollutant concentrations. An analysis based on wind direction and landfill working versus non-working days and hours is used to quantify the relationship of these factors to PM_{10} and BC concentrations. This analysis also provides quantitative estimates of landfill contributions to ambient concentrations of PM_{10} and BC. A summary of the analytical method is presented in Section 6, with additional analyses in Appendix B.

One area of concern to the residents of nearby communities is the occurrence of offensive odors. An abatement hearing in March 2010 (SCAQMD Case 3448-13) resulted in several stipulated requirements placed on landfill operations to help address the odor problems. However, the frequency of odor complaints continued to increase, and the original Order for Abatement was amended in November 2011 to add several additional conditions. One of the November 2011 abatement amendments directly affected STI's monitoring protocols. The landfill was required to conduct one-in-six day sampling of VOCs for a minimum of one year, following established U.S. Environmental Protection Agency (EPA) schedules and the protocols of SCAQMD's MATES IV. This program, conducted separately from STI's monitoring, effectively made the LFG sampling required under City Conditions of Approval C.10.a redundant. Since June 2012, STI has not conducted any LFG sampling as previously required in fulfillment of City Condition C.10.a and County Condition 81.

In early 2015, STI won the competitive bidding process to continue the monitoring program for an additional five years. The new five-year contract spans from April 1, 2015, through March 31, 2020. The contract contained a conditional provision for one year of one-in-six day VOC sampling. In early 2016, the City and County requested that STI move ahead with this VOC sampling program. STI is conducting sampling from mid-July 2016 through mid-July 2017. These data will be summarized after completion of sampling.

2. Data Completeness

Table 2-1 shows completeness statistics for all measured variables for the nine years considered in this analysis. Except for Year 2 (when the Sayre Fire shut down the Landfill monitoring site's data collection effort from November 15, 2008, through January 8, 2009) and Year 9 (due to instrument maintenance), the percent data capture exceeded 90% in each site-year for $PM_{10,}$ and averaged more than 95% over all nine years at the Landfill and Community sites. Additionally, annual completeness statistics are included for the Landfill North site. The values in this table are based on valid hourly averages and may differ slightly from percentages presented in the quarterly reports, which are based on 1-minute or 5-minute data.

Slightly different methods were used to calculate the values in Table 2-1 over the years, and previous annual reports contained some errors in this table. All percent completeness statistics have been recalculated by the methods detailed in the following paragraph, and numbers in the table have been updated accordingly. Numbers have also been updated to reflect compensated BC data completeness (comparable in completeness to uncompensated BC data).

Percent Data Capture is the percent of hourly data values that were collected divided by the total number of expected data intervals in the date range (e.g., 24 hourly data values are expected per day, and 8,760 hourly data values are expected per year—8,784 during leap years). Percent Data Valid or Suspect is the percent of data values that are either valid or suspect divided by the number of captured data values. Percent Data Suspect is the percent of data values that are labeled as suspect divided by the number of captured data values. WS/WD is wind speed/wind direction.

Table 2-1. Data completeness statistics for hourly data during Years 1–9 of continuous monitoring and overall nine-year averages. The begin and end dates for each year are chosen to allow comparison with data collected from the baseline year (November 22, 2001–November 21, 2002).

Years	Monitoring Location	Percent Data Capture (%)			Percent Data Valid or Suspect (%)			Percent Data Suspect (%)		
		PM_{10}	BC	WS/ WD	PM_{10}	BC	WS/ WD	PM_{10}	BC	WS/ WD
Yr. 1 Nov. 22, 2007– Nov. 21, 2008	Sunshine Canyon Landfill Site	94.2%	90.7%	88.3%	98.0%	99.9%	93.3%	0.0%	0.0%	0.0%
	Van Gogh Elementary School Site	95.8%	92.3%	95.4%	96.0%	100.0%	94.7%	0.0%	0.0%	0.0%
Yr. 2 Nov. 22, 2008– Nov. 21, 2009	Sunshine Canyon Landfill Site	86.6%	81.3%	86.8%	97.9%	100.0%	98.3%	0.0%	0.0%	0.0%
	Van Gogh Elementary School Site	98.7%	98.5%	99.9%	96.3%	100.0%	99.9%	0.0%	0.0%	0.0%
Yr. 3 Nov. 22, 2009– Nov. 21, 2010	Sunshine Canyon Landfill Site	99.7%	87.8%	98.4%	98.2%	100.0%	99.2%	0.0%	0.0%	4.3%
	Van Gogh Elementary School Site	98.4%	87.9%	98.3%	97.0%	100.0%	100.0%	0.3%	23.3%[a]	0.0%
Yr. 4 Nov. 22, 2010– Nov. 21, 2011	Sunshine Canyon Landfill Site	90.8%	99.6%	99.9%	96.9%	100.0%	97.5%	0.0%	0.0%	1.6%
	Van Gogh Elementary School Site	100.0%	99.8%	100.0%	99.2%	99.9%	96.3%	0.0%	0.0%	0.0%
Yr. 5 Nov. 22, 2011– Nov. 21, 2012	Sunshine Canyon Landfill Site	99.1%	99.6%	99.4%	95.4%	99.9%	96.7%	5.0%	0.0%	1.0%
	Van Gogh Elementary School Site	94.1%	99.9%	98.7%	98.1%	99.9%	96.1%	0.0%	0.0%	0.0%
Yr. 6 Nov. 22, 2012– Nov. 21, 2013	Sunshine Canyon Landfill Site	99.9%	99.7%	98.7%	98.6%	99.9%	100.0%	0.5%	0.0%	0.0%
	Van Gogh Elementary School Site	100.0%	99.8%	99.4%	97.7%	100.0%	100.0%	0.4%	0.1%	0.0%
Yr. 7 Nov. 22, 2013– Nov. 21, 2014	Sunshine Canyon Landfill Site	100.0%	87.9%	98.1%	99.3%	100.0%	100.0%	0.2%	0.0%	0.0%
	Van Gogh Elementary School Site	100.0%	99.1%	98.5%	98.0%	100.0%	100.0%	0.1%	0.6%	0.0%
Yr. 8 Nov. 22, 2014– Nov. 21, 2015	Sunshine Canyon Landfill Site	99.9%	88.4%	98.6%	98.3%	100.0%	100.0%	0.3%	0.1%	0.0%
	Van Gogh Elementary School Site	99.9%	85.1%	99.0%	82.2%	100.0%	100.0%	0.1%	0.0%	0.0%
Yr. 9 Nov. 22, 2015– Nov. 21, 2016	Sunshine Canyon Landfill Site	91.8%	93.3%	99.16%	74.7%	99.8%	100%	0.0%	0.0%	0.0%
	Van Gogh Elementary School Site	89.9%	92.4%	99.18%	80.1%	99.7%	100%	0.0%	0.0%	0.0%
	Sunshine Canyon Landfill North Site	93.6%	85.6%	88.0%	81.3%	99.9%	100.0%	0.0%	0.0%	0.0%
Nine-Yr. Average	Sunshine Canyon Landfill Site	95.8%	92.0%	96.4%	96.0%	99.9%	98.3%	0.8%	0.0%	0.8%
	Van Gogh Elementary School Site	97.4%	95.0%	98.7%	94.9%	99.9%	98.6%	0.2%	2.7%	0.0%

[a] Three-fourths of the data from the June 2010–August 2010 quarter were suspect because flow rates as measured by the reference flow meter were outside of tolerance levels. This was due to a leak in the push-to-connect fitting at the back of the Aethalometer. Further details can be found in the Eleventh Quarterly report. This quarter negatively affects the eight-year average for percent suspect. Without this quarter, the eight-year average would be 0.1% instead of 3.4%.

3. PM$_{10}$ Exceedances

Table 3-1 lists all the days during the past nine years of continuous monitoring on which the federal 24-hr PM$_{10}$ standard was exceeded at any of the monitoring sites operated by STI, along with 24-hr average concentrations from those days at the three comparative SCAQMD sites (Burbank, Santa Clarita, and downtown Los Angeles). The federal standard was exceeded on 20 occasions at the Landfill site; on two of those 20 days, the Community monitor also registered an exceedance. Note that the first exceedance reported in Table 3-1 occurred in October 2007, after the equipment at the sites was refurbished and continuous monitoring began, but before the period covered by this report. These early concentration data are valid and thus included here for completeness. The SCAQMD sites in Burbank, Santa Clarita, and Los Angeles did not report exceedances on any of those days. However, the SCAQMD sites did report high 24-hr PM$_{10}$ concentrations on the two days when the Community monitor recorded PM$_{10}$ exceedances. The downtown Los Angeles monitor was only 3 µg/m^3 below the PM$_{10}$ exceedance threshold on October 27, 2009, and the concentrations measured at Burbank were also elevated. The elevated concentrations at other sites suggest that, when regional concentrations are high, a synergistic effect between landfill contributions and regional contributions can push the Community site's PM$_{10}$ concentrations over the federal standard. Note that when regional concentrations are low, high 24-hr concentrations at the Landfill monitor, such as those seen during three days in 2011, have no significant effect on Community PM$_{10}$ concentrations.

The Burbank and Los Angeles sites have continuous PM$_{10}$ monitors, like those at the Landfill and Community sites, which report hourly concentrations; the Santa Clarita site, however, employs Federal Reference Method (FRM) sampling (integrated 24-hr samples on filters) on a one-in-six day schedule. Only one of the days listed in Table 3-1 happened to fall on the one-in-six day Santa Clarita sample schedule. This serves as a reminder of the utility of continuous monitoring: on October 22, 2007, there was a PM$_{10}$ exceedance at the Landfill site, and the PM$_{10}$ concentration at the downtown Los Angeles site was elevated, but there was no filter sample collected at the Santa Clarita station.

Since 2011, there have been 13 days when the PM$_{10}$ concentrations at the Landfill site were greater than 150 µg/m^3. On all but one of these days, the PM$_{10}$ concentrations at the Community site and, when available, at regional monitoring sites, were low. After nine years of continuous data collection, it is clear that PM$_{10}$ exceedances at the Landfill site are more common than they are in the Community or at regional monitoring sites, suggesting that surface material is being entrained at high wind speeds and subsequently detected by the Landfill monitor. By the time these air parcels reach the Community or regional monitors, they have been diluted, and some of the larger particles may have been removed by deposition. The Landfill, Landfill North, and Community sites all had high PM$_{10}$ on July 30, 2016; unfortunately, there are no data available on that day from the nearby regional sites. However, PM$_{10}$ concentrations at monitors outside of the Los Angeles area also recorded concentrations greater than 100 µg/m^3 over many hours, suggesting that there may have been a large, regional-scale PM$_{10}$ event.

Table 3-1. Summary of 24-hr PM_{10} concentrations (µg/m^3) at the Landfill, Community and Landfill North monitoring sites and at the Burbank, Santa Clarita, and Los Angeles regional sites operated by SCAQMD on days when a federal PM_{10} exceedance (more than 150 µg/m^3) occurred at the Landfill site.

Date	Landfill Site	Community Site	Landfill North Site	Burbank West Palm	Los Angeles Main Street	Santa Clarita
10/22/2007	183	41	n/a	93	108	-- [b,c]
2/14/2008	167	48	n/a	19	30	-- [b]
5/21/2008	290	152	n/a	119	140	-- [b]
10/9/2008	158	104	n/a	-- [b]	59	91
11/15/2008	269 [a]	136	n/a	-- [b]	85	-- [b]
1/9/2009	185	71	n/a	-- [b]	68	-- [b]
5/6/2009	257	91	n/a	-- [b]	49	-- [b]
10/27/2009	239	165	n/a	130	147	-- [b]
1/20/2011	207	28	n/a	26	46	-- [b]
4/30/2011	221	32	n/a	25	40	-- [b]
11/2/2011	263	43	n/a	37	56	-- [b]
5/22/2012	186	61	n/a	34	76 [d]	-- [b]
10/26/2012	227	49	n/a	31	40	-- [b]
3/21/2013	181	34	n/a	32	37	-- [b]
4/8/2013	174	64	n/a	53	-- [b]	-- [b]
10/4/2013	200	64	n/a	28	58	-- [b]
12/4/2013	155	18	n/a	21	25 [e]	-- [b]
12/9/2013	181	31	n/a	24	34	-- [b]
7/22/2016	183	51	66	-- [f]	53	-- [b]
7/30/2016	153	129	209	-- [f]	-- [b]	-- [b]
11/17/2016	178	38	-- [b]	-- [f]	51 [g]	-- [b]

[a] Only 6 hours of data available.
[b] No data available.
[c] The previous day at Santa Clarita, 10/21/07, an exceedance of 167 µg/m^3 was recorded.
[d] Only 12 hours of data available.
[e] Only 17 hours of data available.
[f] PM_{10} monitoring was discontinued in July 2014.
[g] Data from AirNowTech, which are considered preliminary.

The PM_{10} exceedances listed in Table 3-1 were generally accompanied by high wind speeds, with wind direction falling within a narrow sector that encompasses the active portion of the landfill. Wind data from the Landfill site for all exceedance days are plotted as a wind rose overlay in **Figure 3-1**, which is an aerial image of the Landfill. The majority of the winds were from the northwest, passing directly over working areas of the landfill. A smaller, but still significant, proportion of the winds were from the north sector. Wind speeds were highest when the wind direction was from the northwest and from the north. In Figure 3-1, the center point of the wind rose diagram is directly over the location of the monitoring trailer on the Landfill site.

Figure 3-1. Wind rose from exceedance days during nine continuous monitoring years at the Landfill monitoring site, illustrating the fetch that encompasses working portions of the landfill. Wind speed units are mph. The wind rose center point is directly over the location of the Landfill site.

4. Regional Comparisons of PM_{10}

Comparing the PM_{10} concentrations measured at the Landfill and Community monitoring sites with those measured at nearby regional monitoring sites places the locally collected data in a larger, more regional context. The Landfill and Community sites are not isolated; they are directly affected by the large SoCAB and the nearby highly trafficked freeway system. The sites chosen for comparison, depicted earlier in Figure 1-1, are the closest regulatory sites that conduct routine PM_{10} monitoring.

Figure 4-1 shows the monthly average PM_{10} concentrations for the Landfill, Landfill North, and Community monitoring sites, and for the three regional locations, for 2008 through 2016. For the first three years of continuous monitoring, the SCAQMD monitor at the downtown Los Angeles location recorded, on average, the highest PM_{10} concentrations, with exceptions noted in May 2009 and June/July 2010. These exceptions were discussed in the *Third Annual Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School (June 1, 2009–May 31, 2010)*, delivered to the Los Angeles City Planning Department in March 2011. The regional monitor in Burbank followed a month-to-month pattern similar to the Los Angeles pattern, but at a lower average PM_{10} concentration, until it was discontinued in summer 2014. The FRM monitor at Santa Clarita, on the very northern edge of the air basin, recorded, on average, the lowest PM_{10} concentrations of the regional sites. From 2008 to 2010, the Landfill and Community measurements tended to track between the Los Angeles and Santa Clarita data.

The monitoring years since 2011 exhibited a deviation from this pattern, with the Landfill monitor usually exhibiting the highest average monthly concentrations during June to September. To help explain this pattern and to emphasize the importance of the effect of meteorology on measured pollutant levels, the June through September meteorological data measured at the Landfill site are presented in **Figure 4-2** for the years 2008 through 2016; these data demonstrate that measurements at the Landfill site are dominated by wind flow from the south to south-southeast and thus by regional PM_{10} concentrations originating in the SoCAB.

During June through September 2009 and 2010, nearly 60% of the winds were from the due south sector. Since 2011, a notable increase in winds from the south-southeast sector occurred. Between 2011 and 2015, more than 89% of the associated hourly wind speeds during the June to September time period were less than 5 mph, implying that entrainment of crustal material from the landfill was not a major contributor to PM_{10} concentrations. The dominance of low speed, south-southeasterly winds from June through September between 2011 and 2015 was coupled with PM_{10} concentrations at the Landfill monitor that consistently exceeded those of the downtown Los Angeles monitor. The main conclusion drawn from these periods of low-speed, southerly winds is that summertime elevations in PM_{10} concentrations measured at the Landfill and Community sites are not attributable to Landfill activities. The cause for the shift in site rankings between years is not discernible from available data, but hypotheses include additional generation of PM_{10} by activities occurring north of downtown Los Angeles, but south of the Landfill monitor. Alternatively, lower concentrations of PM_{10} might exist at ground level during certain periods in downtown Los Angeles, compared to what was entrained at higher altitudes and carried to the higher elevation sites.

The 2016 monitoring year followed the general pattern of the 2011 through 2015 period: the Landfill and Community monitors exhibited higher monthly average PM_{10} concentrations than the regional sites. This is expected, as the wind rose for 2016 in Figure 4-2 suggests consistent predominant wind direction for the whole time period, but higher wind speed compared to previous years. Only 53% of the hourly wind speeds during June to September 2016 were less than 5 mph. In addition to transport from southerly winds in the summertime, the higher wind speeds contributed to the higher PM_{10} concentrations measured at the Landfill site.

Exceptions to the general pattern have been observed in June and July 2010 and 2014, when the highest monthly average concentrations were measured at the Community monitor rather than the Landfill monitor. **Figure 4-3** shows the daily average concentrations during June and July in 2010 and 2014, where we found the Community monitor recorded the highest daily average concentrations almost every day in June. The reason for the exceptions was unknown. One possibility was that when the onshore wind flow prevalent in those months brought pollutants from the SoCAB northward, the PM concentrations dropped gradually due to particle deposition, or there was some construction with significant disturbed dirt going on to the south of the Community site.

The monthly PM_{10} concentrations at the new Landfill North site are also shown in Figure 4-2. From December 2015 to April 2016, the PM_{10} concentrations were lower at the Landfill North site than at the Landfill site. From May to August, PM_{10} levels were higher at the Landfill North site than at the Landfill site. We suspect that the stronger-than-average southerly winds in summer 2016 disturbed the particles on the landfill surface and carried them north toward the Landfill North site.

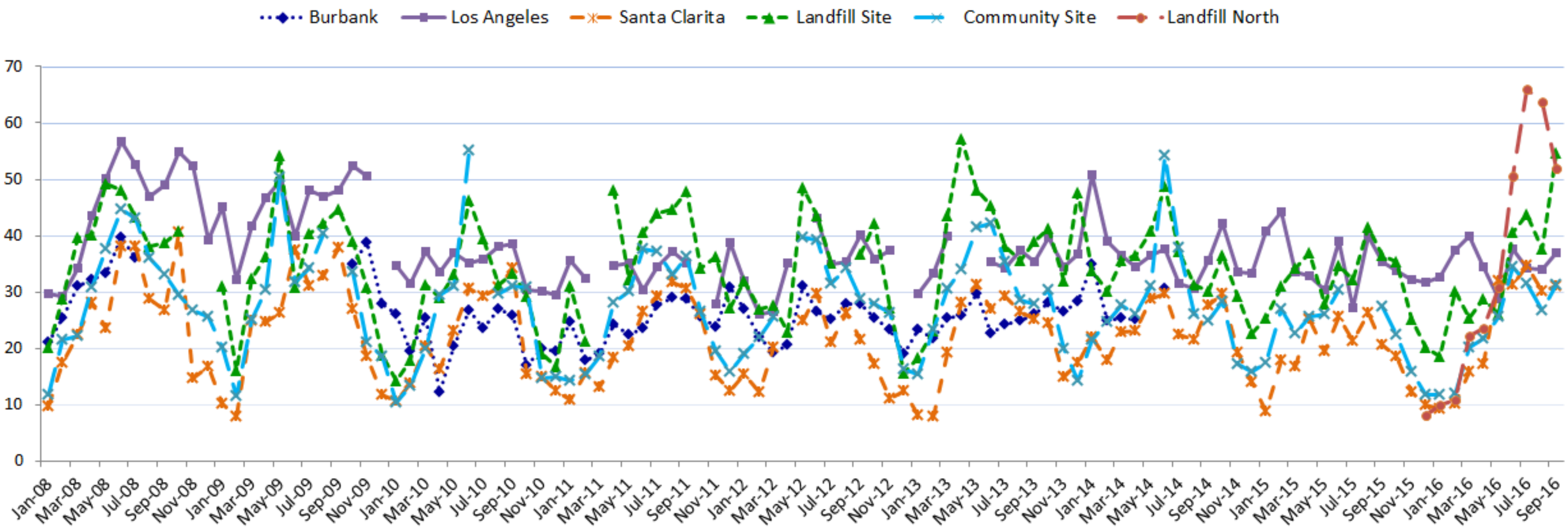


Figure 4-1. Monthly average PM_{10} concentrations for the Landfill, Landfill North, and Community sites, and three regional monitoring sites for 2008–2016. (Notes: Like the Landfill and Community sites, Burbank and Los Angeles sites report hourly concentrations, while the Santa Clarita site reports integrated 24-hr samples on filters on a one-in-six day schedule. As of June 30, 2014, the Burbank site is no longer actively reporting PM_{10} data.)

