Twelfth Annual Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School: A Twelve-Year Summary November 22, 2007–November 21, 2019

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

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Twelfth Annual Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School: A Twelve-Year Summary November 22, 2007–November 21, 2019

Annual Report
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On the cover (clockwise from left): Sunshine Canyon Landfill, DeltaCal NIST-traceable reference meter for auditing flow and temperature, and Aethalometer with Beta Attenuation Monitor and data acquisition system.

Table of Contents

Section **Page**

List of Figures

Figure **Page**

List of Tables

Table **Page**

Executive Summary

Continuous monitoring of particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), black carbon (BC), wind speed, and wind direction began at the Sunshine Canyon Landfill (Landfill site) and at Van Gogh Elementary School (Community site) in Granada Hills in fall 2007. This Twelfth Annual Report includes data summaries, analysis, and interpretation drawn from 12 complete years of data from the Landfill and Community monitoring sites; one year of data from the temporary Landfill North site, which was installed upwind of the landfill for one year (2016); and data from the baseline year (November 22, 2001–November 21, 2002). These data are used to characterize ambient PM_{10} and BC concentrations on a neighborhood scale, in the context of the Southern California Air Basin (SoCAB), and to evaluate the impact of landfill operations on air quality in the community.

The following conclusions are based on data from 12 years of continuous monitoring of PM_{10}, BC, and meteorology at the Landfill and Community monitoring sites. Additionally, this report highlights Year 12 (2019).

- Over the 12-year monitoring period, the federal 24-hr PM_{10} standard was exceeded on 38 occasions at the Landfill site, with a record number occurring in 2017 (Year 10, with 11 exceedances). The federal standard was exceeded on 5 occasions at the Community site. In 2019 (Year 12), the federal standard was exceeded on four occasions at the Landfill site, and on three occasions at the Community site. The majority of the Year 12 exceedance days were associated with nearby wildfires and smoke during the fall quarter.
- Exceedances of the more stringent state 24-hr PM_{10} standard at the Landfill site declined each year between 2013 (Year 6) and 2016 (Year 9), spiked in 2017 (Year 10), and decreased again in 2018 and 2019. The Community site has seen a low number of exceedances of the state PM_{10} standard since 2015; this standard was exceeded at the Community site less than 10 times in each year from 2015 (Year 8) to 2018 (Year 11). In 2019 (Year 12), however, the state standard was exceeded on 16 occasions at the Community site, and 48 at the Landfill site.
- The Landfill site's PM_{10} federal and state exceedances are accompanied by high wind speeds, with wind direction falling within a narrow sector that encompasses the active portion of the landfill. State exceedance days at the Landfill site are also accompanied by low-speed winds from the Los Angeles basin (south and southeast), suggesting that the addition of elevated concentrations within the basin can push the Landfill site's PM_{10} concentrations over the state threshold. On days when PM_{10} concentrations exceed the state standard at the Community site, wind speeds are relatively low and wind direction is predominantly from the Los Angeles basin (southeast). This suggests that regional contributions are the main driver of exceedances of the state PM_{10} standard at the Community site.
- Monthly average PM_{10} concentrations at the Landfill site compared well with the regional monitoring site in downtown Los Angeles in Years 5 through 9. However, in Years 10 and 11, the Landfill site's monthly average PM_{10} concentrations showed a significant increase. In contrast, the annual average concentrations at the Community site have

been steadily decreasing since Year 7, nearing the annual average concentrations measured at Santa Clarita in Years 11 and 12. This is an important finding in that, while PM_{10} concentrations measured at the Landfill site remain relatively high (with a recent trend upward), PM_{10} concentrations measured at the Community site are trending down.

- To estimate the landfill contributions to PM_{10} and BC concentrations at the Landfill and Community sites, we compared the difference between PM_{10} and BC concentrations at the Landfill and Community sites under two wind sectors (“from landfill” and “from SoCAB”) and two working categories (non-working day/hour and working day/hour).
  - The greatest difference in PM_{10} and BC concentrations between the Landfill and Community sites was observed during periods of highest activity levels (i.e., working hours on working days).
  - The Community site measured slightly higher PM_{10} and BC concentrations on working days (both working hours and non-working hours) compared to non-working days (both working hours and non-working hours) when the wind was from the landfill. A similar work day/non-work day pattern exists for PM_{10} concentrations at Burbank and Los Angeles regional sites, which may indicate that the increase is attributable to increased emissions in general on working days relative to non-working days. However, PM_{10} concentrations measured at the Community site were significantly lower than PM_{10} concentrations measured at regional monitoring sites and the Landfill site.
  - When the wind was from the SoCAB, the PM_{10} values at the Community site were slightly higher than at the Landfill site during non-working hours and lower during working hours and days, indicating a regional contribution of PM_{10} to the Community site from the SoCAB. On days in the highest activity level category, the regional contribution of PM_{10} combined with local landfill contributions to increase PM_{10} concentrations at the Landfill site. In Year 12, PM_{10} levels were lower at the Community site than at the Landfill site when wind was from SoCAB for both working and non-working hours and days.
  - When the wind was from the SoCAB, BC concentrations were higher at the Community site than at the Landfill site during the working hour categories, but slightly lower during the non-working hour categories. This suggests that increased regional BC concentrations contributed to BC levels 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.

1.1 Baseline Year and Continuous Monitoring

Continuous monitoring of PM_{10}, BC, and meteorology was performed during a baseline year between November 22, 2001, and November 21, 2002, and a report of the baseline year results was produced by ENVIRON International Corporation.[1] Between the time that the baseline studies were completed and November 2007, when continuous monitoring began, ambient sampling for PM_{10}, BC, and landfill gases (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). STI's technical approach to monitoring 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 to evaluate times when air flows from the landfill to the Community receptor site, as well as to evaluate diurnal trends, day-of-week differences, seasonal differences, and annual trends in pollutant concentrations compared to regional monitors operated by the South Coast Air Quality Management District (SCAQMD) and the California Air Resources Board (CARB).