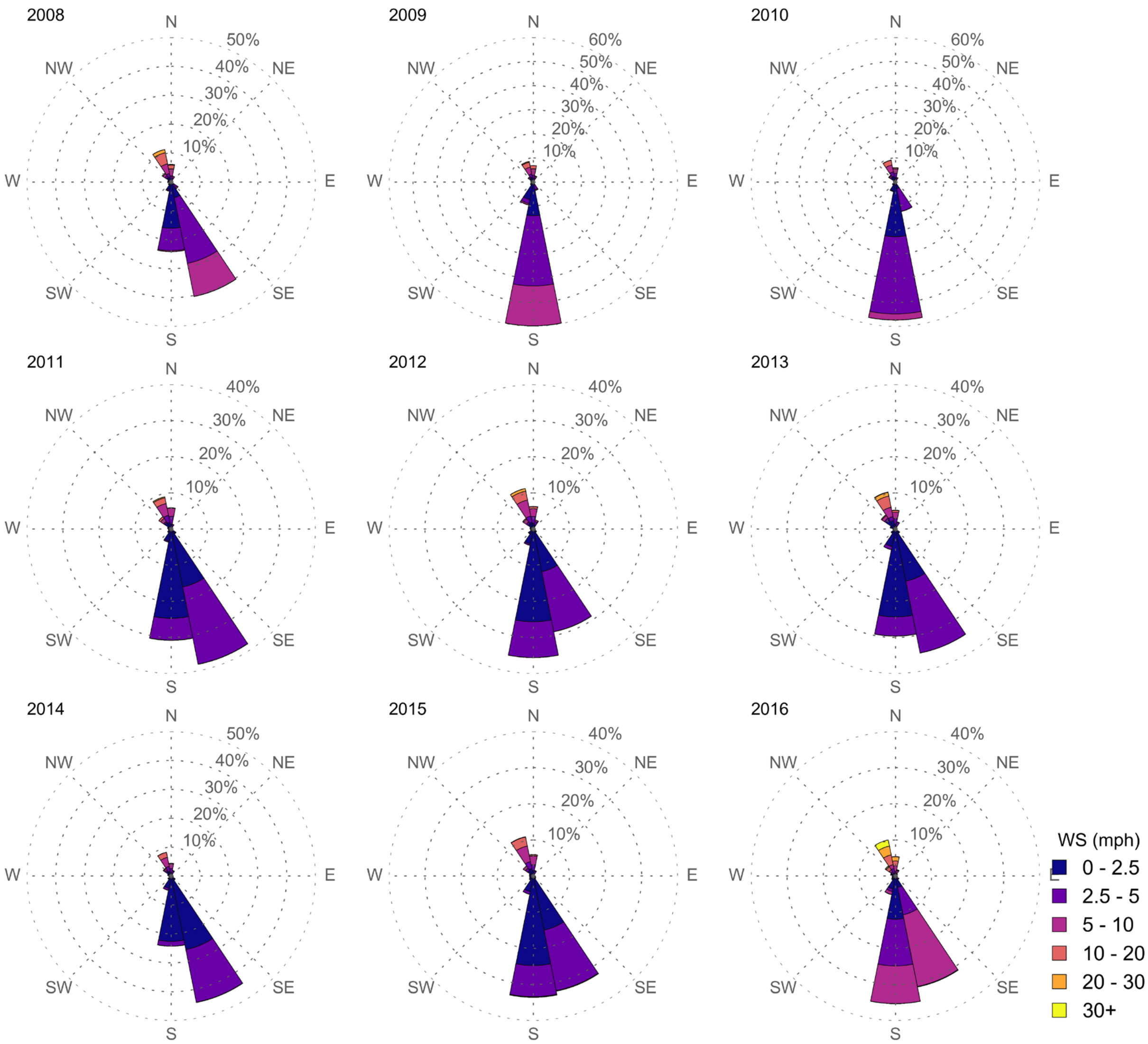


Figure 4-2. Wind roses of hourly data from the Landfill monitor for the months of June through September for 2008 to 2016. The wind roses show the dominance of onshore wind flows in the summer, coupled with relatively low hourly averaged wind speeds, and illustrate the shift to SSE winds since 2011 compared to 2009 and 2010. A greater proportion of higher wind speeds (greater than or equal to 5 mph) were measured in 2016 than in previous years.

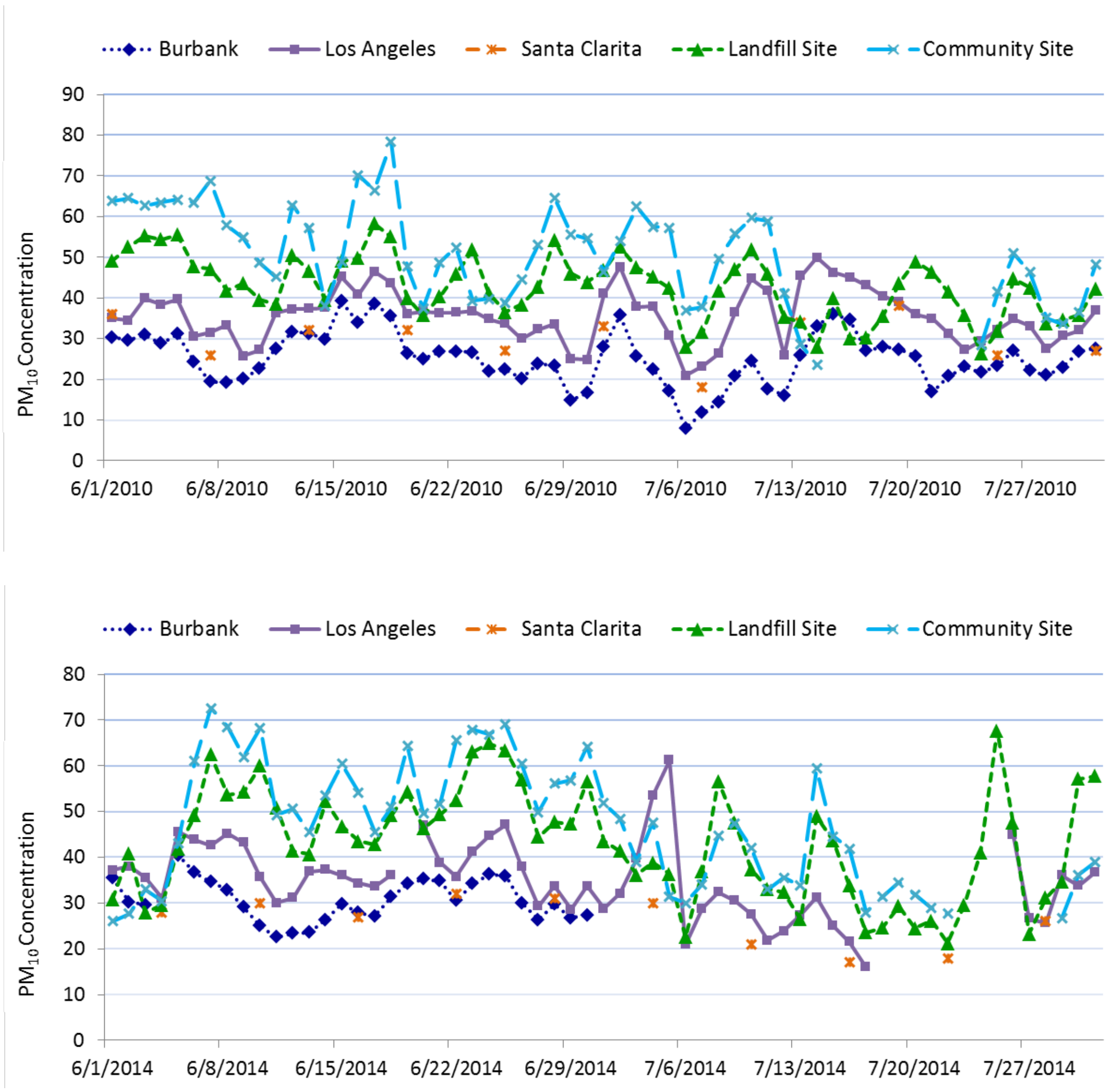


Figure 4-3. Daily average PM_{10} concentrations for the Landfill and Community sites and three regional monitoring sites for June and July in 2010 (upper) and 2014 (lower).

5. PM_{10} and BC: Effects of Wind Direction and Work Activity Levels

Wind direction and landfill work activity levels affect PM_{10} and BC concentrations measured at the Landfill and Community monitoring sites. As demonstrated in Section 4, winds coming from the south, for example, transport pollutants from densely populated areas of the SoCAB and have a major effect on local pollutant concentrations. Similarly, observations of landfill contributions to neighborhood-scale PM_{10} and BC concentrations are expected under northerly wind flow or under calm conditions, such as early morning, when downslope flows or airflow through canyons and around elevated landforms can have an effect. PM_{10} and BC concentrations would also be expected to vary diurnally, and from day to day, as source strengths increase and decrease with changing activity levels. These activity levels vary with different times of day (e.g., daytime versus nighttime) or between working days and holidays, both regionally and at the local (landfill operations) scale.

The nine-year data archive is used here to compare, with long-term averaging, the concentrations of PM_{10} and BC that characterize the Landfill and Community monitoring sites under northerly and southerly wind flows and under differing activity levels (subsections 5.1 to 5.5). Activity levels are binned according to landfill working and non-working days and working and non-working hours. The nine-year averaged results presented in this report concerning the effect of work activity levels on concentrations of PM_{10} and BC are, overall, consistent with those presented in STI's third through eighth annual reports.

As mentioned in Section 4, there were notable differences in PM_{10} and BC levels at the Landfill and Landfill North sites in 2016. A new subsection 5.6 describes the additional comparisons of PM_{10} and BC concentrations by wind direction and landfill work activity levels between the Landfill and Landfill North sites.

5.1 General Wind Roses for the Monitoring Sites

Figures 5-1 and 5-2 show two-year groups of annual wind roses at the Landfill site and Community site from 2007 through 2015, and the wind roses for 2016. Winds at the Landfill site are strongest when they are from the north and north-northwest; conversely, southerly winds are lighter. Community site winds are also strongest from the north-northwest; winds from all other directions are generally lighter. The wind data show that the winds at the Landfill site are highly directional, and winds at the Community sites are more variable. The landfill site is located on the top of a ridge with no visible obstructions; however, the Community site is in a hollow, and nearby trees that have grown over the years contribute to disruption of wind flow.

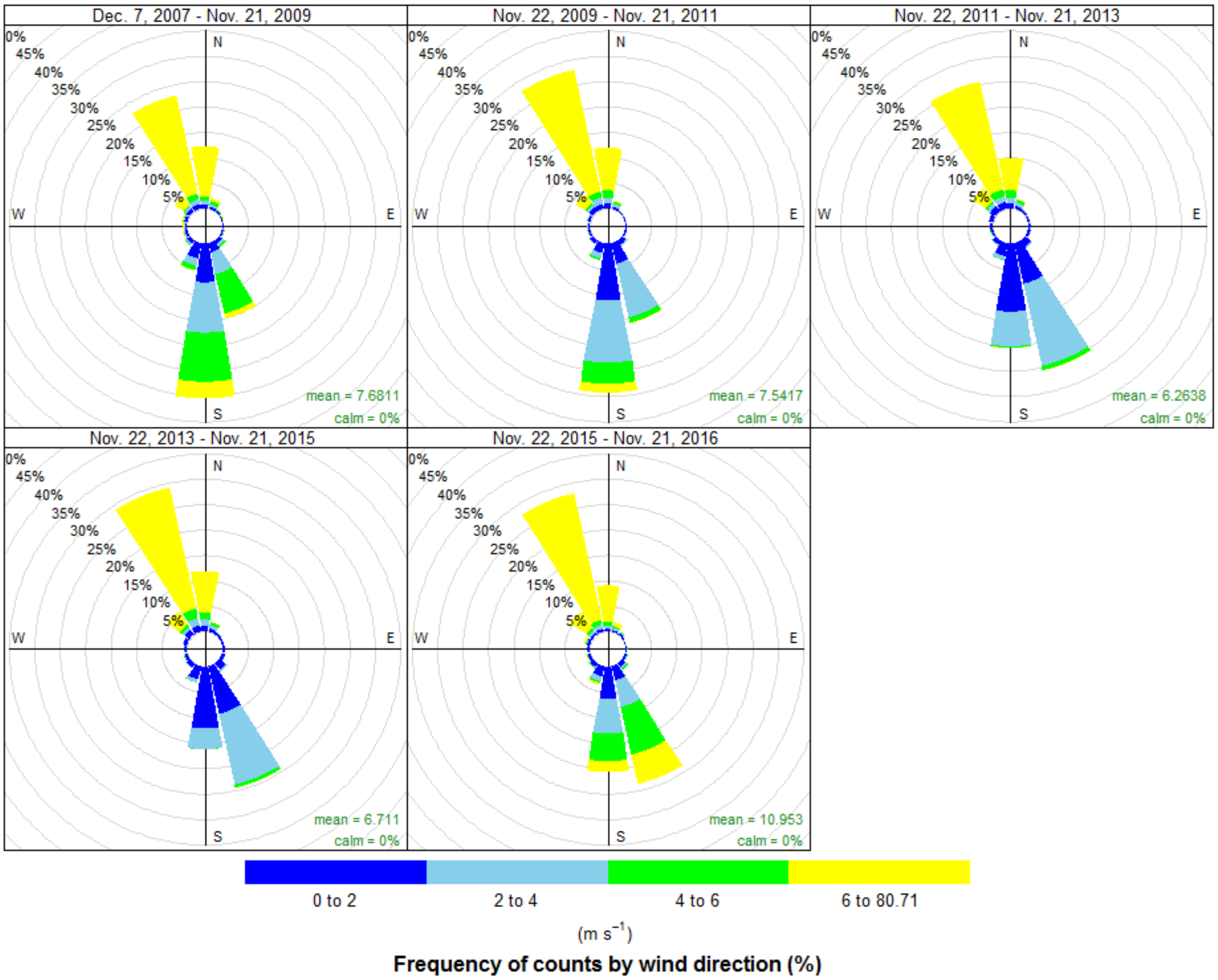


Figure 5-1. Landfill station wind roses over the nine years of monitoring data. Winds are highly directional at the Landfill site. Wind data for monitoring Years One through Eight are shown in two-year groups in the first four wind roses (top three and bottom left), while the data for Year Nine are displayed in an individual wind rose (bottom center).

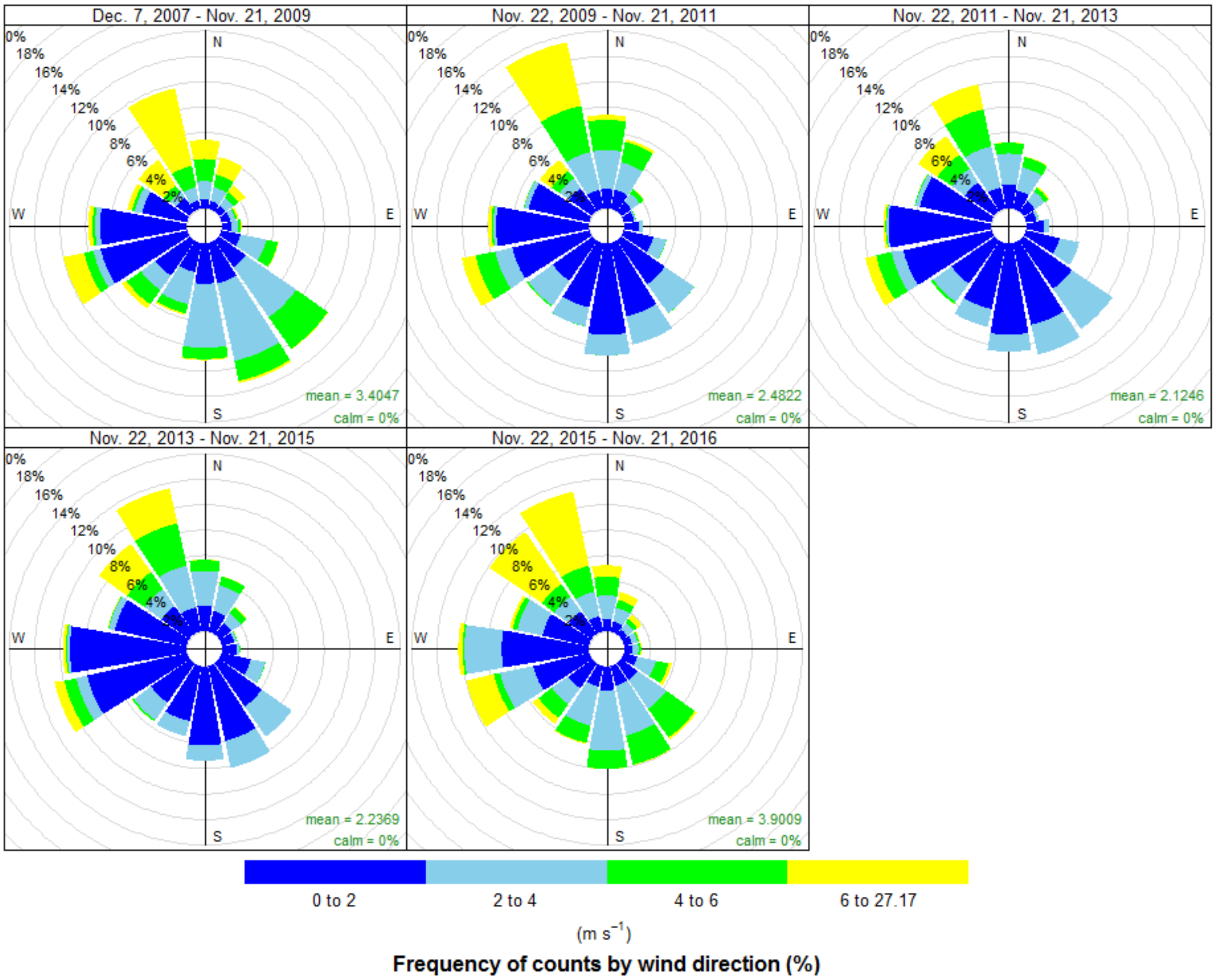


Figure 5-2. Community site wind roses over the nine years of monitoring data. Winds are more variable at the Community site than at the Landfill site. Wind data for monitoring Years One through Eight are shown in two-year groups in the first four wind roses (top three and bottom left), while the data for Year Nine are displayed in an individual wind rose (bottom center).

Figure 5-3 shows the wind data for the Landfill North site collected in Year Nine December 17, 2015. Similar to winds at the Landfill site, the winds at the Landfill North site are highly directional, with predominant winds coming from the northwest and south to south-southeast. However, there were non-trivial winds from the other directions, which differs from the Landfill site. Because of the higher variability in the winds at the Landfill North site and the differences in the wind patterns observed between this site and the Landfill site, we believed the winds measured at the Landfill site are more representative of the general wind flow patterns of the Sunshine Canyon Landfill.

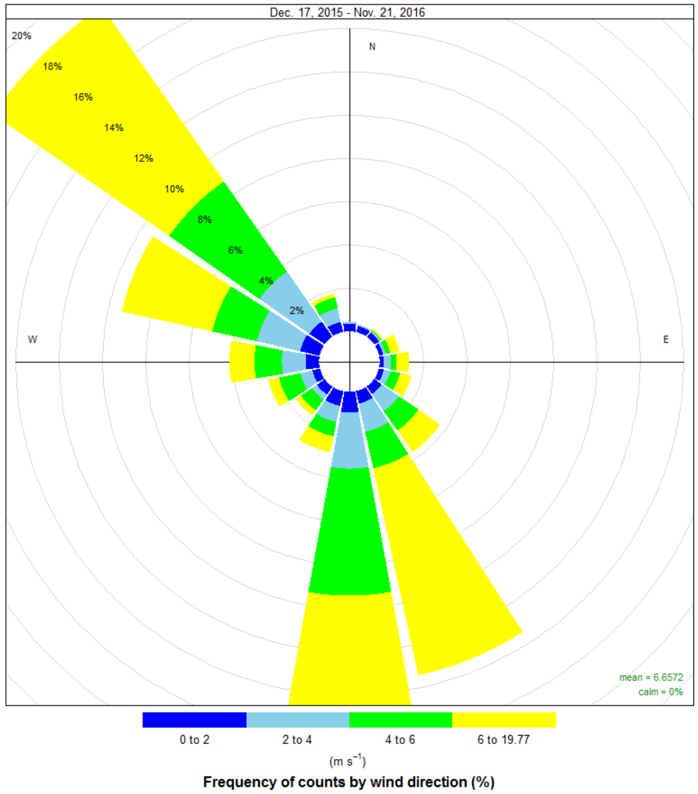
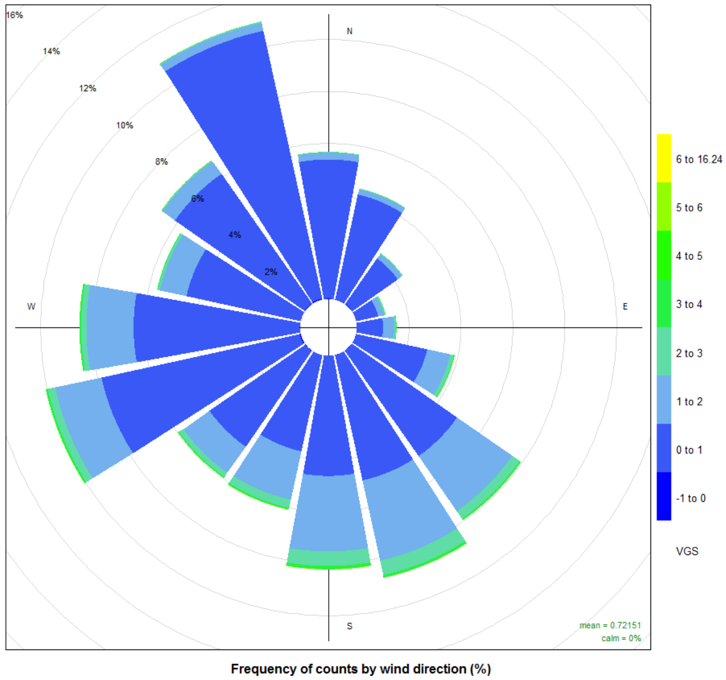


Figure 5-3. Landfill North site wind rose for Year Nine starting from December 17, 2015. Winds are highly directional at the Landfill North site, but not to the extent of the winds at the Landfill site.

Figure 5-4 shows a pollution rose and a pollution differential rose for the Community site. A pollution rose is akin to a bar graph of concentrations associated with wind direction. The lowest BC concentrations at the Community site are associated with winds from the northwest. In contrast, the highest BC concentrations at the Community site are associated with winds from the south.



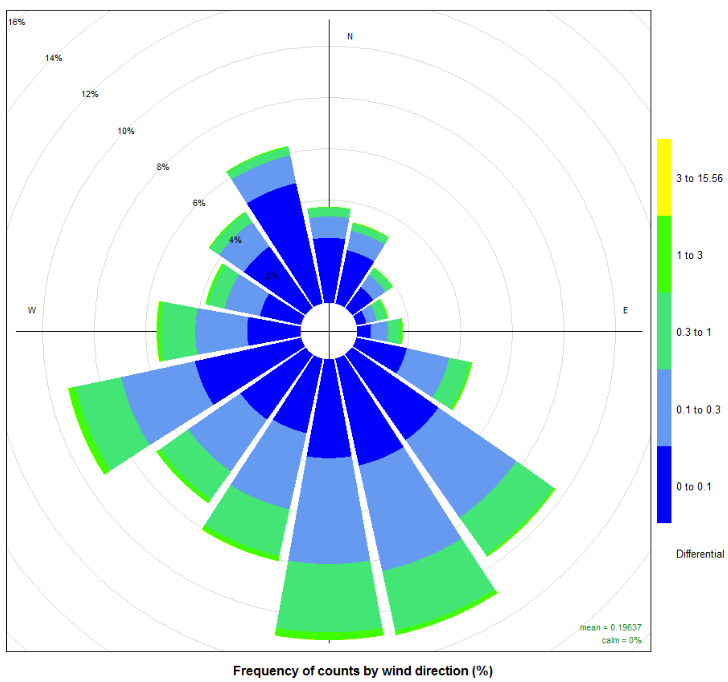


Figure 5-4. Black carbon pollution roses for the Community site showing (top) the directions associated with highest BC concentrations and (bottom) the directions associated with BC concentrations that are higher than those at the Landfill site.

5.2 Wind Direction Sectors for Categorizing Data

In light of the information about directional winds influencing pollutant concentrations, data for this analysis were selected by using one wind sector to represent the landfill source and areas to the north and another wind sector to represent the area from which pollutants travel from the SoCAB. **Figure 5-5** shows the wind sectors representing the landfill source in black for the Landfill monitor and in green for the Community monitor. The Landfill monitor's wind sector (greater than or equal to 303 degrees and less than or equal to 360 degrees from true north) is broader than the Community monitor's (greater than or equal to 325 degrees and less than or equal to 355 degrees from true north). Hourly pollution data corresponding to hourly wind direction data that fall within the boundaries of these sectors are used to compute the pollution metrics for working and non-working days (or hours). The analysis is based only on direction, not on matching times between records at the two sites. The underlying premise is that long-term averages calculated in this manner more accurately represent true average landfill-derived contributions than do those calculated from matched hourly records, because wind direction correlation between the two sites is often poor.

The wind direction correlation between sites is poor because of problems with the siting of the meteorological tower at the Van Gogh School, elevation differences between the sites, and the geographic distance of about one mile. At Van Gogh School, nearby obstructions (e.g., tall trees) deflect the wind, causing localized turbulence and eddies that preclude accurate wind measurements. As a rule of thumb, wind measurements should be made at a minimum horizontal distance of three times the height of any obstruction. There are no obstructions at the Landfill monitoring site. The Landfill site is at 1,722 feet above sea level (ASL), 440 feet higher than the Community site (1,282 feet ASL). Thus, some hourly records included in an individual monitor's averages do not appear in the other monitor's averages.

Figure 5-6 shows the wind sector representing the SoCAB source for both the Landfill and Community monitors (greater than or equal to 150 degrees and less than or equal to 210 degrees from true north).

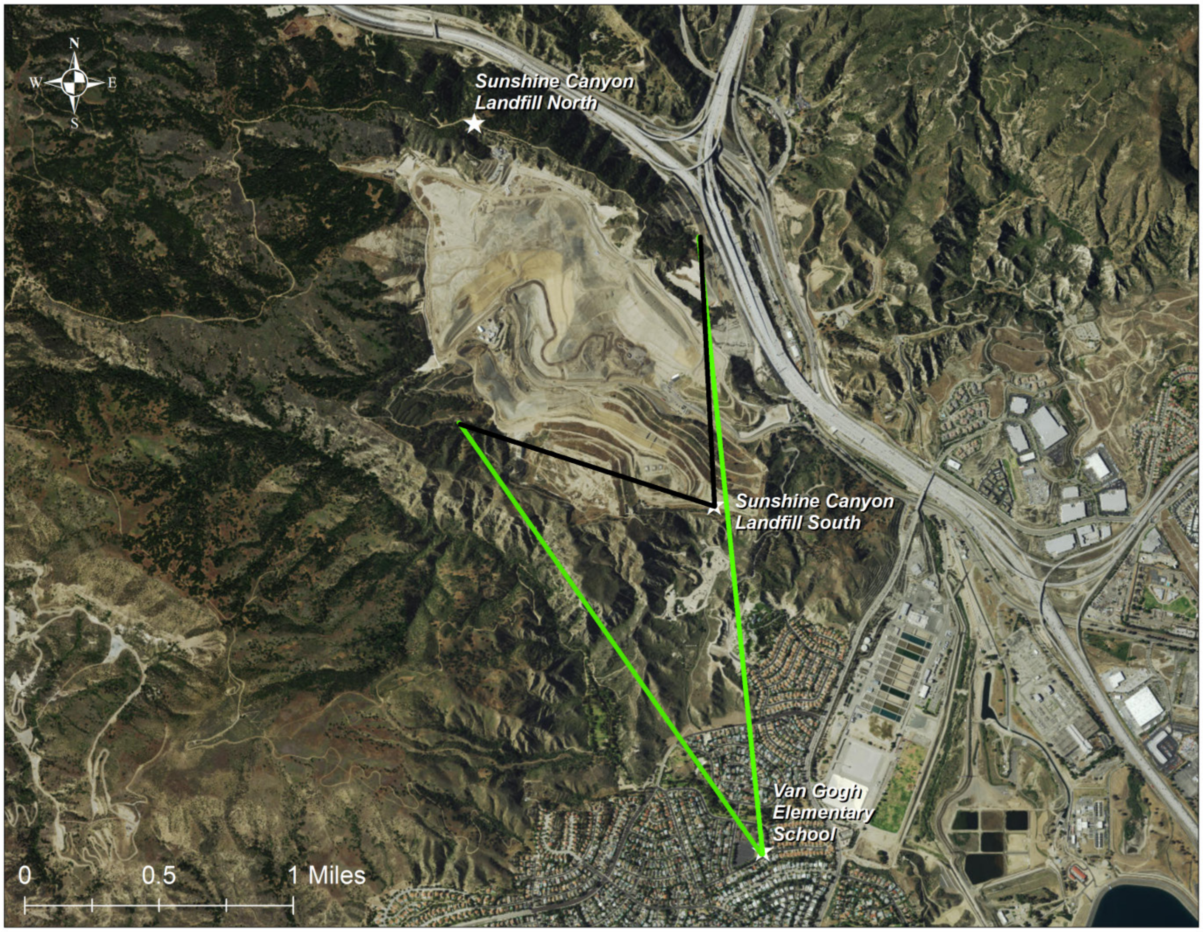


Figure 5-5. Aerial image of the Sunshine Canyon Landfill and the surrounding area, showing the wind direction sectors representing the landfill source used to select data for analysis from the Landfill monitor (in black) and the Community monitor (in green).

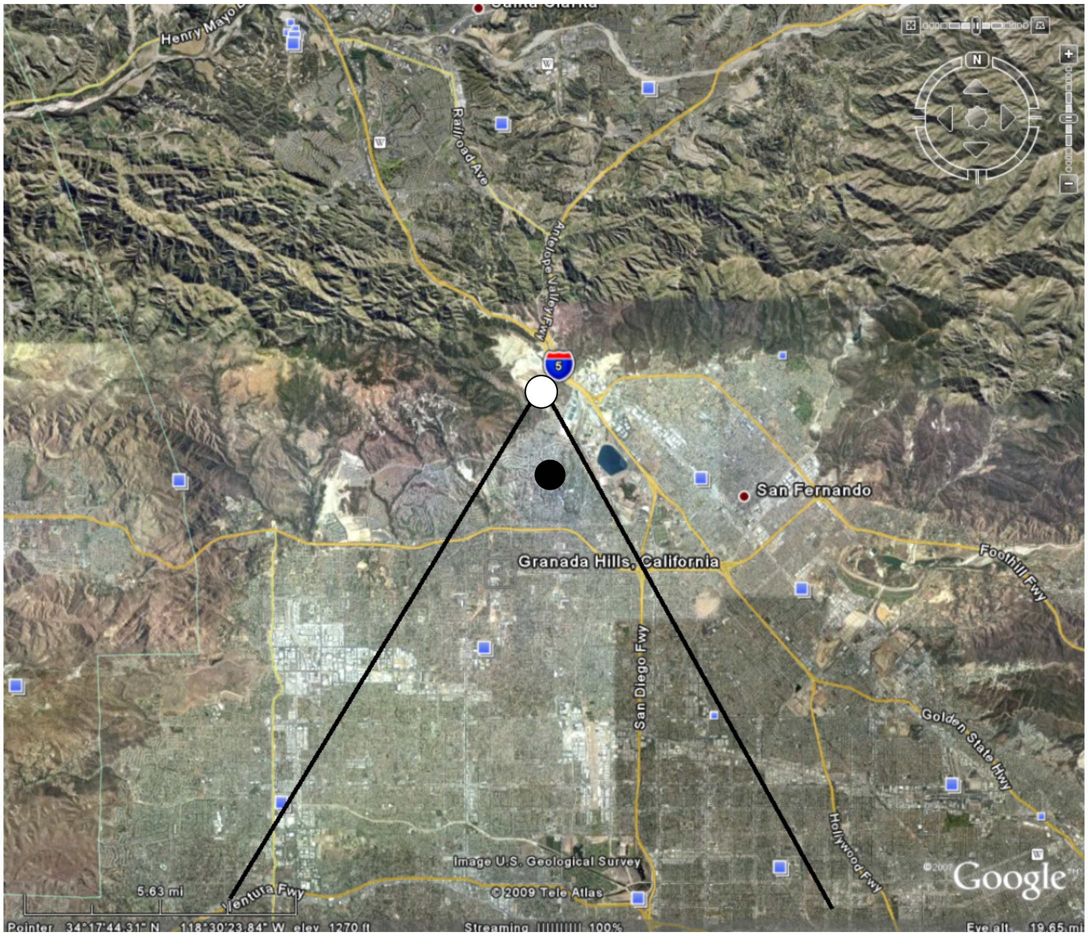


Figure 5-6. Aerial image of the Sunshine Canyon Landfill and the northern portion of the SoCAB, showing the wind direction sector representing the SoCAB source used to select data for analysis to compare with the landfill wind direction sectors depicted in Figure 5-5. The white dot represents the Landfill monitor, and the black dot represents the Community monitor.

5.3 Working and Non-Working Days and Hours for Categorizing Data

After the hourly data have been initially binned by the wind direction sectors described above, hourly PM_{10} and BC concentrations are categorized into the landfill's working and non-working days, and working hours (defined as beginning at 0600 PST and ending at 1700 PST) and non-working hours within those days. Working days at the landfill are defined as Monday through Friday, excluding federal holidays. Non-working days are considered Sundays and federal holidays, including New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day; operations occurring on those days would confound the averages to an unknown degree. Additional non-Sunday holidays when the landfill is closed, but operating, would also be incorrectly binned and thus slightly skew the resulting estimates for that category. Saturdays are categorized "mixed use" at the landfill; thus, they do not fit easily into either category. The non-Sunday holidays and Saturdays are excluded from the analysis.

5.4 PM_{10} Concentrations

Figure 5-7 summarizes the nine-year hourly average PM_{10} concentrations at the Landfill and Community sites for the northerly and southerly wind sectors for working and non-working days and for working and non-working hours within those days in a notched box-whisker plot.[6] The following general conclusions are based on the median values presented in Figure 5-6. Note that these conclusions are nearly identical to those reached in the Eighth Annual Report (delivered in March 2016), as are the proportions cited in the following bullets:

- During the highest activity levels (working hours on working days, panel (a)):
  - When the wind is from the SoCAB, the Landfill and Community monitors measure about the same median concentrations of PM_{10}.
  - When the wind is from the SoCAB, the median concentration of PM_{10} at the Community site is about three times higher than when the wind is from the landfill.
  - When wind is from the landfill, the median PM_{10} concentration at the Community site is one-third of that measured at the landfill itself, suggesting that although the landfill-derived PM_{10} concentrations are significant, they remain mostly localized to the landfill.
- During non-working hours on working days (panel (b)):
  - When the wind is from the SoCAB, the Community monitor measures higher PM_{10} concentrations than when wind is from the landfill. When the wind is from the landfill, PM_{10} concentrations are lower at both monitoring sites than when the wind is from the SoCAB, and the Community monitor is characterized by lower concentrations than the Landfill monitor, illustrating a localized landfill contribution during times of low activity (nighttime).
- During the lowest activity levels (non-working days, panels (c) and (d)):
  - Median ambient concentrations of PM_{10} are lower on non-working days, but the extent of the decrease is influenced by wind direction. At the Landfill site, median ambient PM_{10} concentrations in daytime (working hours) showed a greater proportional decrease on non-working days when wind direction was from the landfill (approximately 69% lower) than on non-working days when wind came from the SoCAB (approximately 19% lower), reflecting the larger regional PM_{10} influence of the SoCAB on non-working days.

[6] A notched box-whisker plot shows the entire distribution of concentrations for each year. In box-whisker plots, each box shows the 25th, 50th (median), and 75th percentiles. The boxes are notched (narrowed) at the median and return to full width at the 95% lower and upper confidence interval values. These plots indicate that we are 95% confident that the median falls within the notch. If the 95% confidence interval is beyond the 25th or 75th percentile, then the notches extend beyond the box (hence a “folded” appearance).