November 21, 2019, marked the completion of 12 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. 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 Years 9 and 11 because the BAM instruments were removed from the field and sent to the manufacturer for maintenance. The

[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.

most recent data disruption occurred this year. From October 10 to October 24, 2019, the Landfill monitoring site was without power because of the Saddle Ridge Fire. Even with these interruptions, however, PM_{10} data completeness statistics for the 12 years indicate average data capture rates of approximately 95% at the Landfill site and approximately 98% at the Community site (see Section 2). On average, less than 5% 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 12 years between November 2007 and November 2019 at the Landfill and Community sites are analyzed and summarized to offer a realistic characterization of ambient air quality concentrations at the Sunshine Canyon 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 of state and federal standards.
- Section 4 discusses regional comparisons of PM_{10}. No regional comparisons of BC were done in Year 12 because the most recent MATES data set used for comparison is not yet available. The BC data in Year 12 would not change the conclusions from the previous comparison included in the 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 (excerpt included as **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 of wind and the Landfill North site data are provided in **Appendix B**.
- **Appendix C** compares the Environmental Impact Report's estimated annual increment from landfill emissions to ambient air toxics concentrations and ambient air toxics from the 2016-2017 measurements made at the Landfill and Community sites.

Regulatory standards for pollutants are commonly used to judge the compliance status of air quality management districts. 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. In this report, both the 24-hr federal standard and the 24-hr state standard are used as a benchmark metric for evaluating the specific monitoring locations in relation to each other and to the standards.

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),[2] and Santa Clarita. **Figure 1-1** shows the relative locations of the sites.

[2] PM_{10} monitoring at the Burbank (West Palm) site was discontinued in July 2014.

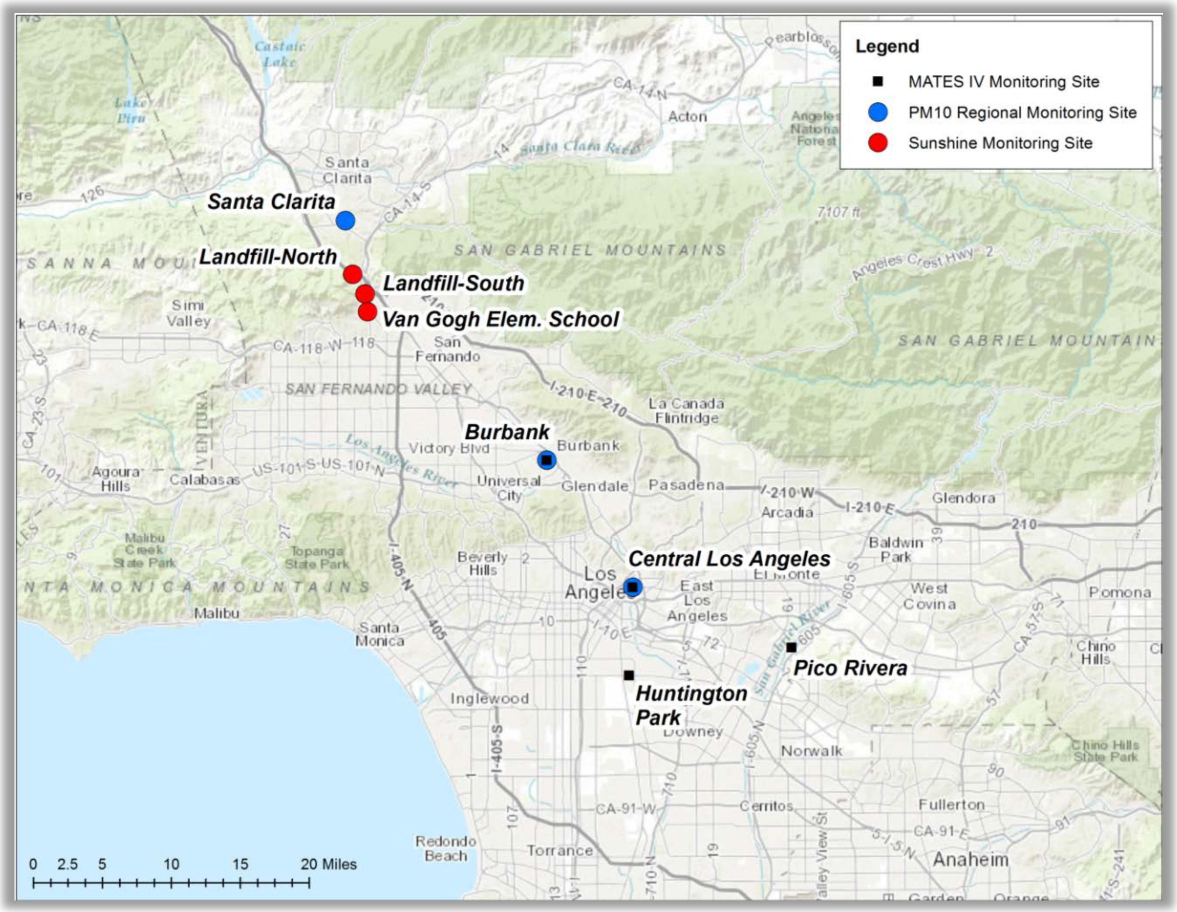


Figure 1-1. Locations of the Landfill and Community monitors in relation to the three SCAQMD PM_{10} sites and four MATES IV BC sites used for regional comparisons. The Landfill site is labeled "Landfill South," and the Community monitor is labeled "Van Gogh Elem. School." In MATES IV documentation, the Central Los Angeles site is referred to as "Central LA." The Landfill North site was operated from 2016-2017.