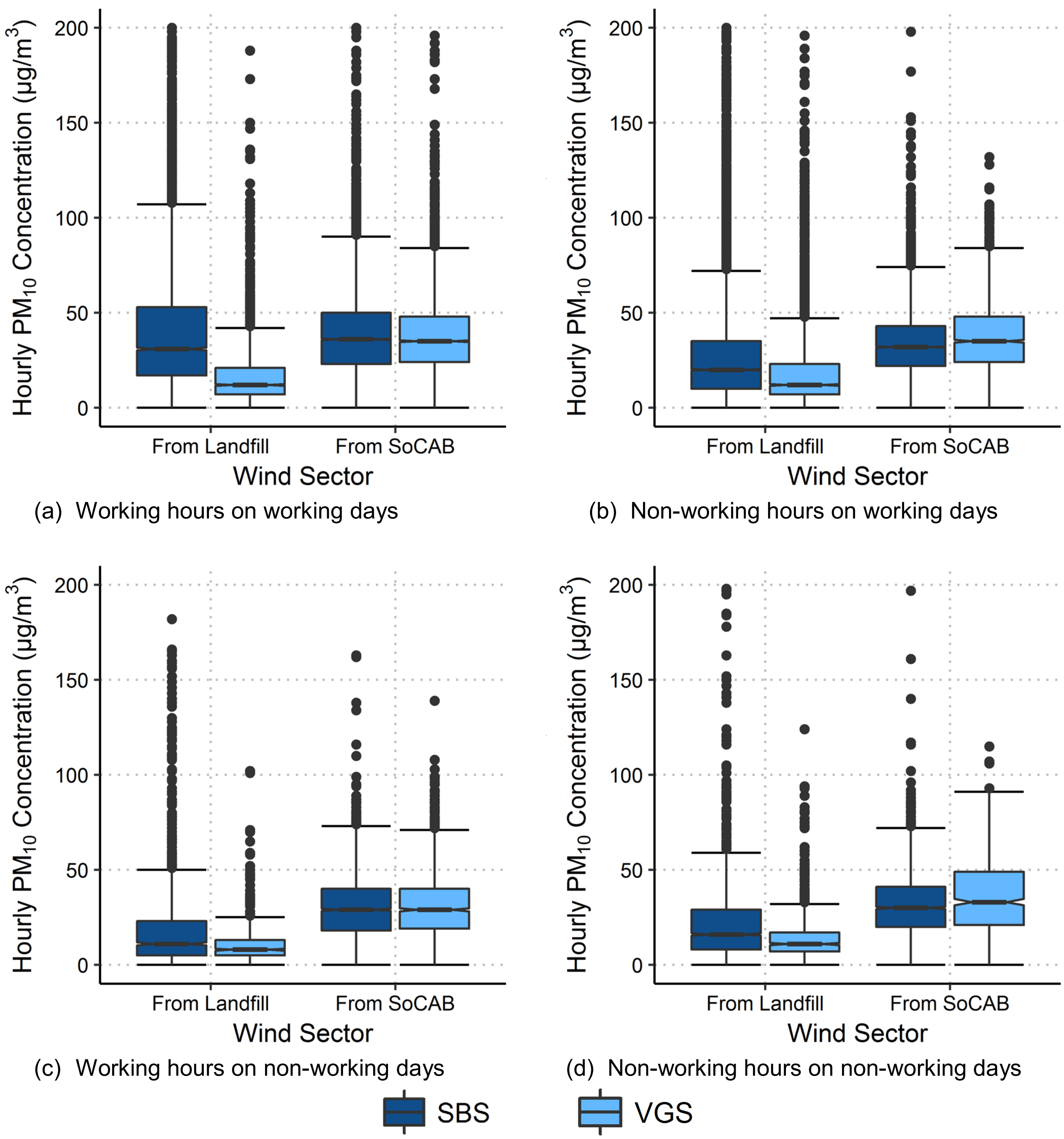


Figure 5-7. Notched box plots of nine-year hourly average PM_{10} concentrations for northerly ("From Landfill") and southerly ("From SoCAB") wind sectors for working and non-working days and for working and non-working hours within those days for the Landfill (Sunshine Berm Site [SBS], dark blue box) and Community (Van Gogh School [VGS], light blue box) monitor sites. Outliers over 200 µg/m^3 are not displayed.

5.5 BC Concentrations

Figure 5-8 summarizes the nine-year hourly average BC concentrations for the northerly and southerly wind sectors during working and non-working days and during working and non-working hours within those days in a notched box-whisker plot.

The following general conclusions are based on the median values presented in Figure 5-8:

- During the highest activity levels (working hours on working days, panel (a)):
  - When the wind is from the SoCAB, the Community monitor measures slightly higher levels of BC concentrations than the Landfill monitor.
  - When the wind is from the SoCAB, the Community monitor measures roughly four and a half times the median concentration of BC as when the wind is from the landfill.
  - When wind is from the landfill, the Community BC levels are about one-half of the BC levels measured at the landfill itself.
- During the lowest activity levels (non-working days, panels (c) and (d)):
  - Median ambient concentrations of BC are lower on non-working days than on working days in all categories, but the extent of the decrease is influenced by wind direction. The proportional decrease in concentrations on non-working days was larger for BC than for PM_{10}. Compared to working days, BC concentrations on non-working days decreased by a factor of 2 (Community site) to 4 (Landfill site) when winds were from the landfill, and decreased by about a factor of 1.8 when winds were from the SoCAB. On working days, diesel-powered vehicles (trucks and earth moving equipment) operating at the landfill appear to increase the ambient concentrations of DPM, as determined by the BC measurements. However, the large metropolitan area of the SoCAB remains the dominant source of DPM.

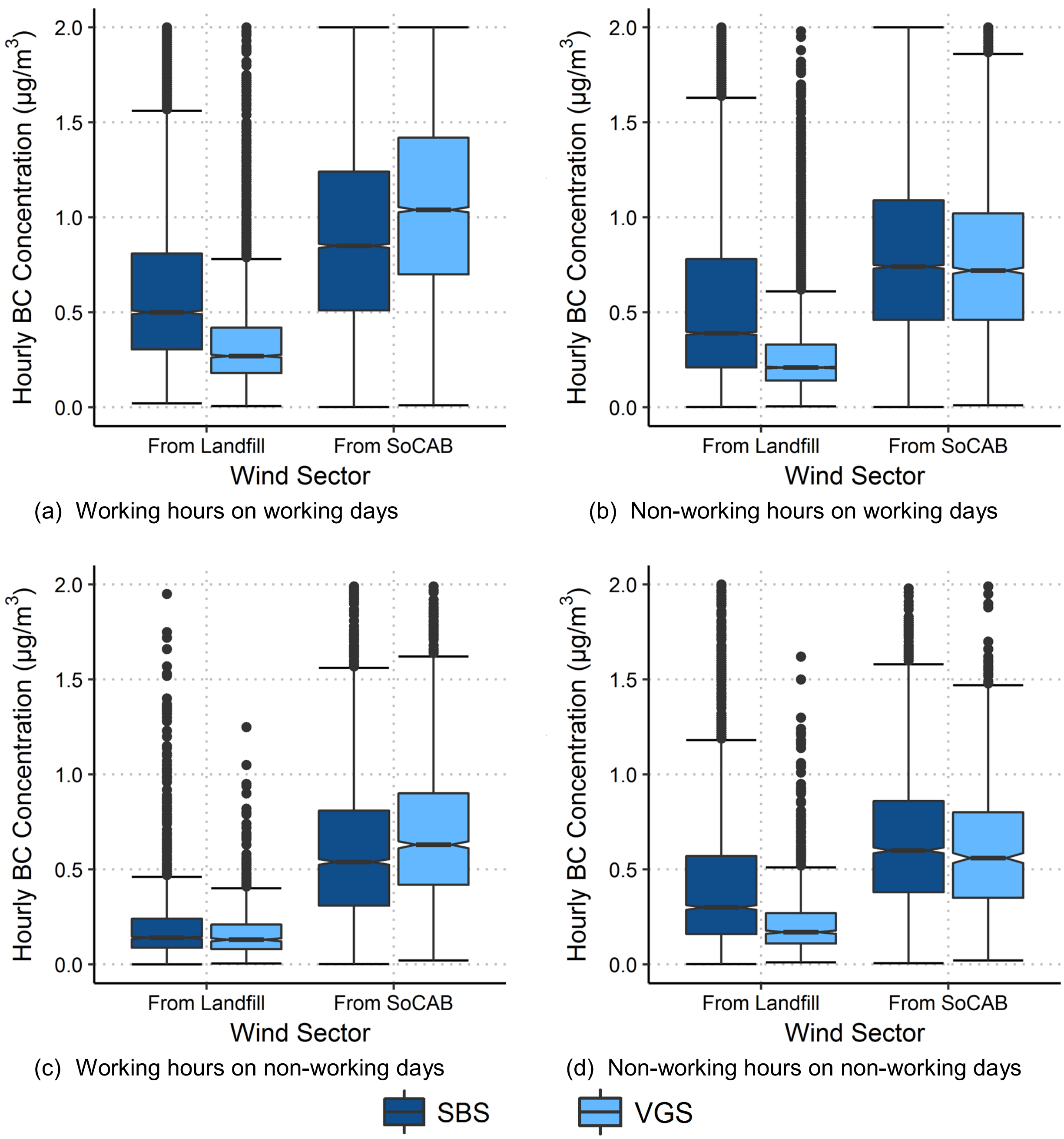


Figure 5-8. Notched box plots of nine-year hourly average BC concentrations for northerly and southerly wind sectors for working and non-working days and for working and non-working hours within those days for the Landfill (SBS, dark blue box) and Community (VGS, light blue box) monitor sites. Outliers over 2 µg/m^3 are not displayed.

5.6 PM_{10} and BC: Landfill vs. Landfill North and Community Sites

The data collected at the new Landfill North site in the ninth monitoring year provided an opportunity to further investigate and characterize the impacts of wind direction and landfill work activity levels on the measured PM_{10} and BC concentrations at the Landfill site. The hourly PM_{10} and BC concentration data from the Landfill and Landfill North sites when the measured winds at the Landfill site were from the landfill and from the SoCAB were compared by subtracting the Landfill North site values from the Landfill site values to obtain the differences. The results for PM_{10} and BC are shown in Figures 5-9 and 5-10, respectively.

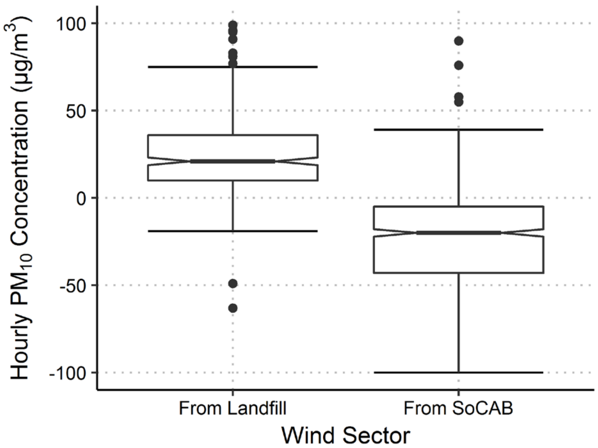
The following general conclusions are based on the median PM_{10} difference values presented in **Figure 5-9**:

- The greatest difference between the Landfill and Landfill North sites was observed during the periods of highest activity (i.e., working hours on working days, panel (a)). The PM_{10} differences were 22 and -26 μg/m^3 when the winds were from the landfill and from the SoCAB respectively, suggesting a consistent localized PM_{10} contribution of low- to 20 to 25 μg/m^3 from the landfill to the landfill monitors downwind.
- When the wind was from the landfill, the PM_{10} values were higher at the Landfill site (downwind) than the values at the Landfill North site (upwind) in all working categories, indicating a localized contribution of PM_{10} from the landfill to the Landfill site.
- When the wind was from the SoCAB, the PM_{10} values were higher at the Landfill North site (downwind) than the values at the landfill site (upwind) in all but the non-working hours on non-working days category, indicating a localized contribution of PM_{10} from the landfill to the Landfill North site. The median difference for the non-working hours on non-working days category was zero with a negative mean of -0.2 μg/m^3.

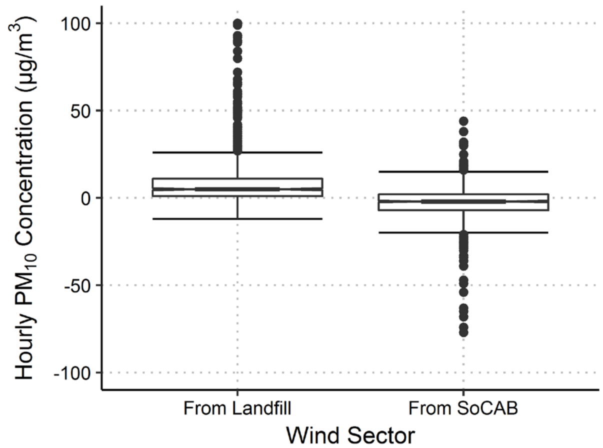
The following general conclusions are based on the median BC difference values presented in **Figure 5-10**:

- During the highest activity levels (working hours on working days, panel (a)), the greatest BC differences were observed. The BC differences were 0.1 and -0.3 μg/m^3 when the winds were from the landfill and from the SoCAB, respectively, suggesting a localized BC contribution from activities at the landfill to the landfill monitors downwind. This is the only category where the downwind monitor showed higher BC concentrations than the upwind monitor.
- During the time periods of the other working categories, although the median concentrations were slightly higher at the upwind monitor, the BC levels between the two sites were mostly very similar regardless of wind direction. The only exception is that the Landfill site measured notably higher BC when the wind came from SoCAB during non-working hours on non-working days (panel (d)).

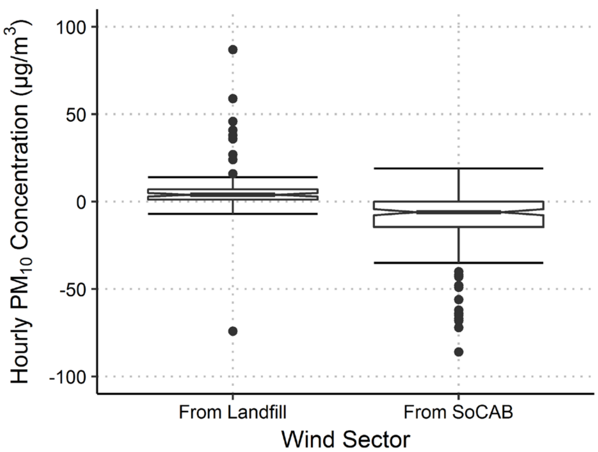
Figure 5-11 provides an illustration of landfill impact on PM_{10} and BC concentrations at the downwind site when wind is from either the landfill or the SoCAB as measured at the Landfill site during working hours on working days.



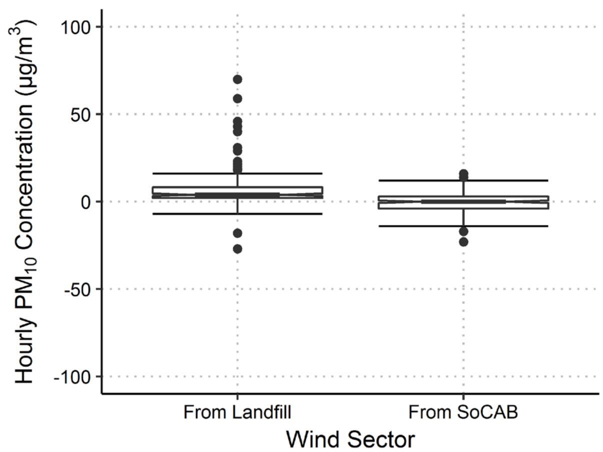
(a) Working hours on working days



(b) Non-working hours on working days

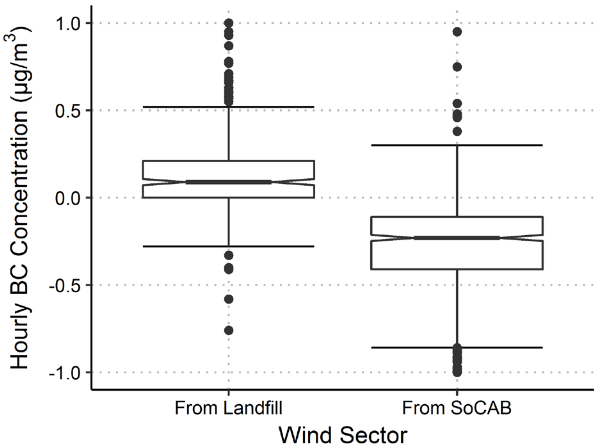


(c) Working hours on non-working days

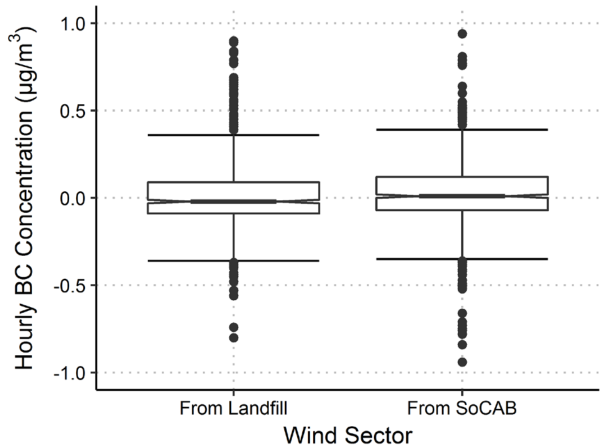


(d) Non-working hours on non-working days

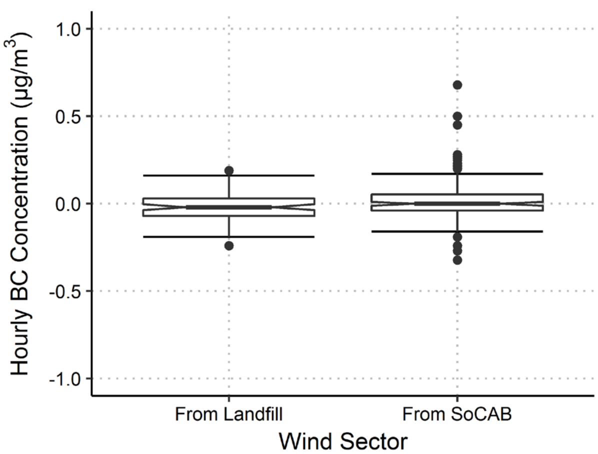
Figure 5-9. Notched box plots of the differences in PM_{10} concentrations between the Landfill North and the Landfill sites (Landfill site values – Landfill North site values) for northerly and southerly wind sectors for working and non-working days and for working and non-working hours within those days. Outliers over ±100 µg/m^3 are not displayed.



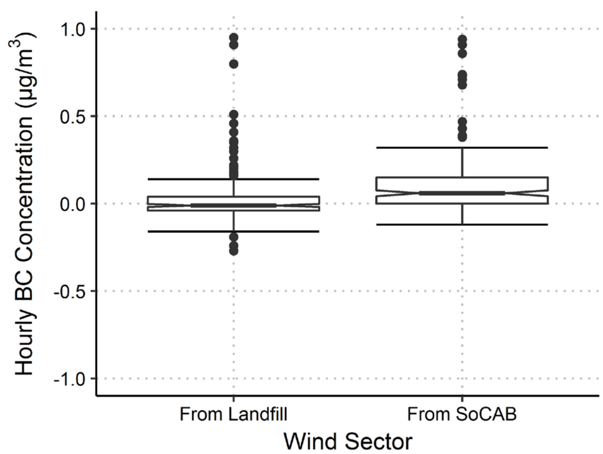
(a) Working hours on working days



(b) Non-working hours on working days



(c) Working hours on non-working days



(d) Non-working hours on non-working days

Figure 5-10. Notched box plots of the differences in BC concentrations between the Landfill North and the Landfill sites (Landfill site values – Landfill North site values) for northerly and southerly wind sectors for working and non-working days and for working and non-working hours within those days. Outliers over ±1 µg/m^3 are not displayed.

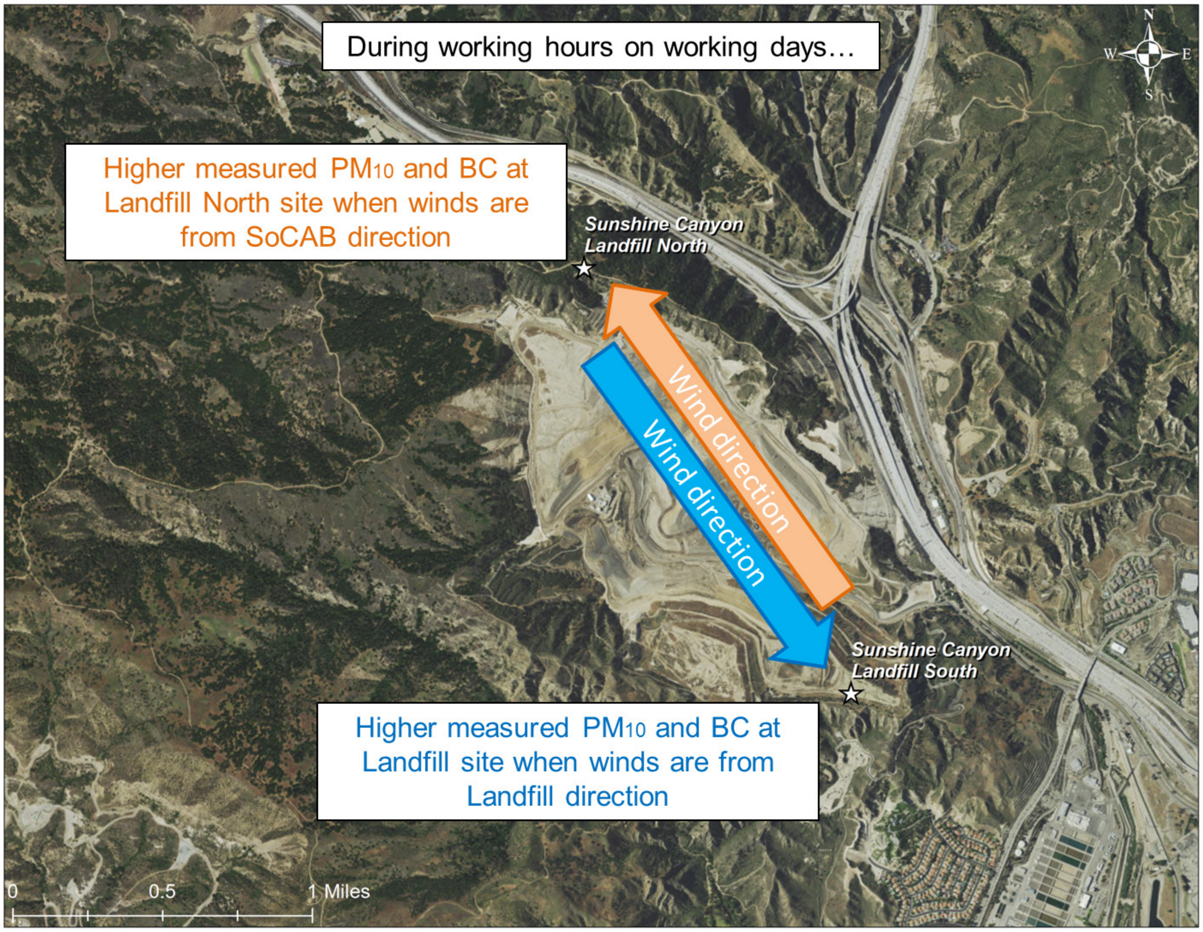


Figure 5-11. Map depicting the localized impact of the landfill on PM_{10} and BC concentrations when the wind is from the landfill or the SoCAB as measured at the Landfill site during working hours on working days.

A similar analysis was conducted for the Landfill and Community sites to determine if there was any evidence of landfill contribution to the PM_{10} and BC concentrations at the Community site. The hourly PM_{10} and BC concentration data from the Landfill and Community sites when the measured winds at the Community site were from the landfill and from the SoCAB were compared by subtracting the Landfill site values from the Community site values to obtain the differences. The results for PM_{10} and BC are shown in Figures 5-12 and 5-13, respectively.

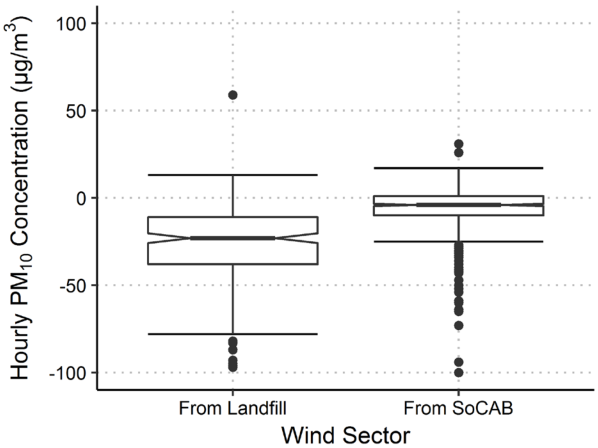
The following general conclusions are based on the median PM_{10} difference values presented in **Figure 5-12**:

- The greatest difference between the Landfill and Community sites was observed during the highest activity levels (i.e., working hours on working days, panel (a)). The PM_{10} differences were -24 and -4 µg/m^3 when the winds were from the landfill and from the SoCAB respectively. Because the PM_{10} levels at the Community site were lower than those at the Landfill site regardless of wind sectors, landfill contribution to PM_{10} concentrations at the Community site was not evident in this analysis.

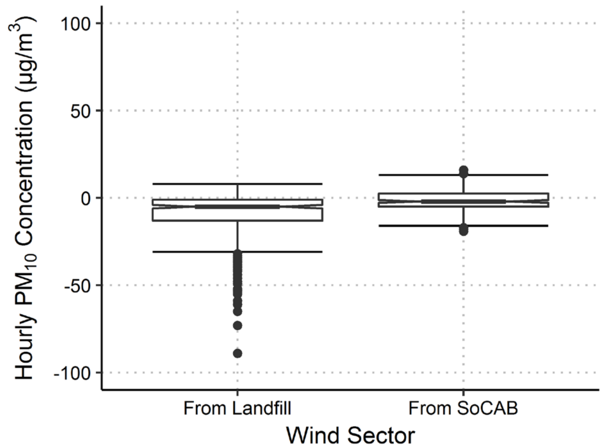
- The differences in PM_{10} measured at the Landfill and Community sites were negligible in all other categories.

The following general conclusions are based on the median BC difference values presented in **Figure 5-13**:

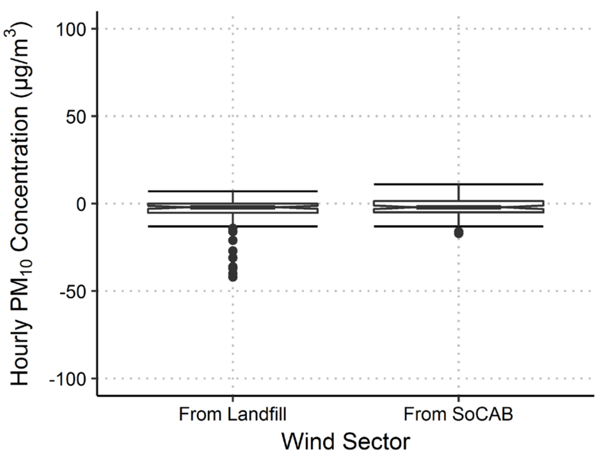
- The BC concentrations at the Community site were lower than those at the Landfill site during the highest activity levels (i.e., working hours on working days, panel (a)) when the wind was from the landfill. Therefore, landfill contribution to BC levels at the Community site was not evident in this analysis.
- BC concentrations at the Community site were higher than those at the Landfill site when the wind was from the SoCAB in all work activity categories, indicating a clear contribution from the SoCAB.



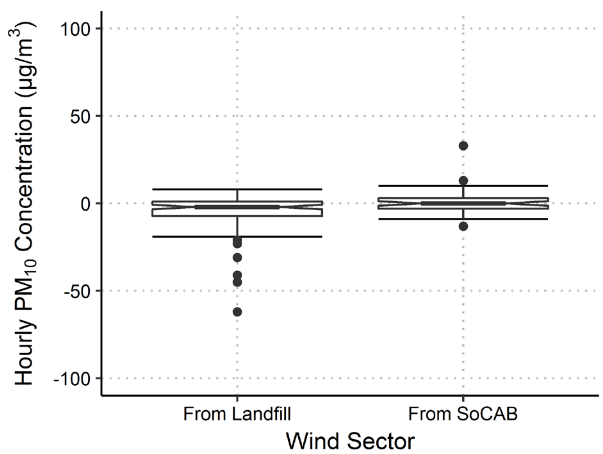
(a) Working hours on working days



(b) Non-working hours on working days

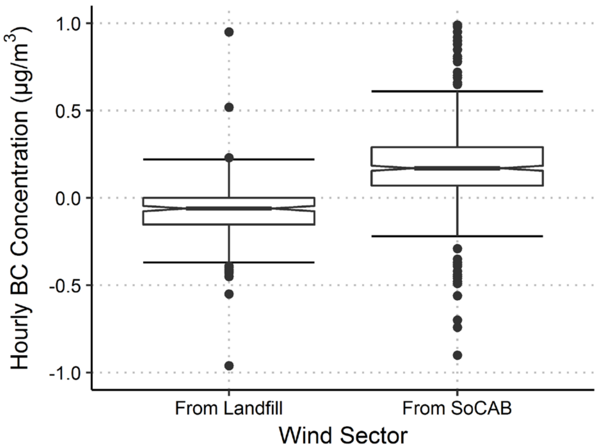


(c) Working hours on non-working days

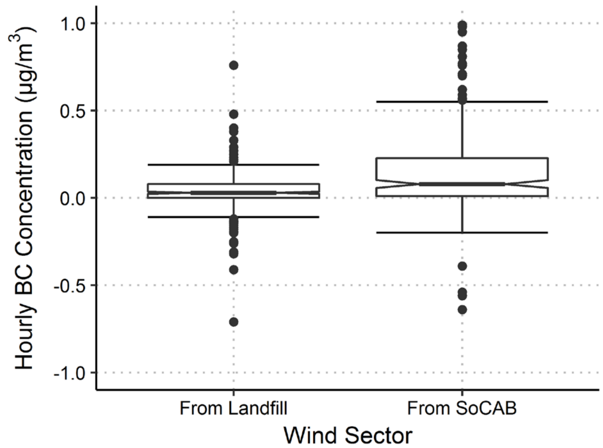


(d) Non-working hours on non-working days

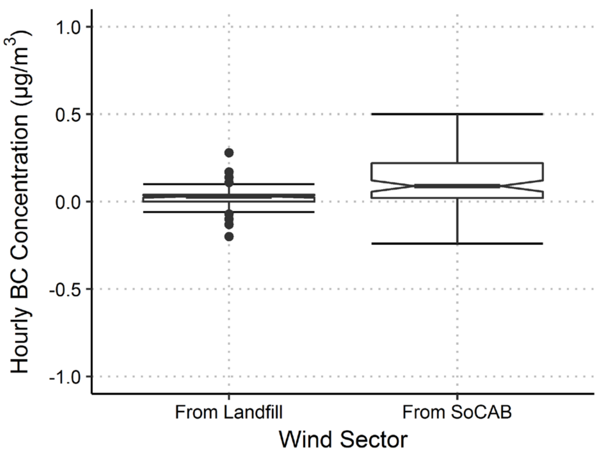
Figure 5-12. Notched box plots of the differences in PM_{10} concentrations between the Landfill and Community sites (Community site values – Landfill site values) for northerly and southerly wind sectors for working and non-working days and for working and non-working hours within those days. Outliers over ±100 $\mu g/m^3$ are not displayed



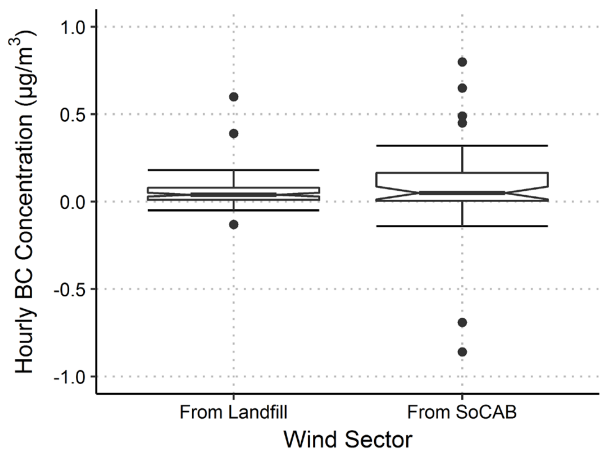
(a) Working hours on working days



(b) Non-working hours on working days



(c) Working hours on non-working days



(d) Non-working hours on non-working days

Figure 5-13. Notched box plots of the differences in BC concentrations between the Landfill and Community sites (Community site values – Landfill site values) for northerly and southerly wind sectors for working and non-working days and for working and non-working hours within those days. Outliers over ±100 $\mu g/m^3$ are not displayed

6. Quantitative Estimates of Landfill Impacts on Ambient Concentrations of PM_{10} and BC

Quantitative estimates of the impact of landfill operations on neighborhood-scale ambient air quality are required by the original Conditions of Approval (C.10.a) and the nearly identical County Condition 81. Specifically, the Conditions require determination of “whether air quality near the Landfill is consistent with the supporting environmental documentation for the City Project (i.e., the City’s Final Supplemental Environmental Impact Report or ‘FSEIR’).” The FSEIR reported the emissions estimates of pollutants likely to result from landfill operations, modeled by the Industrial Source Complex Short Term (ISCST3) regulatory model. Beginning with baseline year data (November 22, 2001–November 21, 2002) and continuing through 2008, no attempt was made to specifically address this requirement, probably because there is no way to *directly* calculate an appropriate metric. The primary reason is that no pollutant monitoring data were gathered immediately upwind of the landfill to enable accurate estimates of the regional concentrations north of the landfill (and thus unaffected by landfill contributions). While the SCAQMD operates a BAM-1020 monitor at the Santa Clarita station, it is configured for $PM_{2.5}$ sampling. These $PM_{2.5}$ data are not directly comparable to the PM_{10} data provided by the BAM-1020 instruments currently deployed at the Landfill and Community monitoring sites. The Santa Clarita station does employ FRM measurements of PM_{10} (integrated 24-hr samples on filters) on a one-in-six day schedule. While 24-hr averaged data from the Landfill PM_{10} monitor could be compared with the 24-hr integrated data from the FRM samples every sixth day, the low frequency of sampling supports only minimal statistical power for calculating upwind (background) PM_{10} concentrations. Additionally, the location of the Santa Clarita station relative to the landfill and nearby freeways further complicates the potential for direct application of that data for calculating landfill contributions of PM_{10}, and wind direction often changes during the 24-hour period, meaning the 24-hour averages from Santa Clarita likely confuse any apportionment by wind direction.

For this annual report, we used the method used in recent years. Beginning with STI’s Second Annual Report[7] in 2009, a data analysis method for approximating landfill contributions to neighborhood-scale PM_{10} and BC concentrations, intended to address City Ordinance C.10.a (and subsequently, County Condition 81), was developed. The method was used to assess regional concentrations and provide estimates of landfill contributions above the regional contributions. It uses long-term averaging to maximize the sample size (hourly values) to be sufficiently representative. In the 2009 Second Annual Report, rolling averages were used to maximize the sample size. Since the Third Annual Report, rolling averages have not been used, because full years of continuous data are available for calculating the yearly averages used in the analysis. The results of the analysis have an undefined level of uncertainty because, in lieu of directly measured concentrations upwind of the landfill, regional pollutant concentrations are estimated from a southerly wind direction sector, isolating the SoCAB, to provide an estimate of regional pollutant levels during working days and non-working days.

[7] Vaughn D.L. and Roberts P.T. (2009) Second annual report of ambient air quality monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School. Prepared for the Planning Department, City of Los Angeles, CA, by Sonoma Technology, Inc., Petaluma, CA, STI-907032-3671-AR, August.

The method involves using the same specific wind direction sectors and activity level bins for selecting the BC and PM_{10} data as described above for the annual average regional comparisons. Although presented in previous reports, the method is described again here for completeness.

6.1 Justification of the Method

When the wind is from the south, bringing pollutants northward from the SoCAB, the long-term average pollutant concentrations measured at the Community and Landfill monitoring sites are similar. When the wind is from the north, bringing pollutants southward, the pollutant concentrations measured at the two monitoring sites are much less similar. This observation provides the framework to

- Calculate regional pollutant concentrations not affected by contributions from the landfill.
- Calculate differences in regional pollutant concentrations between regular working days and non-working days. The data from non-working days provide estimates of baseline or background pollutant levels, and the data from working days provide estimates of any additional regional contribution associated with regular work days.
- Estimate regional contributions and use this estimate to assess landfill contributions to neighborhood-scale pollutant concentrations when winds are from the north (i.e., when landfill impacts, if any, would be measurable at both monitoring sites). In the absence of a monitor north of the landfill, the application of this estimate results in an undefined degree of uncertainty, since it is unknown how well this estimate of regional concentrations truly reflects the impact of concentrations from areas north of the landfill.

6.2 Specific Steps of the Method

Implementation of this analytical approach involves the following basic steps, using only validated and quality-assured data:

- From the two monitoring sites, select the hourly pollutant concentration data for the analysis based on wind direction sectors, as described in Section 5.2.
- Categorize the data from the two sites into landfill-operating days (referred to as “working days”) and non-operating days (referred to as “non-working” days), as described in Section 5.3.
- Categorize the data from the two sites into working hours (chosen to reflect the main operating hours of the landfill) and non-working hours (non-operating periods), as described in Section 5.3.
- Calculate average pollutant concentrations for each data category.
- Using only the average concentrations derived from data attributed to the SoCAB, calculate the difference in regional concentrations between working days and non-working days.

- Compare the average concentrations measured on working days when the wind direction is from the landfill with the regional estimates and calculate an estimate of landfill contributions. Under these sampling conditions, the working day concentrations are assumed to have three components:
  1. A regional contribution, estimated using data from non-working days when winds are from the landfill
  2. An additional regional contribution, estimated by multiplying the estimate in (1) by the proportional increase in concentrations observed during times of southerly winds on working days compared to non-working days
  3. Average concentrations, measured when winds blow from the landfill on working days, in excess of the sum of (1) and (2), which are attributed to the landfill. If average concentrations measured when winds are from the landfill increase proportionally with the regional increases associated with working days, no contribution from the landfill would result from this calculation.

The hours within each of these working and non-working day categories are additionally binned into working hours (defined as beginning at 0600 PST and ending at 1700 PST) and non-working hours. While the level of activity may vary within each timeframe, reliance on long-term averaging of pollutant concentrations will help to integrate the effect of these varying activity levels.

6.3 Estimates of Landfill Contributions of BC and PM_{10}

The results of the analyses are presented in two figures and two tables: Figure 6-1 and Table 6-1 for PM_{10}, and Figure 6-2 and Table 6-2 for BC. The bar charts shown for each parameter depict the measured average concentration at both monitoring sites for working days during daytime hours, apportioned among three components: a component attributable to a background regional concentration estimated from non-working days, an additional regional component attributable to working days, and a component estimated as the landfill contribution on working days. The tables show the percent contribution by the landfill to the Landfill and Community sites, for each pollutant, by year.

6.3.1 PM_{10} Impacts

Figure 6-1 shows the estimated apportionment of average PM_{10} concentrations to regional, non-working day levels; additional regional inputs on working days; and landfill contributions associated with working days (calculated by difference). **Table 6-1** shows the contribution of PM_{10} by the landfill at the Community and Landfill sites, by year.