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 air 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, 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). MATES V results will be available before the next Annual Report.

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

1.3 Methods and Operations Background

Aethalometers measure BC concentrations using an optical attenuation technique, and measurements 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., higher concentrations) of BC particles on the tape. This artifact can bias reported BC concentrations low. However, mathematical methods to correct the BC concentrations are available and are widely used. BC values from the Landfill and Community sites were compensated for this tape saturation effect and therefore are representations of ambient concentrations.

Meteorological factors and landfill 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.

[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.

2. Data Completeness

Table 2-1 shows completeness statistics for all measured variables for the 12 years considered in this analysis. 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 percentage of data values that are labeled as suspect divided by the number of captured data values. WS/WD is wind speed/wind direction.

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 Years 9 and 11 (due to instrument maintenance), the percent data capture for PM_{10} exceeded 90% in each site-year at both the Landfill and Community sites, and averaged more than 95% over all 12 years. The percent data capture for PM_{10} in the 12th year is above 95% at both sites. The percent data capture for BC at the Landfill and Community sites averaged more than 92% over 12 years and is above 95% in the 12th year.

As shown in Table 2-1, the percent data capture for WS/WD exceeded 95% at the Landfill site in Year 12 and averaged 96% over all 12 years. At the Community site in Year 10, data logging computer failures caused significant WS/WD data loss, resulting in roughly 65% data capture. In Year 12 at the Community site, the percent data capture for WS/WD was 100%, and over the 12-year period the data capture at the Community site averaged more than 96%.

Table 2-1. Data completeness statistics for hourly data during Years 1–12 of continuous monitoring and overall 12-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%	0.1%	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%	0.1%	0.0%	4.3%
	Van Gogh Elementary School Site	98.4%	87.9%	98.3%	97.0%	100.0%	100.0%	0.5%	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%	0.3%	0.0%	1.6%
	Van Gogh Elementary School Site	100.0%	99.8%	100.0%	99.2%	99.9%	96.3%	0.5%	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%	5.4%	0.0%	1.0%
	Van Gogh Elementary School Site	94.1%	99.9%	98.7%	98.1%	99.9%	96.1%	0.2%	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%	0.8%	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%	0.3%	0.0%	0.0%
	Van Gogh Elementary School Site	100.0%	99.1%	98.5%	98.0%	100.0%	100.0%	0.2%	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%	81.3%	99.8%	100.0%	0.0%	8.7%	0.0%
	Van Gogh Elementary School Site	89.9%	92.4%	99.18%	89.1%	99.7%	100.0%	0.0%	0.3%	0.0%
	Sunshine Canyon Landfill North Site[b]	80.3%	85.6%	88.0%	94.8%	99.9%	100.0%	0.0%	0.2%	0.0%
Yr. 10 Nov. 22, 2016–Nov. 21, 2017	Sunshine Canyon Landfill Site	98.6%	94.0%	97.5%	99.1%	100.0%	100.0%	0.0%	0.0%	0.0%
	Van Gogh Elementary School Site	99.9%	91.5%	64.7%	99.8%	99.8%	100.0%	0.0%	0.0%	0.0%
	Sunshine Canyon Landfill North Site[b]	99.6%	90.3%	99.6%	99.4%	100.0%	100.0%	0.0%	17.5%	0.0%
Yr. 11 Nov. 22, 2017–Nov. 21, 2018	Sunshine Canyon Landfill Site	87.0%	91.1%	91.6%	98.1%	100.0%	100.0%	0.0%	10.9%	0.0%
	Van Gogh Elementary School Site	100.0%	95.6%	100.0%	98.0%	99.3%	100.0%	0.0%	6.9%	0.0%
Yr. 12 Nov. 22, 2018–Nov. 21, 2019	Sunshine Canyon Landfill Site	95.9%	95.0%	95.8%	98.4%	100.0%	94.6%	0.1%	2.2%	0.0%
	Van Gogh Elementary School Site	99.9%	96.3%	100.0%	97.1%	99.8%	99.9%	0.0%	4.1%	0.0%
Twelve-Yr. Average	**Sunshine Canyon Landfill Site**	**95.3%**	**92.4%**	**96.0%**	**96.6%**	**100.0%**	**98.3%**	**0.6%**	**1.8%**	**0.6%**
	Van Gogh Elementary School Site	**98.1%**	**94.9%**	**96.1%**	**95.7%**	**99.9%**	**98.9%**	**0.2%**	**2.9%**	**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 12-year average for percent suspect. Without this quarter, the 12-year average would be 1.1% instead of 2.9%.
[b] Sunshine Canyon Landfill North site operated from June 2016 through May 31, 2017.

3. PM$_{10}$ Exceedances

The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS, 40 CFR Part 50) for pollutants considered harmful to public health and the environment.[6] Included in the NAAQS is PM$_{10}$. Currently, the only federal health-based standard for PM$_{10}$ is the daily (24-hr) average concentration of 150 µg/m^3.

In 1959, California enacted legislation requiring the state Department of Public Health to establish air quality standards and necessary controls for motor vehicle emissions.[7] California law continues to mandate California ambient air quality standards (CAAQS), which are often more stringent than national standards. The State of California's current 24-hr standard for PM$_{10}$ is 50 µg/m^3.

Table 3-1 shows the number of federal and state PM$_{10}$ exceedances for the Landfill, Community, and regional monitoring sites by season over the 12-year period. Additional information on the federal and state exceedance days are described in the following sections.

Table 3-1. Total number of 24-hr federal (150 µg/m^3) and state (50 µg/m^3) PM$_{10}$ exceedances at the Landfill, Community, and regional monitoring sites by season over the 12-year period.