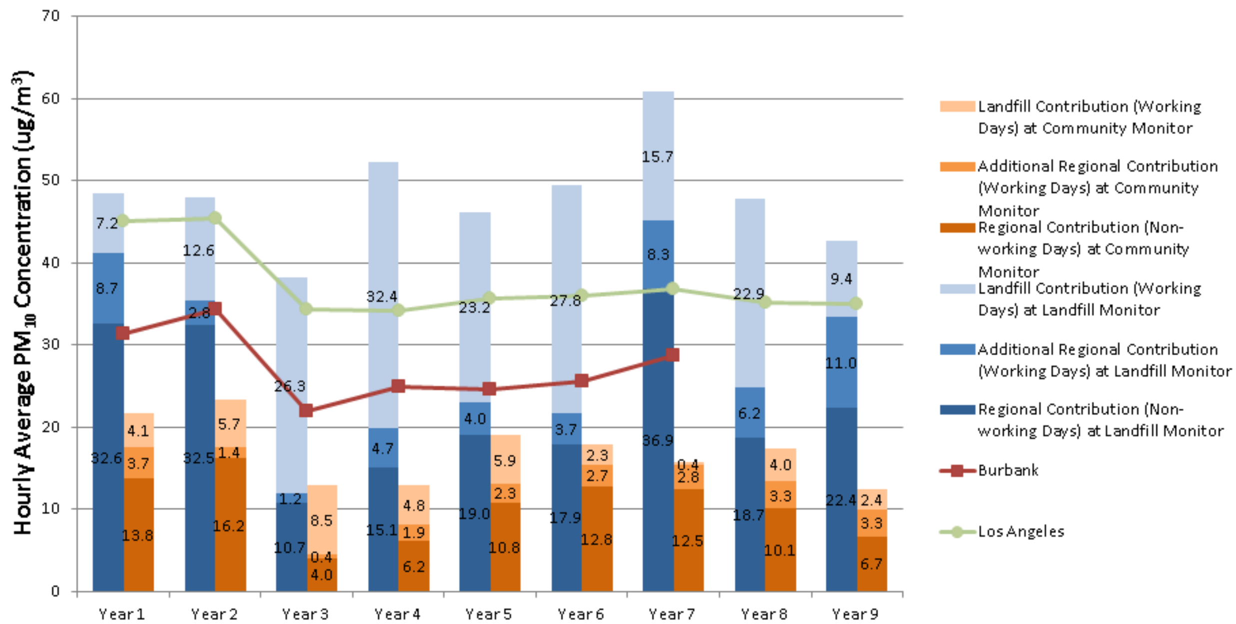


Figure 6-1. Summary of nine consecutive years of quantitative estimates of the average regional contribution to ambient PM_{10} levels on non-working days (dark blue/orange bars), the additional regional contribution associated with increased activity levels on working days (medium blue/orange bars), and the average hourly landfill contribution on working days (light blue/orange bars) for the Landfill (blue bars) and Community (orange bars) monitor sites. Line graphs show annual averages for Los Angeles and Burbank (January through December).[8]

Table 6-1. Contribution of hourly average PM_{10} by the landfill to concentrations at the Landfill and Community sites.

Year	Landfill Site		Community Site	
	Amount (µg/m^{-3})	% of Total	Amount (µg/m^{-3})	% of Total
Year 1 – 11/22/07–11/21/08	7.2	15%	4.1	19%
Year 2 – 11/22/08–11/21/09	12.6	26%	5.7	24%
Year 3 – 11/22/09–11/21/10	26.3	69%	8.5	66%
Year 4 – 11/22/10–11/21/11	32.4	62%	4.8	37%
Year 5 – 11/22/11–11/21/12	23.2	50%	5.9	31%
Year 6 – 11/22/12–11/21/13	27.8	56%	2.3	13%
Year 7 – 11/22/13–11/21/14	15.7	26%	0.4	2%
Year 8 – 11/22/14–11/21/15	22.9	48%	4.0	23%
Year 9 – 11/22/15–11/21/16	9.4	22%	2.4	20%

[8] For Los Angeles in Year 9 (2016), the average only covers January through September, and for Burbank in Year 7 (2014), the average only covers January through June, because of data availability.

The following comments apply to the estimates of regional and landfill contributions of PM_{10} shown in Figure 6-1:

- As measured at the Landfill monitor only, the landfill's contribution (light blue bars) to hourly average PM_{10} concentrations decreased to 9.4 µg/m^3 in Year 9. No trend in landfill contributions is evident. Compared to the results shown in Figure 5-9 panel (a), the contribution of the landfill estimated using this method was much lower than the observed contribution of low- to mid- 20 µg/m^3.
- Estimates of landfill contributions to community levels of PM_{10} remain comparatively low, with no trend. In Year 9, the landfill's contribution to Community PM_{10} concentrations was lower than the average of previous years.
- Ambient PM_{10} concentrations at the Landfill and Community monitoring sites have tracked regional concentrations fairly well, except for in Year 4 at the Landfill monitor, where increased landfill contributions contributed to higher average levels, while the Community and regional sites remained about the same as Year 3. (Note: the annual averages shown by the regional concentration lines in Figure 6-1 are meant to illustrate the degree of agreement in regional trends of annual average PM_{10} concentrations between the SCAQMD sites and the two local monitoring sites. They are January-through-December averages, and thus not directly comparable to the November-to-November averages shown for the Landfill and Community monitoring sites.)
- In any given year, the "background" PM_{10} concentration at the Landfill site, estimated from non-working days when wind direction is from the landfill (dark blue bars), is two to three times higher than concentrations at the Community monitor (dark orange bars). This non-working day background value is a direct measurement, bound by the "from landfill" wind direction sector on Sundays and holidays. The confidence level in this measurement is high. This finding suggests that, even on non-working days, the landfill is contributing PM_{10} that is measured by the Landfill monitor but not detected by the Community monitor.
- PM_{10} measured at the landfill location in Year 7 exhibited a higher hourly average than any other year to date. This was driven largely by a twofold increase in the background regional contribution measured on non-working days. In general, variations in nearby landfill contributions could be due to variations in landfill activity or in meteorology.
- The estimated landfill contribution to PM_{10} concentrations measured at the Community monitor in Year 9 was in the same range as the contributions in previous years.

6.3.2 Black Carbon Impacts

Figure 6-2 shows the estimated apportionment of average BC concentrations to regional non-working day levels, additional regional inputs on working days, and landfill contributions associated with working days (calculated by difference) for each of the eight monitoring years. Note that the data values shown in Figure 6-2 are different from those in the first six annual reports, as the compensated BC values are now used (see Section 1.2). However, the general patterns and trends are consistent. **Table 6-2** shows the contribution of BC by the landfill at the Community and Landfill sites, by year.

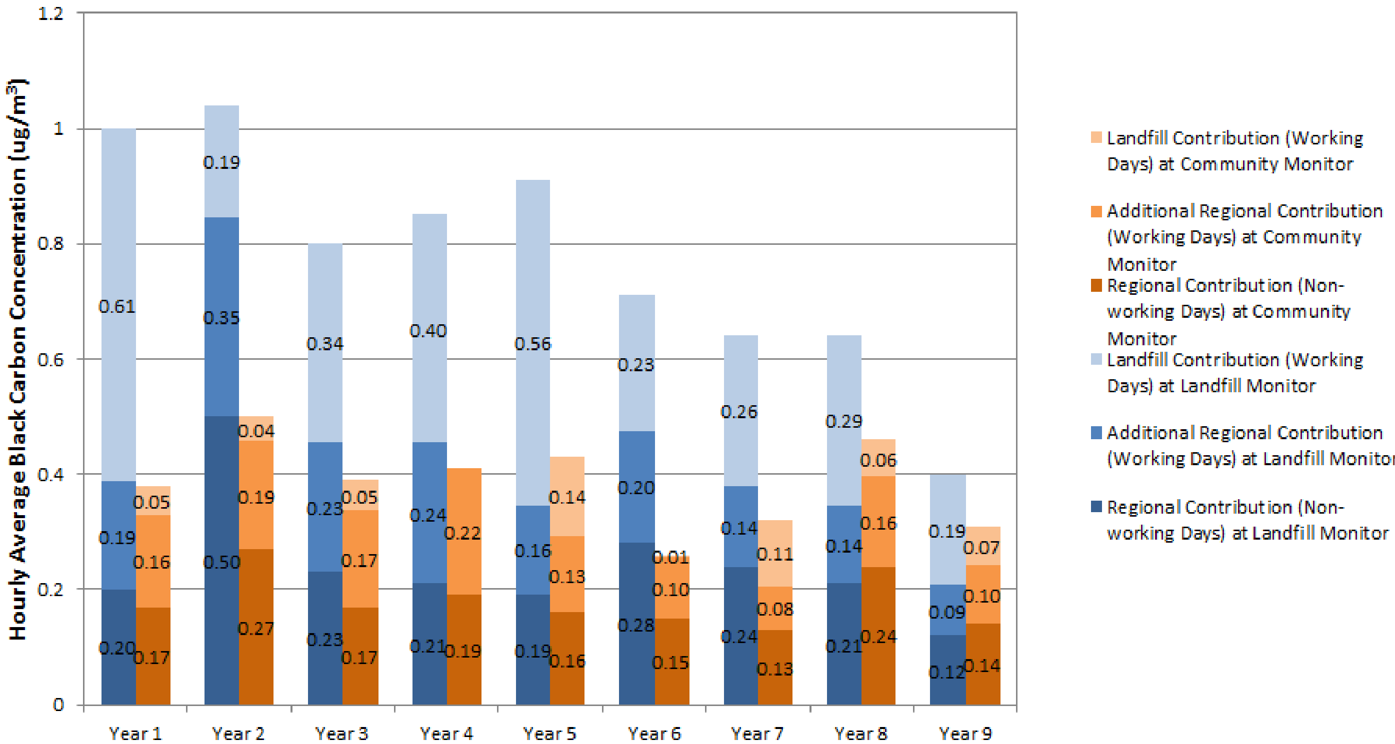


Figure 6-2. Summary of nine consecutive years of quantitative estimates of the average regional contribution to ambient BC levels on non-working days (dark blue/orange bars), the additional regional contribution associated with increased activity levels on working days (medium blue/orange bars), and the average hourly landfill contribution on working days (light blue/orange bars).

Table 6-2. Contribution of hourly average BC by the landfill at the Landfill and Community sites.

Year	Landfill Site		Community Site	
	Amount (μg/m^{-3})	% of Total	Amount (μg/m^{-3})	% of Total
Year 1 – 11/22/07–11/21/08	0.61	61%	0.05	13%
Year 2 – 11/22/08–11/21/09	0.19	19%	0.04	9%
Year 3 – 11/22/09–11/21/10	0.34	43%	0.05	14%
Year 4 – 11/22/10–11/21/11	0.40	47%	-0.03	0%
Year 5 – 11/22/11–11/21/12	0.56	62%	0.14	32%
Year 6 – 11/22/12–11/21/13	0.23	33%	0.01	2%
Year 7 – 11/22/13–11/21/14	0.26	41%	0.11	36%
Year 8 – 11/22/14–11/21/15	0.29	46%	0.06	14%
Year 9 – 11/22/15–11/21/16	0.19	48%	0.07	22%

The following comments apply to Figure 6-2:

- Overall BC concentrations at the Community monitor decreased in Year 9 to 0.31 μg/m^3 from 0.46 μg/m^3 in Year 8.
- As shown previously with PM_{10}, annual landfill contributions to ambient BC concentrations (light blue bars) are substantial at the Landfill monitor, but lower at the Community monitor (light orange bars).
- As measured at the Landfill BC monitor, the landfill contribution to ambient BC concentrations (light blue bar) in Year 9 at 0.19 μg/m^3 tied Year 2 as the lowest value over the nine-year period. This estimate was comparable to the observed BC contribution by the landfill as shown in Figure 5-10, panel (a).

6.4 Comparison of Methods

In this report time period, the Landfill North site provided the opportunity for a more direct measure of contributions of PM_{10} and BC from landfill operations. Using data from the Landfill North site (Section 5.6), we found:

- The PM_{10} differences between the Landfill and Landfill North sites were 22 μg/m^3 when the winds were from the landfill and 26 μg/m^3 when the winds were from the SoCAB, suggesting a consistent localized PM_{10} contribution of about 20 to 25 μg/m^3 from the landfill to the downwind landfill monitors. This directly measured contribution is more than two times higher than the estimate made in Section 6.3 (without the benefit of the Landfill North site data).
- The BC differences between the Landfill and Landfill North sites were 0.1 μg/m^3 when the winds were from the landfill and 0.3 μg/m^3 when the winds were from the SoCAB, suggesting a small localized BC contribution from activities at the landfill to the downwind landfill monitors. This finding is similar to the estimated BC contribution from the landfill discussed in Section 6.3.
- Because the PM_{10} and BC levels at the Community site were lower than those at the Landfill (and Landfill North) site regardless of wind sector, landfill contribution to PM_{10} and BC concentrations at the Community site was not evident.

Therefore, while the Landfill North site provided a direct measure of landfill impacts on PM_{10} and BC concentrations onsite that was higher than estimated using the less precise technique discussed in Section 6, the data show that the elevated concentrations did not reach the Community site. Also of note, the BC concentrations from landfill activities are quite low. In order to more accurately quantify PM_{10} and BC from landfill operations, keeping the Landfill North site should be considered.

7. Field Operations

7.1 Routine Field Operations

Field operations include regular visits to both monitoring sites. During the first four years of the study, these visits were scheduled at two-week intervals. We changed this interval to monthly because experience has demonstrated that monthly visits suffice to meet the routine maintenance operations associated with the Beta Attenuation Monitor (BAM) and the Aethalometer. This protocol is in keeping with the maintenance schedule recommended by Met One (manufacturer of the BAM) and Magee Scientific (manufacturer of the Aethalometer). This protocol is accompanied by daily review of data that allows problems to be detected quickly. Many times the detected problems can be addressed remotely via cellular connection to the site instruments. Occasionally, non-scheduled onsite visits by an STI technician are required and occur as soon as reasonably possible.

Each quarterly report contains tables with the dates and times of each site visit and a summary of activities that took place. Consult these reports for a summary of field activities that occurred in Years 1 through 8. **Tables 7-1, 7-2, and 7-3** summarize all visits during Year 9 for the three monitoring sites.

Table 7-1. Sunshine Canyon Landfill monitoring site visits and field maintenance and operations in Year 9.

Date of Site Visit	Description of Work
December 1, 2015	Collected PM_{10} and BC data. Incomplete site check due to high winds.
December 9, 2015	Replaced BAM s/n A3306 with BAM 1020 s/n T19280. Performed flow check on BAM sampler.
January 12, 2016	Performed flow check on BC and BAM samplers. Cleaned BAM roller, vane, and nozzle. Found BAM out of tape; installed new tape spool and restarted. Collected PM_{10} and BC data.
February 11, 2016	Performed flow check on BC and BAM samplers. Noticed puncture holes in Aethalometer tape and unevenly spaced sample marks; restarted Aethalometer. Found new signs of water leaks in trailer and on BAM; leak is in the roof at sample inlet penetrations and tripod base mounts. Seams repaired with Henry's roofing adhesive. Collected PM_{10} and BC data.
March 16, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers. Changed BAM tape supply.

Date of Site Visit	Description of Work
April 20, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers. Performed BAM calibration. Found BAM tape supply good, approximately 50% remaining. Cleaned BAM roller, vane, and nozzle.
April 27, 2016	Performed flow check on BAM sampler. Replaced pump. Reset flow, performed calibration, and rechecked flow.
May 17, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers. Found BAM tape supply low; installed new tape and restarted. Cleaned BAM roller and nozzle.
June 2, 2016	Collected PM_{10} and BC data.
June 20, 2016	Collected PM_{10} and BC data. Restarted BC sampler. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on BC and BAM samplers. Calibrated BAM flow. Performed wind anemometer calibration.
July 20, 2016	Collected PM_{10} and BC data. Restarted BC sampler. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on BC and BAM samplers. Calibrated BAM flow.
August 19, 2016	Collected PM_{10} and BC data. Checked BC sampler tape supply and cleaned cabinet. Restarted BC sampler. Cleaned BAM roller, vane, and nozzle and performed leak check. Left BAM tape with 40% supply. Performed flow check on BC and BAM samplers. Calibrated BAM flow.
September 14, 2016	Collected PM_{10} and BC data. Cleaned BAM roller, vane, and nozzle and performed leak check. Re-spooled BAM tape supply. Performed flow check on Aethalometer and BAM samplers.
October 1, 2016	BAM removed for maintenance.
November 3, 2016	Re-installed BAM onsite. Powered up the instrument, re-spooled, and checked BAM tape. Performed flow and leak checks on BAM.
November 22, 2016	Collected PM_{10} and BC data. Restarted Aethalometer. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.

Table 7-2. Sunshine Canyon Landfill North site visits and field maintenance and operations in Year 9.

Date of Site Visit	Description of Work
December 10-11, 2015	Cleaned trailer, secured trailer scissor jacks. Mounted Aethalometer to rack and installed BAM. Installed 10-m meteorological tower and 5305V wind sensor. Performed flow check and leak check on BAM sampler. Performed zero test. Adjusted wind data setup on 12/11/2015 (removed multiplier). Installed VAC and set to “Heat” (will need to be changed to “Cool” next summer). No data written to database until 12/11/2015 09:00.
December 23, 2015	Performed flow check on BC and BAM samplers. Found BAM load spool loose; re-spooled and re-tensioned with new roll.
January 12, 2016	Performed flow check on BC and BAM samplers. Collected PM_{10} and BC data.
February 11, 2016	Performed flow check on BC and BAM samplers. BAM had a filter tape break error; no break found but spool cap was loose; re-tensioned spool cap. Changed BAM tape supply. Collected PM_{10} and BC data.
March 16, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers.
April 20, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers. Cleaned BAM roller, vane, and nozzle. Changed BAM tape supply.
May 17, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers. Cleaned BAM roller, vane, and nozzle.
July 20, 2016	Collected PM_{10} and BC data. Found BAM tape supply low; changed tape spool. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on BC and BAM samplers.
August 19, 2016	Collected PM_{10} and BC data. Restarted Aethalometer and returned to normal operating mode. Left Aethalometer tape at 30% supply. Cleaned BAM roller and nozzle and performed leak check. Left BAM tape at 40% supply. Performed flow check on BC and BAM samplers.

Date of Site Visit	Description of Work
September 14, 2016	Collected PM_{10} and BC data. Restarted Aethalometer. Found tape supply for Aethalometer low; did not replace as there was none available on site. Replaced BAM tape supply. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.
October 19, 2016	Collected PM_{10} and BC data. BAM found non-operational; scheduled for repair. Replaced Aethalometer tape supply.
October 20, 2016	BAM removed for maintenance.
November 22, 2016	Collected BC data. Restarted Aethalometer. Re-installed BAM onsite. Powered up the instrument, re-spooled, and checked BAM tape. Replaced BAM tape supply and returned to normal operating mode. Performed flow check on Aethalometer and BAM samplers.

Table 7-3. Community monitoring site visits and field maintenance and operations in Year 9.

Date of Site Visit	Description of Work
December 1, 2015	Performed flow check on BC and BAM samplers. Collected PM_{10} and BC data.
December 9, 2015	BAM 1020 s/n A4987 replaced with BAM 1020 s/n T19279. Performed flow check on new BAM sampler.
December 18, 2015	BAM zero and offset calibrations entered. BAM sample inlet installed.
January 12, 2016	Performed flow check on BC and BAM samplers. Found BAM out of tape; re-spooled tape supply. Collected PM_{10} and BC data.
January 13, 2016	Performed flow check on BAM sampler. Removed debris from BAM nozzle and cleaned BAM nozzle.
February 11, 2016	Performed flow checks on BC and BAM samplers. Restarted Aethalometer. Cleaned BAM roller. Collected PM_{10} and BC data.
March 16, 2016	Collected PM_{10} and BC data. Found new spool of tape required for Aethalometer. Replaced and tensioned tape. Found rocker switch was broken. Performed flow check on BC and BAM samplers. Found BAM Delta Cal flow out of calibration. Performed flow calibration, temp, BP references adjusted first. Changed BAM tape supply.
March 23, 2016	Found breaker tripped inside Y classroom. Reset breaker. Performed flow check on BAM sampler. Found BAM flow out of range. Performed flow calibration.
March 28, 2016	Performed flow check on BAM sampler.
April 20, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers. Calibrated BAM flow. Cleaned BAM roller, vane, and nozzle.
April 27, 2016	Performed flow check on BAM sampler.
May 17, 2016	Collected PM_{10} and BC data. Performed flow check on BC and BAM samplers. Recalibrated BAM flow. Found BAM tape supply low; replaced BAM tape supply. Cleaned BAM roller, vane, and nozzle.
June 2, 2016	Collected PM_{10} and BC data.