Exceedance Type	Season[a]	Sunshine Canyon Landfill (LS)	Community Site (CS)	Burbank	Los Angeles North Main	Santa Clarita
# of Federal Exceedances	Spring	14	1	0	0	0
	Summer	2	0	0	1	0
	Fall	13	4	0	0	0
	Winter	9	0	0	0	0
Total # of Federal Exceedances		***38***	***5***	***0***	***1***	***0***
# of State Exceedances	Spring	167	68	6	116	2
	Summer	207	124	6	106	1
	Fall	184	75	9	171	3
	Winter	90	25	7	138	1
Total # of State Exceedances		***648***	***292***	***28***	***531***	***7***

[a] Spring: March 1–May 31; Summer: June 1–August 31; Fall: Sept. 1–Nov. 30; Winter: Dec. 1–Feb. 28.

3.1 Federal Exceedances

Figure 3-1 depicts the number of federal PM$_{10}$ exceedances measured at the Landfill, Community, and regional monitoring sites for each year of the 12-year period. In Year 12, the federal standard was exceeded on four occasions at the Landfill site, and on three occasions at

[6] https://www.epa.gov/criteria-air-pollutants/naaqs-table.
[7] https://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm.

the Community site. The three exceedances at the Community site, and three of the four at the Landfill site, happened in the fall quarter of Year 12. Throughout most of October and into early November 2019 (fall quarter), several wildfires were active near the monitoring sites. In addition, other fires within and around the Los Angeles Basin produced several smoky days. **Table 3-2** and **Figure 3-2** show the major fire events in the immediate area of the Landfill and Community monitoring sites. **Figures 3-3 through 3-5** highlight days when nearby wildfire activity heavily contributed to the PM$_{10}$ 24-hr federal standard exceedance at the Landfill and/or Community monitoring sites. The NOAA HYSPLIT Trajectory Model was used to model wind flow coming to the monitoring sites at three different heights (10, 100, and 250 meters above ground). Wind flow is an indicator for potential smoke impact on the monitoring sites from nearby wildfires.

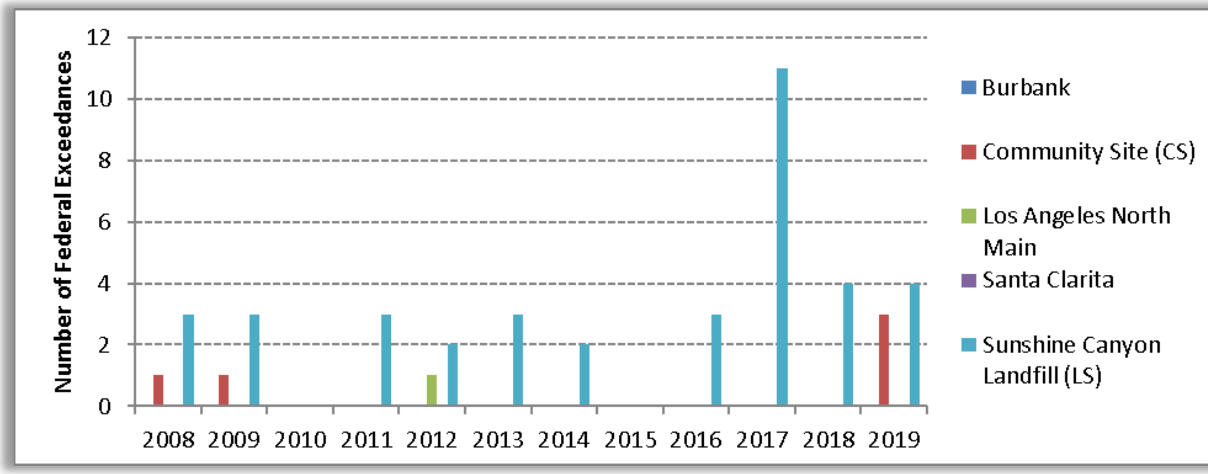


Figure 3-1. Number of federal exceedances of 24-hr PM$_{10}$ at the Landfill, Community, and regional monitoring sites by year over the 12-year study period.

Table 3-2. Active wildfire events in the immediate areas around the Landfill and Community sites during the fall quarter of 2019.

Fire Event	Occurrence Date	Acres Burned
Wendy Fire	Oct 10 – Oct 14	91
Saddle Ridge Fire	Oct 10 – Oct 31	8,799
Olivas Fire	Oct 11 – Oct 12	200
Palisades Fire	Oct 21 – Oct 31	42
Tick Fire	Oct 24 – Nov 5	4,615
Getty Fire	Oct 28 – Nov 5	745
Easy Fire	Oct 30 – Nov 2	1,806
Maria Fire	Oct 31 – Nov 6	9,999

Figure 3-2. Location of the active wildfire events in the immediate areas around the Landfill and Community sites during the fall quarter of 2019. Note: other wildfires in the Southern California region were active in the fall quarter and contributed to regional smoke impacts.