Date of Site Visit	Description of Work
June 20, 2016	Found air conditioning unit not cooling. Collected PM_{10} and BC data. Checked tape supply and performed flow check on BC and BAM samplers. Cleaned BAM roller and nozzle and performed leak check. Calibrated BAM flow.
June 21, 2016	Performed flow and leak check on BAM sampler.
July 20, 2016	Replaced air conditioning unit. Collected PM_{10} and BC data. Powered down and restarted BC sampler. Cleaned BAM roller and nozzle and performed leak check. Performed flow check on BC and BAM samplers. Performed a second flow check on BAM. Calibrated BAM flow.
August 19, 2016	Collected PM_{10} and BC data. Checked tape supply. BAM sampler with 40% tape remaining. Cleaned BAM roller and nozzle and performed leak check. Performed flow check on BAM sampler. Calibrated BAM flow.
September 14, 2016	Collected PM_{10} data. Replaced BAM tape supply. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.
September 23, 2016	BAM removed for maintenance.
November 2, 2016	Re-installed BAM onsite. Powered up the instrument, re-spooled, and checked BAM tape. Performed BAM flow and leak check and returned to normal operating mode.
November 22, 2016	Collected PM_{10} and BC data. Powered down and restarted Aethalometer. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.

Appendix A: Regional Concentrations of BC

Concentrations of black carbon by month and time of day, and a differential between the Landfill and Community sites, are shown in **Figure A-1**. These data are from the time period of the MATES IV study in 2012-2013. Concentrations of BC are highest in the summer, with a maximum median concentration occurring at both sites in August. While Figure A-1 represents only one year of data, this seasonal trend is consistent across all eight years of monitoring data with one exception: the very high variability in February concentrations is a one-year issue that was not seen in the other eight years of monitoring data. Concentrations of BC are highest in the early morning hours (Figure A-1, bottom). The big diurnal dip in the differential in the early morning hours at 6:00 a.m. LST is consistent across years. This indicates a clear pattern of higher local concentrations at the landfill station in the early morning hours.

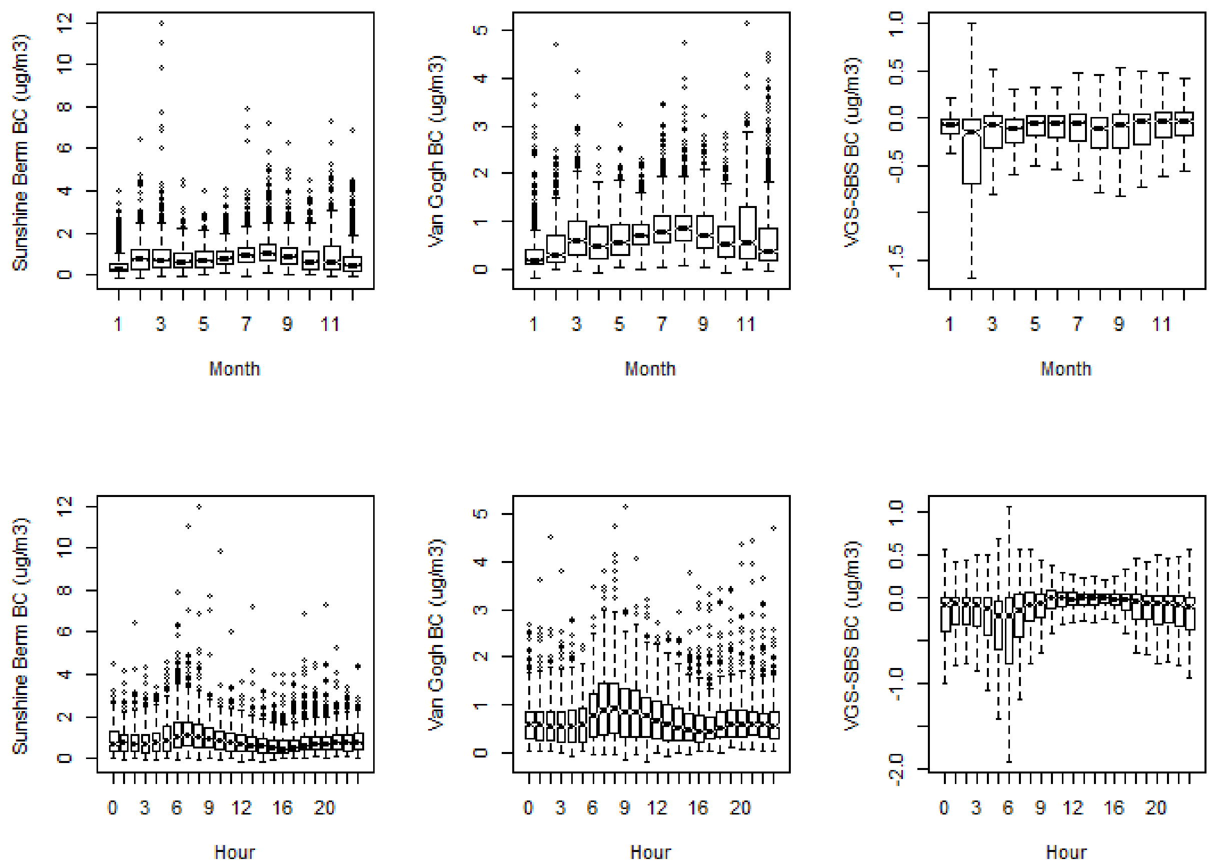


Figure A-1. Concentrations of black carbon at the two stations by month (top three figures) and time of day (bottom three figures) for the time period of the MATES IV study (July 2012–June 2013). Differentials are shown on the far right; concentrations below zero indicate that concentrations were higher at the Sunshine Berm station than at the Van Gogh station. Note that the scale is higher for the data for the Berm site (far left).

To place the data in a regional context, Landfill and Community black carbon concentrations during the MATES IV period (July 2012–June 2013) are shown in comparison to MATES IV black carbon measurements that were made at Burbank, Los Angeles, Pico Rivera, and Huntington Park. **Figure A-2** shows a comparison of concentrations for the days and hours when each of the sites had valid BC data available during this time period. Concentrations at the Sunshine Berm site (SBS) and Van Gogh site (VGS) are shown in blue, while other nearby Los Angeles sites are shown in gray. Median concentrations at the Landfill and Community sites are significantly lower than those measured at the other four sites during the same time period. Moreover, 75th percentile (top of the box) and upper percentile concentrations (indicated by error bars) are also significantly lower at the Landfill and Community sites than at other sites in the Los Angeles Basin. Diurnal differences in concentrations are greatest during early morning rush hours, and concentrations across the basin are most similar during afternoon and early evening hours.

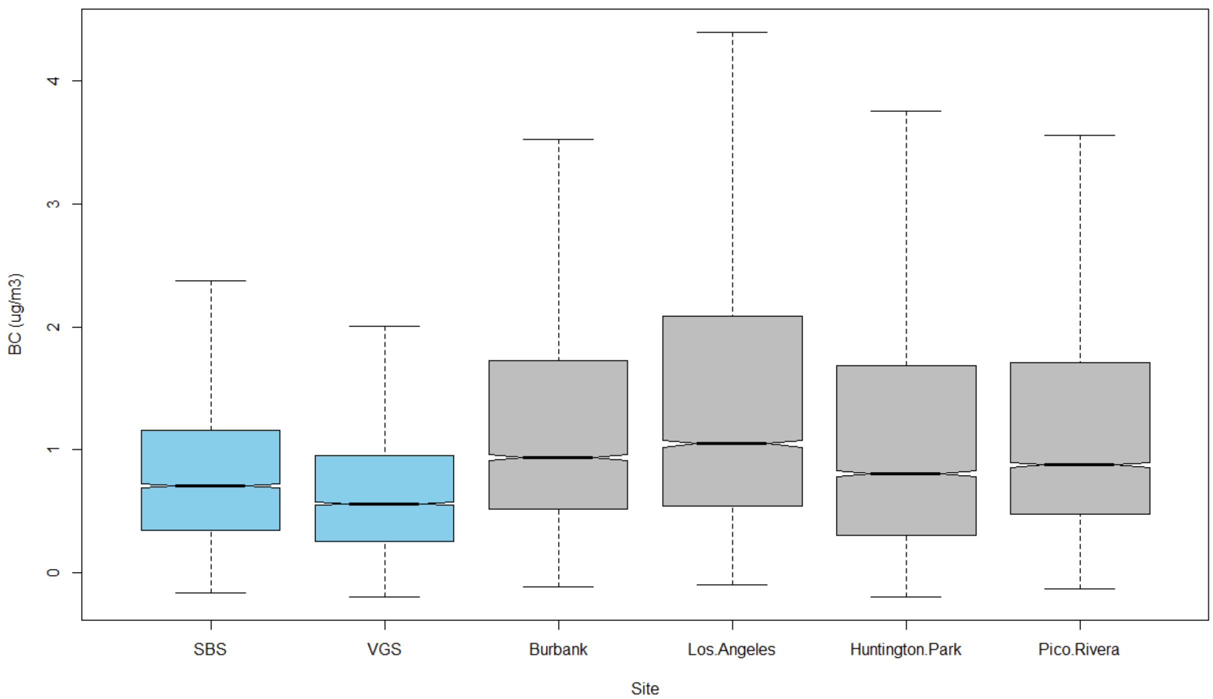


Figure A-2. A comparison of regional BC concentrations from July 2012 through June 2013 at landfill sites (blue) and MATES IV monitoring stations (gray). In MATES IV documentation, Los Angeles is referred to as “Central LA.”

Appendix B: Additional Analyses

This appendix contains discussions of the temporal variability in BC, PM_{10}, and wind direction (Section B.1), and of the effects of wind direction and work activity on BC and PM_{10} (Section B.2).

B.1 Temporal Variability in BC, PM_{10}, and Wind Direction

As shown in **Figure B-1**, the diurnal profiles of BC and PM_{10} are characterized by a morning peak in concentrations at both monitoring locations. The peak in BC occurs between 6:00 a.m. and 8:00 a.m., while the peak in PM_{10} is broader, occurring between 6:00 a.m. and 10:00 a.m. Overall, the mean hourly concentrations of both BC and PM_{10} are lower at the Community monitor than at the Landfill monitor. The diurnal profiles in Year 9 (November 22, 2015, through November 21, 2016) are consistent with the previous eight years.

As shown in the box-whisker plots (**Figure B-2**), median concentrations of BC and PM_{10} are higher during the warm season (approximately May through September) at both the Community and the Landfill sites.

Figures B-3 through B-6 show seasonal wind roses of hourly data collected at the Landfill, Landfill North, and Community sites. At the Landfill site, winds are predominantly from the northerly and southerly directions during all seasons, with a larger proportion of winds from the north during the winter and from the south during the summer (Figures B-4 and B-5). At the Landfill North site, the prevailing winds are northwesterly in the winter, southerly in the spring and summer, and a mix of northwesterly and southerly in the fall. The prevailing wind direction at the Community site varies during all seasons (Figure B-6).

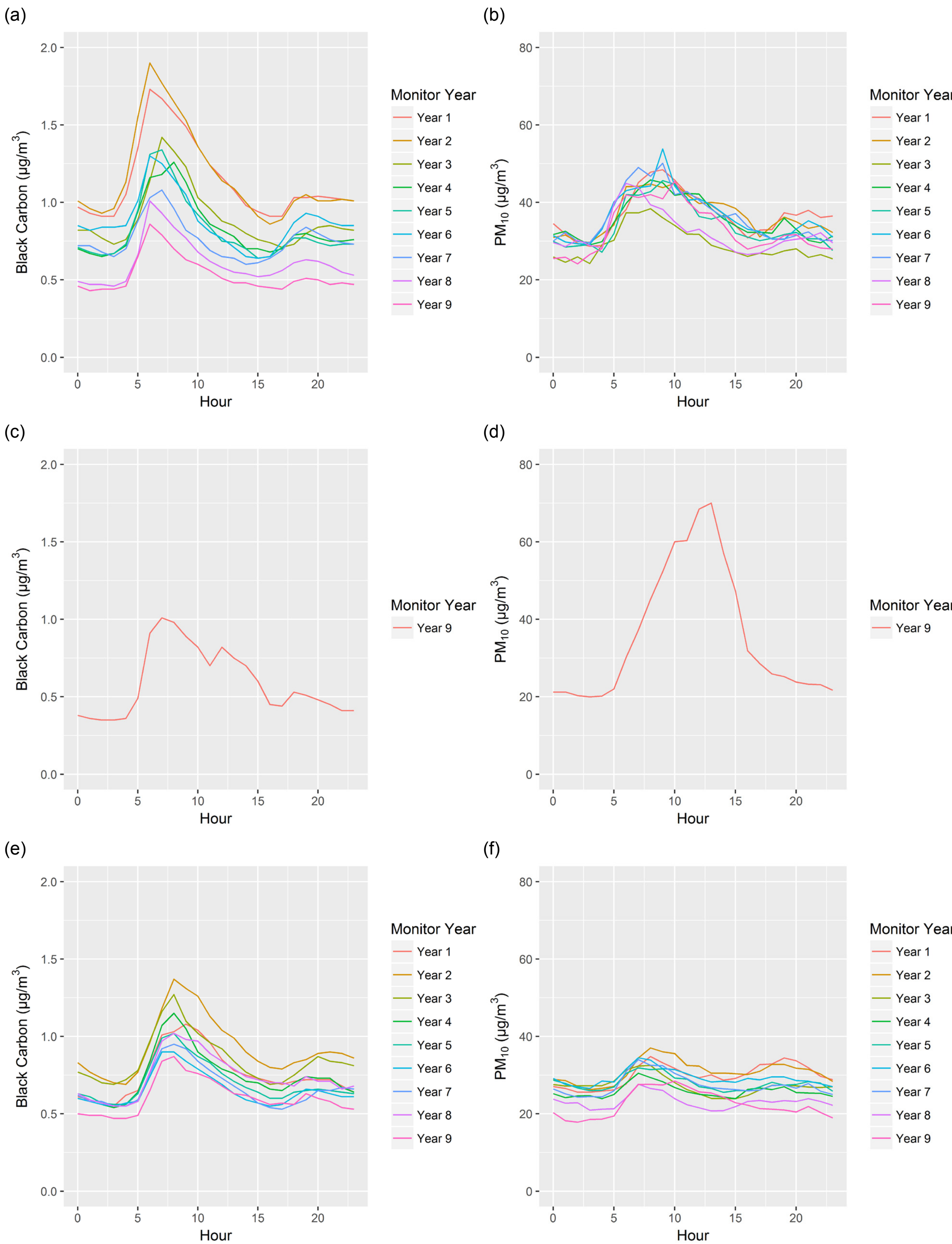


Figure B-1. Mean BC and PM_{10} concentrations by hour for the nine monitoring years at the Landfill (a, b) and Community (e, f) sites, and for Year Nine at the Landfill North (c, d) site.

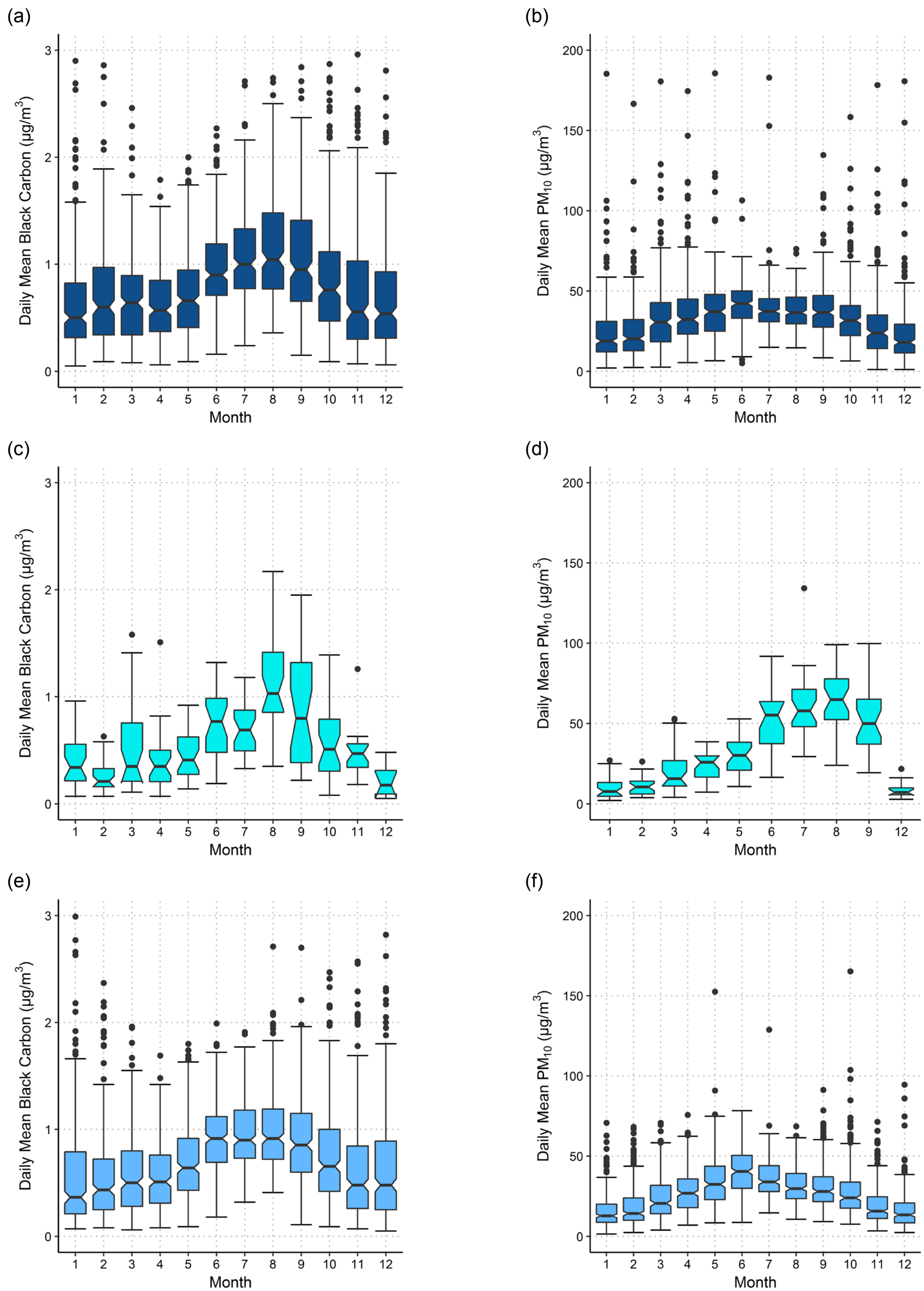
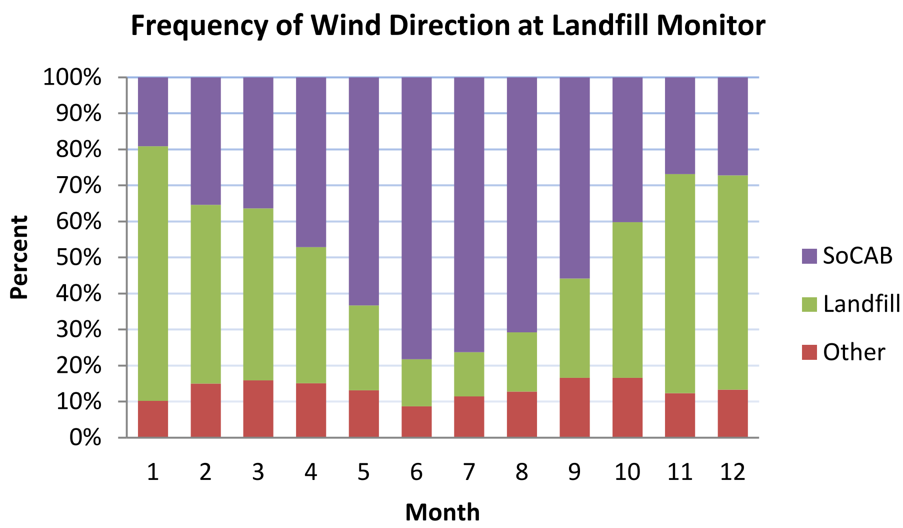


Figure B-2. Distribution of daily mean BC and PM_{10} concentrations by month during all nine monitor years (2007–2016) at the Landfill (a, b) and Community (e, f) sites, and during Year Nine at the Landfill North (c, d) site. BC outlier data greater than 3 µg/m^3 and PM_{10} outlier data greater than 200 µg/m^3 are excluded.