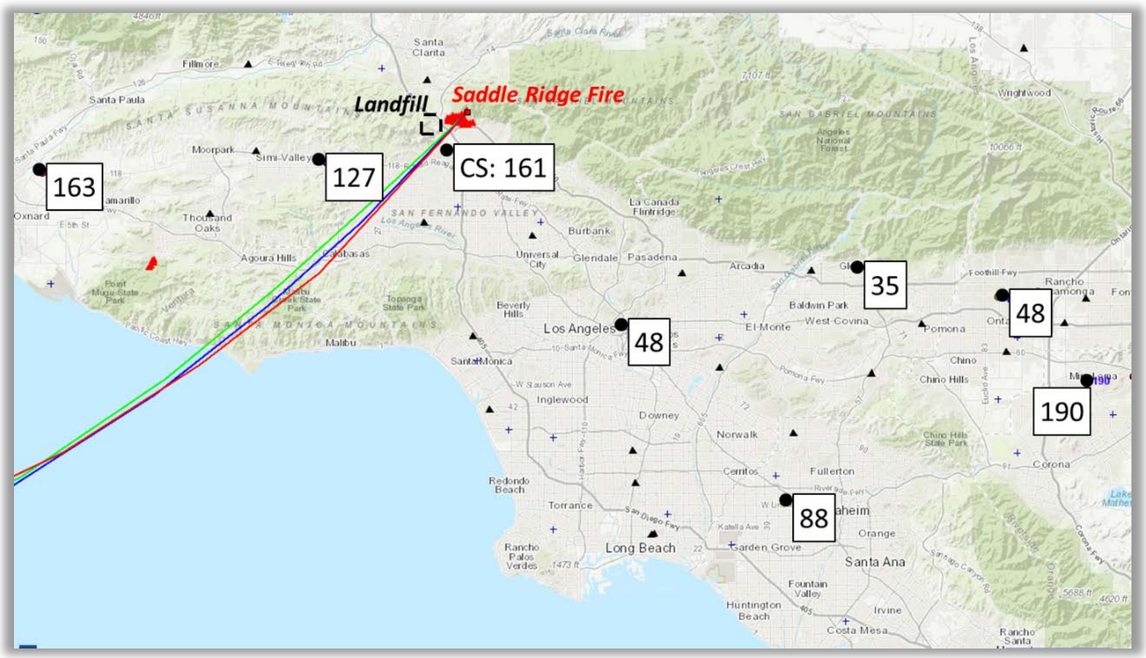


Figure 3-3. PM$_{10}$ concentrations and fire activity for October 10, 2019. Red triangles indicate hazard mapping system (HMS) satellite-detected fire hot spots. Black dots represent 24-hr PM$_{10}$ concentrations ($\mu g/m^3$) at monitoring sites within the Los Angeles Basin. The NOAA HYSPLIT trajectory model is used to model wind flow at three different heights: 10 meters (green line), 100 meters (blue line), and 250 meters (red line) above ground. The Community site (CS) exceeded the federal standard on this date. Note that the Landfill site was offline due to power loss.

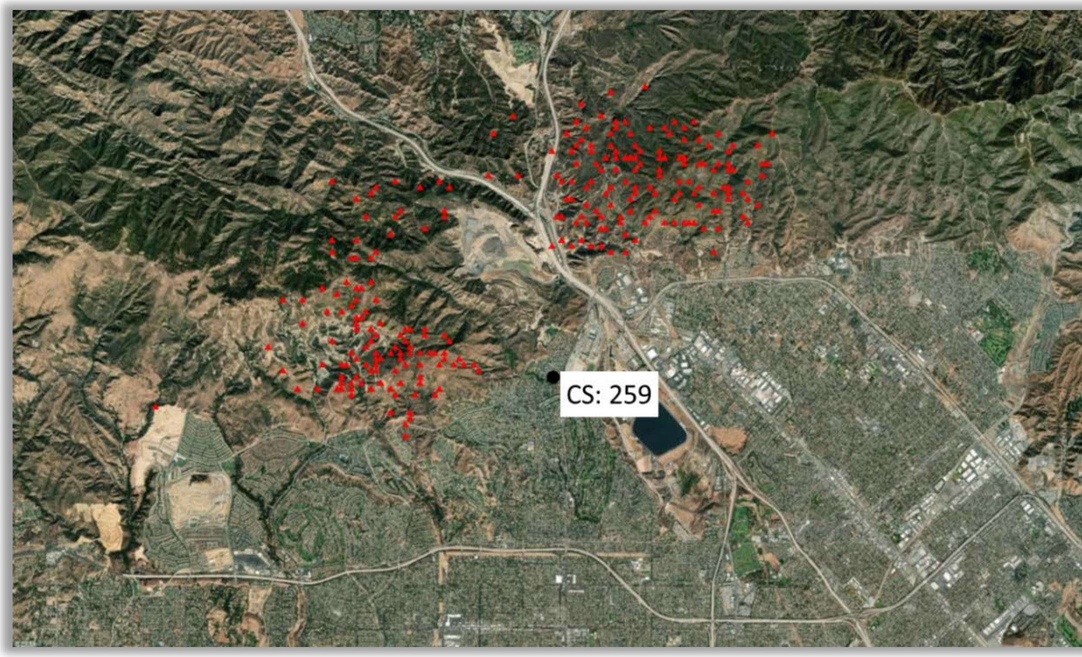


Figure 3-4. PM$_{10}$ concentrations and fire activity for October 11, 2019. Red triangles indicate HMS fire hot spots from the Saddle Ridge Fire. The Community site (CS) exceeded the federal standard on this date. Note that the Landfill site was offline due to power loss.

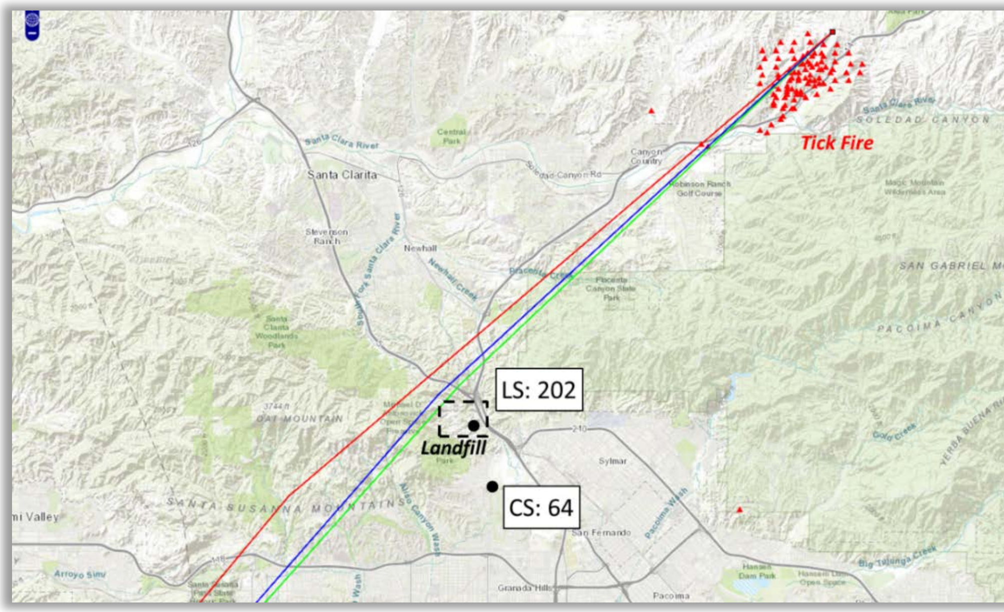


Figure 3-5. PM$_{10}$ concentrations and fire activity for October 25, 2019. Red triangles indicate HMS fire hot spots for the Tick Fire. Black dots represent 24-hr PM$_{10}$ concentrations (µg/m^3) at the Landfill (LS) and Community (CS) sites. The NOAA HYSPLIT trajectory model is used to model wind flow at three different heights: 10 meters (green line), 100 meters (blue line), and 250 meters (red line) above ground. The Landfill site exceeded the federal standard, while the Community site exceeded the state standard.

Table 3-3 lists all the days during the past 12 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 Burbank and Los Angeles sites have continuous (hourly) PM$_{10}$ monitors, like those at the Landfill and Community sites; the Santa Clarita site, however, employs Federal Reference Method (FRM) sampling (integrated 24-hr samples on filters) on a one-in-six day schedule. Of the four exceedance days in Year 12, April 9, 2019, happened to fall on the one-in-six day Santa Clarita sample schedule.

The federal standard was exceeded on 38 occasions at the Landfill site; on two of those 38 days, the Community monitor also registered an exceedance. While the SCAQMD sites in Burbank, Santa Clarita, and Los Angeles did not report exceedances on any of those days, the 24-hr PM$_{10}$ concentrations were relatively high. The elevated concentrations at other sites suggest that, when regional concentrations are high, the combination of landfill and regional contributions can push the Community site's PM$_{10}$ concentrations over the federal standard. However, over the 12 years of monitoring, high regional concentrations combined with high landfill concentrations have only occurred on two days. More conclusive, however, is the insignificant effect on Community PM$_{10}$ concentrations when Landfill concentrations exceed federal limits and regional concentrations are relatively low. As shown in **Table 3-3** and **Figure 3-1**, this is particularly evident on the 11 federal exceedance days at the Landfill site in Year 10 (2017).

Table 3-3. Summary of 24-hr PM_{10} concentrations (µg/m^3) at the Landfill, Community, and Landfill North monitoring sites and the SCAQMD Burbank, Santa Clarita, and Los Angeles regional sites when a federal PM_{10} exceedance (>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
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 [c]	-- [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[d]	-- [b]
12/9/2013	181	31	n/a	24	34	-- [b]
7/22/2016	183	51	66	-- [e]	53	-- [b]
7/30/2016	153	129	209	-- [e]	36	-- [b]
11/17/2016	178	38	-- [b]	-- [e]	51	-- [b]
12/2/2016	245	76	84	-- [e]	35	22
12/18/2016	204	32	21	-- [e]	26	-- [b]
3/27/2017	170	37	26	-- [e]	28	-- [b]
4/20/2017	236	37	30	-- [e]	35	-- [b]
4/21/2017	167	41	29	-- [e]	40	-- [b]
4/25/2017	191	42	38	-- [e]	28	67
4/27/2017	184	45	45	-- [e]	45	-- [b]
4/28/2017	165	47	46	-- [e]	33	-- [b]
10/9/2017	200	61	-- [b]	-- [e]	61	-- [b]
10/24/2017	276	35	-- [b]	-- [e]	39	-- [b]
11/21/2017	170	30	-- [b]	-- [e]	48	25
12/5/2017	225	62	-- [b]	-- [e]	54	-- [b]
12/17/2017	210	54	-- [b]	-- [e]	36	-- [b]
4/12/2018	237	50	-- [b]	-- [e]	40	-- [b]
11/8/2018	231	60	-- [b]	-- [e]	49	-- [b]
4/9/2019	193	53	-- [b]	-- [e]	59	42
10/25/2019	202	64	-- [b]	-- [e]	47	-- [b]
10/31/2019	170	61	-- [b]	-- [e]	42	-- [b]
11/16/2019	157	30	-- [b]	-- [e]	43	-- [b]

[a] Only 6 hours of data available. [b] No data available. [c] Only 12 hours of data available. [d] Only 17 hours of data available. [e] PM_{10} monitoring was discontinued in July 2014.

The Landfill PM$_{10}$ exceedances listed in **Table 3-3** 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 in **Figure 3-6**. A wind rose gives a depiction of how wind speed and direction are typically distributed at a particular location. Presented in a circular format, the length of each “spoke” is related to the frequency of time that wind blows from that direction. The color of each spoke indicates differences in wind speed. The majority of the winds were from the northwest, passing directly over working areas of the landfill. Wind speeds were highest when the wind direction was from the northwest and from the north. Also shown in Figure 3-6 is wind data from the Community site for the five exceedance days. While the wind direction is also mainly from the north-northwest, wind speeds are significantly lower.

After 12 years of continuous data collection, it is clear that PM$_{10}$ federal 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.