(a)



(b)

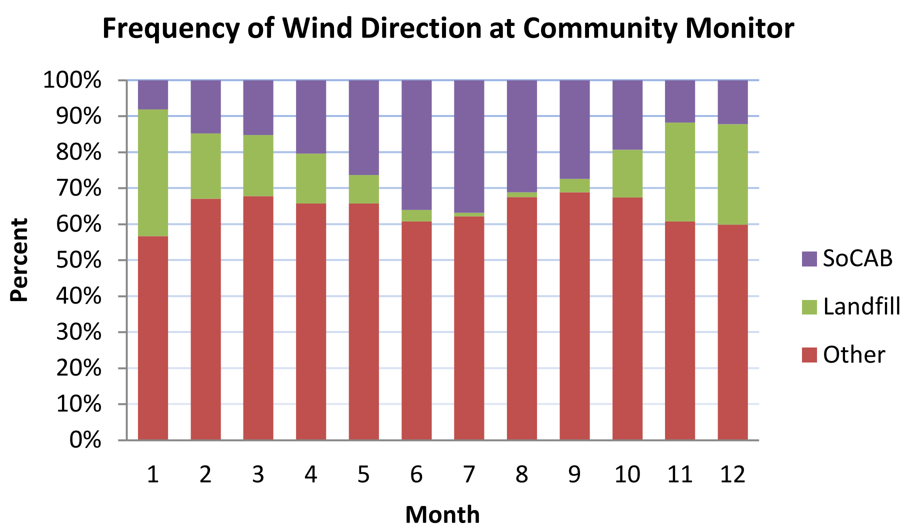


Figure B-3. Percent of time that the Landfill (a) and Community (b) monitoring sites experienced winds that originated from each wind direction sector (South Coast Air Basin, Landfill, Other) during each month in all nine years (2007–2016).

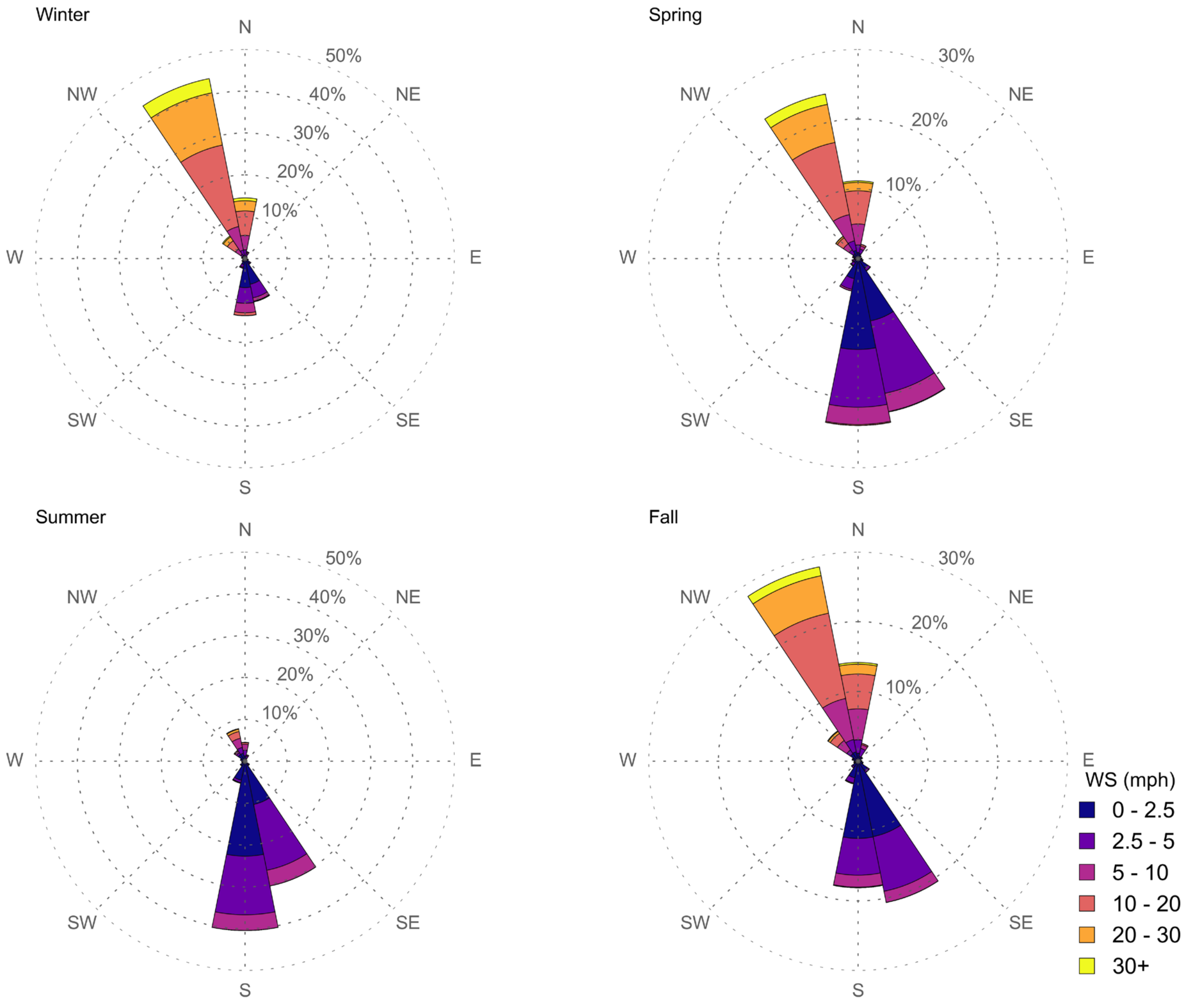


Figure B-4. Seasonal wind roses of hourly data collected at the Landfill monitor during 2007-2016.

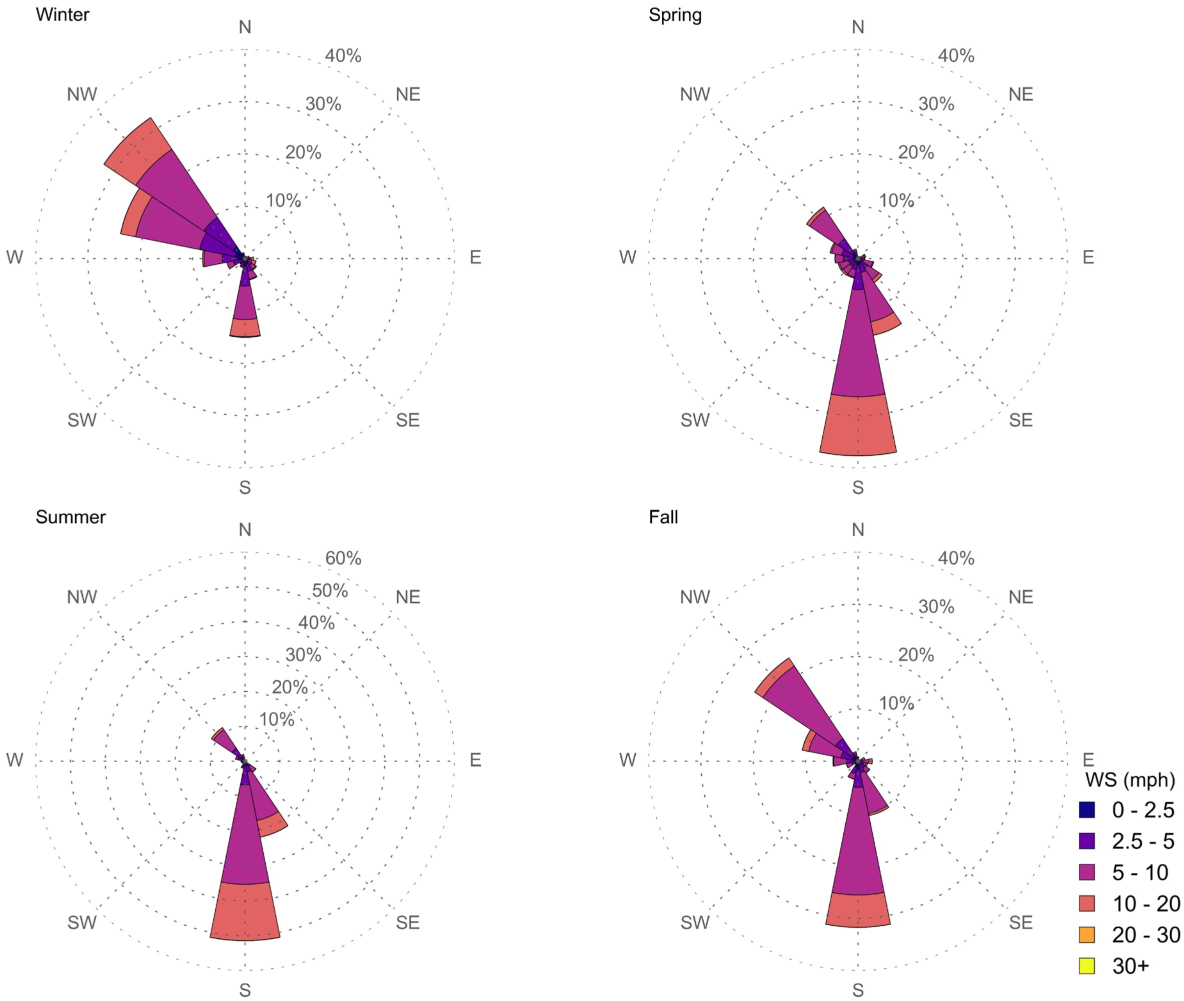


Figure B-5. Seasonal wind roses of hourly data collected at the Landfill North monitor in Year Nine.

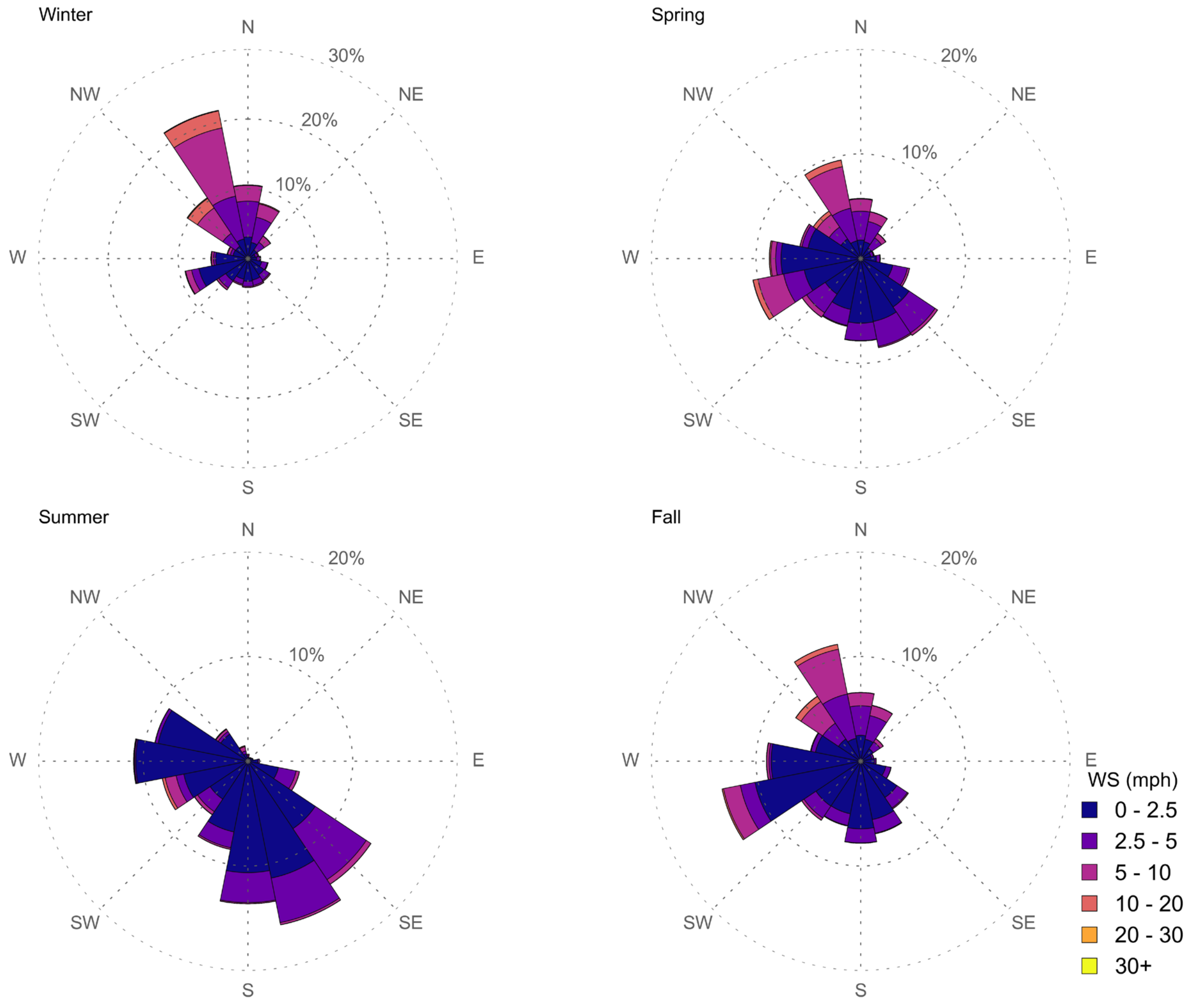


Figure B-6. Seasonal wind roses of hourly data collected at the Community monitor during 2007-2016.

B.2 BC and PM_{10}: Effects of Wind Direction and Work Activity Levels

As shown in **Figure B-7**, concentrations of BC and PM_{10} are higher on weekdays than weekends. Higher concentrations are consistent with greater activity at the landfill during the week, as well as with more vehicles on the roads throughout the SoCAB. Concentrations of BC and PM_{10} are higher on Saturdays than Sundays at the Landfill site. Activity occurs at the landfill on some Saturdays, but not on Sundays.

As shown in **Figure B-8**, concentrations of BC and PM_{10} are several times greater when winds come from the south than from the north. In addition, concentrations are typically similar between the Landfill and Community sites when winds are from the SoCAB direction. Concentrations are greater at the Landfill site than the Community site when winds are from the north.

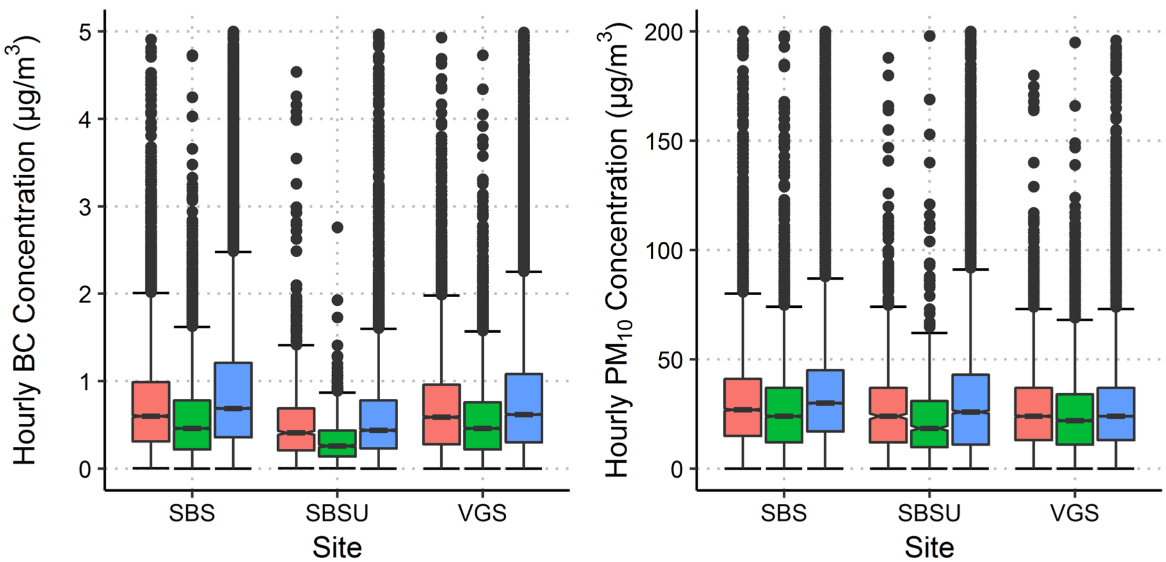


Figure B-7. Hourly BC (left) and PM_{10} (right) concentrations at the Landfill (SBS), Landfill North (SBSU), and Community (VGS) monitoring sites on weekdays (blue), Saturdays (pink), and Sundays (green) from November 22, 2007, through November 21, 2016. BC data greater than 5 µg/m^3 and PM_{10} data greater than 200 µg/m^3 are excluded.

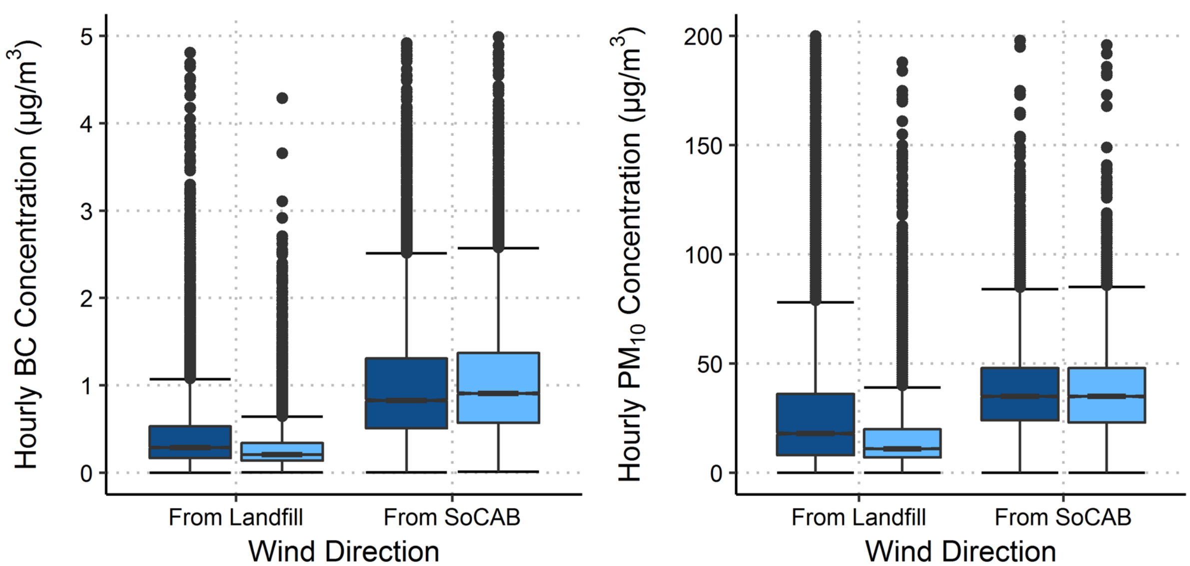


Figure B-8. BC (left) and PM_{10} (right) concentrations at the Landfill (dark blue) and Community (light blue) monitors during November 22, 2007, through November 21, 2016, when winds originate from the Landfill versus when they originate from the SoCAB. Results are based on hourly data points where both sites experienced winds from the same sector. BC data greater than 5 µg/m^3 and PM_{10} data greater than 200 µg/m^3 are excluded.