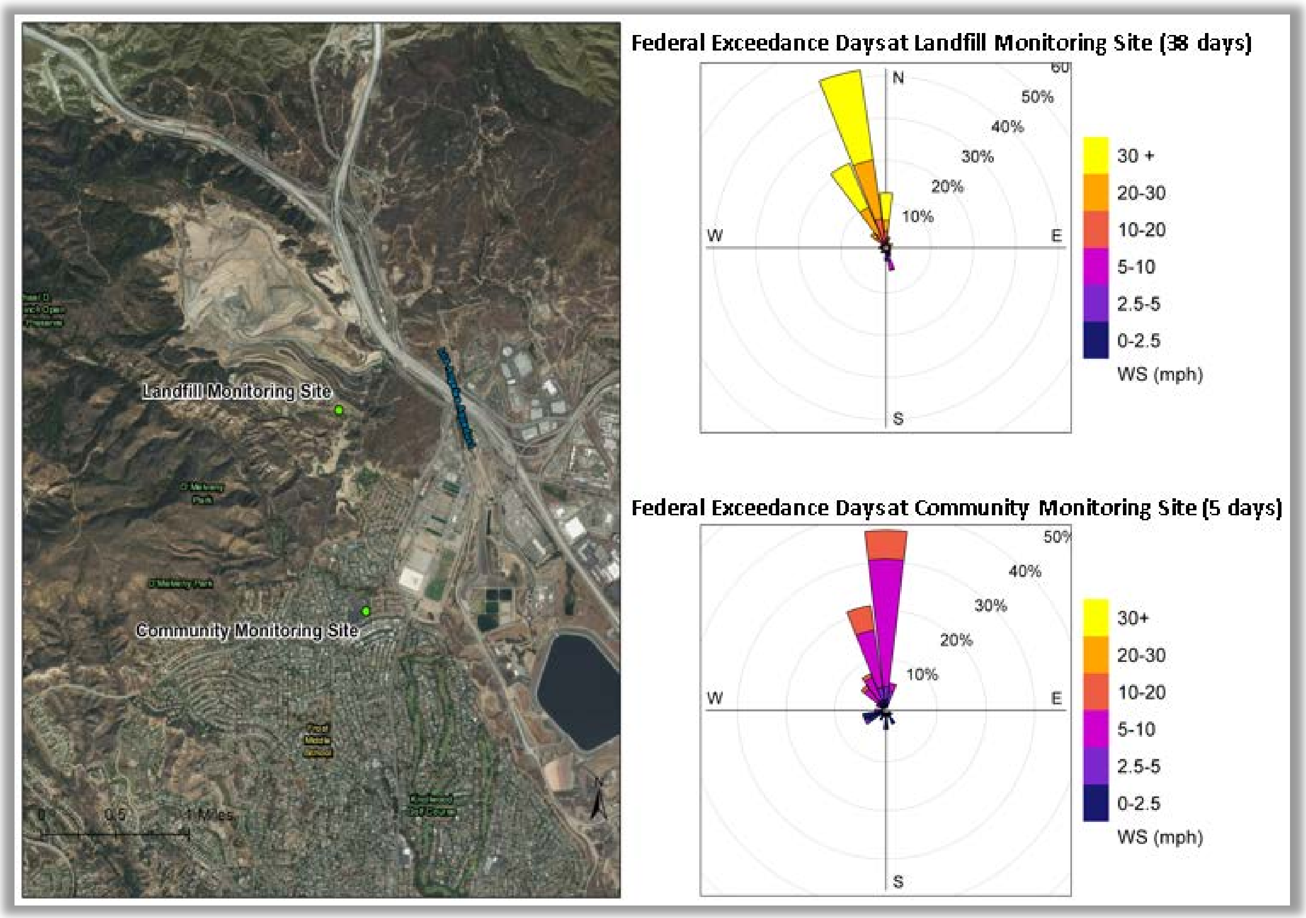


Figure 3-6. Wind rose from federal exceedance days during 12 continuous monitoring years at the Landfill (top right) and Community (bottom right) monitoring sites. Wind data at the Community site are replaced with those from the Reseda site since Year 11.

3.2 State Exceedances

Figure 3-7 depicts the number of PM$_{10}$ California state exceedances measured at the Landfill, Community, and regional monitoring sites for each year of the 12-year period. State exceedances are more common across sites than the federal exceedances shown in Figure 3-1. Although state exceedances at the Landfill site declined each year between 2013 (Year 6) and 2016 (Year 9), 2017 (Year 10) saw a record number of state exceedances over the 12-year monitoring period. The number of state exceedances in 2018 (Year 11) and 2019 (Year 12) decreased to about half of the number of those in 2017 (Year 10). The Community site has seen a low number of state 24-hr PM$_{10}$ standard exceedances since 2015; this standard was exceeded at the Community site less than 10 times in each year until Year 12, when the standard was exceeded 16 times. However, the majority of the Year 12 exceedances occurred in the fall quarter during times of nearby wildfire and smoke activity.

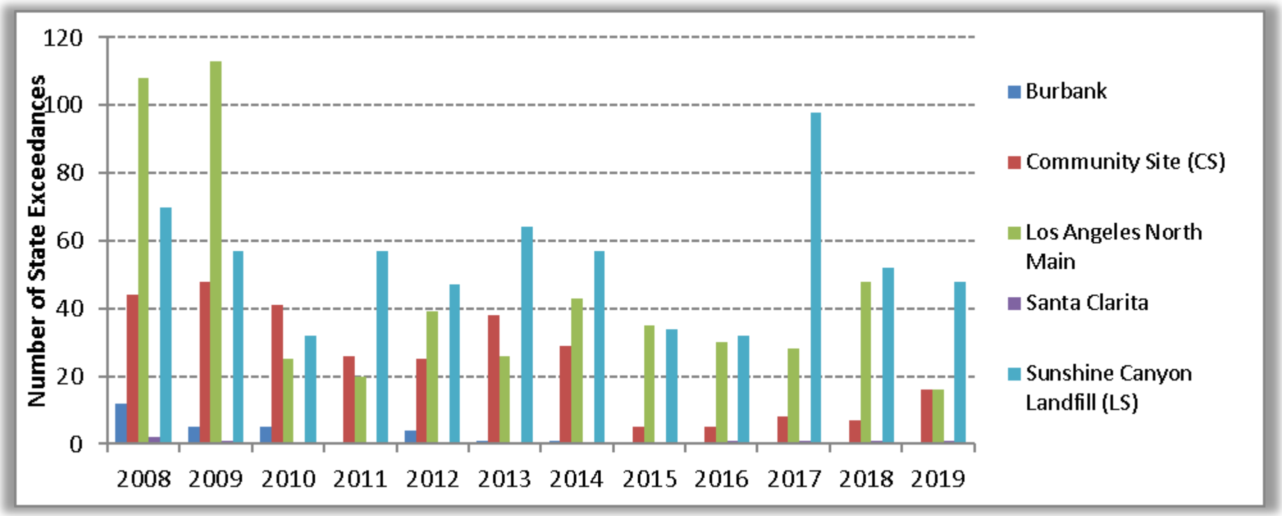


Figure 3-7. Number of state exceedances of 24-hr PM$_{10}$ at the Landfill, Community, and regional monitoring sites by year over the 12-year study period.

Table 3-4 lists the number of days during the past 12 years of continuous monitoring when the state 24-hr PM$_{10}$ standard was exceeded at any of the monitoring sites operated by STI, along with the three comparative SCAQMD sites (Burbank, Santa Clarita, and downtown Los Angeles).

Table 3-4. Summary of state PM_{10} exceedance (more than 50 µg/m^3) at the Landfill, Community, Landfill North monitoring sites and at the Burbank, Santa Clarita, and Los Angeles regional sites operated by SCAQMD.

	Year	No. of Exceedances	No. of Valid 24-hr Averages	% Exceedances
Sunshine Canyon Landfill (LS)	Year 1	70	337	21%
	Year 2	57	307	19%
	Year 3	32	354	9%
	Year 4	57	320	18%
	Year 5	47	341	14%
	Year 6	64	359	18%
	Year 7	57	364	16%
	Year 8	34	358	9%
	Year 9	32	270	12%
	Year 10	98	356	28%
	Year 11	52	311	17%
	Year 12	48	342	14%
Sunshine Canyon Landfill North (LN)[8]	Year 9	77	274	28%
	Year 10	14	190	7%
Community Site (CS)	Year 1	44	335	13%
	Year 2	48	341	14%
	Year 3	41	346	12%
	Year 4	26	362	7%
	Year 5	25	336	7%
	Year 6	38	354	11%
	Year 7	29	359	8%
	Year 8	5	299	2%
	Year 9	5	291	2%
	Year 10	8	365	2%
	Year 11	7	357	2%
	Year 12	16	354	5%
Burbank[9]	Year 1	12	217	6%
	Year 2	5	58	9%
	Year 3	5	363	1%
	Year 4	0	362	0%
	Year 5	4	366	1%
	Year 6	1	360	0%
	Year 7	1	200	1%

[8] Sunshine Canyon Landfill North Site operated June 2016 through May 31, 2017.
[9] PM_{10} monitoring was discontinued in July 2014.

	Year	No. of Exceedances	No. of Valid 24-hr Averages	% Exceedances
Los Angeles North Main	Year 1	108	312	35%
	Year 2	113	354	32%
	Year 3	25	342	7%
	Year 4	20	286	7%
	Year 5	39	335	12%
	Year 6	26	301	9%
	Year 7	43	342	13%
	Year 8	35	335	10%
	Year 9	30	360	8%
	Year 10	28	338	8%
	Year 11	48	364	13%
	Year 12	16	358	4%
Santa Clarita[10]	Year 1	2	51	4%
	Year 2	1	53	2%
	Year 3	0	57	0%
	Year 4	0	56	0%
	Year 5	0	55	0%
	Year 6	0	60	0%
	Year 7	0	59	0%
	Year 8	0	53	0%
	Year 9	1	60	2%
	Year 10	1	57	2%
	Year 11	1	50	2%
	Year 12	1	60	2%

Similar to the federal exceedance pattern (discussed in Section 3.1), the Landfill PM$_{10}$ state exceedances were accompanied by high wind speeds, with wind direction falling within a narrow sector that encompasses the active portion of the landfill. However, as shown in **Figure 3-8**, state exceedance days at the Landfill site were also accompanied by low wind speeds and wind directions from the Los Angeles basin (south and southeast). These elevated concentrations within the basin, in combination with landfill contributions, can push the Landfill site's PM$_{10}$ concentrations over the state standard. To help explain this pattern and to emphasize the importance of the effect of meteorology on measured pollutant levels, the Ninth Annual Report provided meteorological data measured at the Landfill site for the years 2008 through 2016; these data demonstrated that measurements at the Landfill site are dominated by summer season wind flow from the south to south-southeast and thus by regional PM$_{10}$ concentrations originating in the SoCAB.

[10] FRM sampling (integrated 24-hr samples on filters) on a one-in-six day schedule.

Also shown in **Figure 3-8** are wind data from the Community site for the 292 state exceedance days during the 12-year period. On days when 24-hr PM$_{10}$ concentrations exceed the state standard at the Community site, wind speeds are relatively low and wind direction is predominantly from the Los Angeles basin (southeast). Regional contributions are thus the main driver of PM$_{10}$ concentration state exceedances at the Community site. After 12 years of continuous data collection, it is clear that PM$_{10}$ state exceedances are more common at the Landfill site than they are at the Community site. In addition, differences in wind speed and direction patterns between the two sites on days of measured state exceedances provide insight on the source contributions.

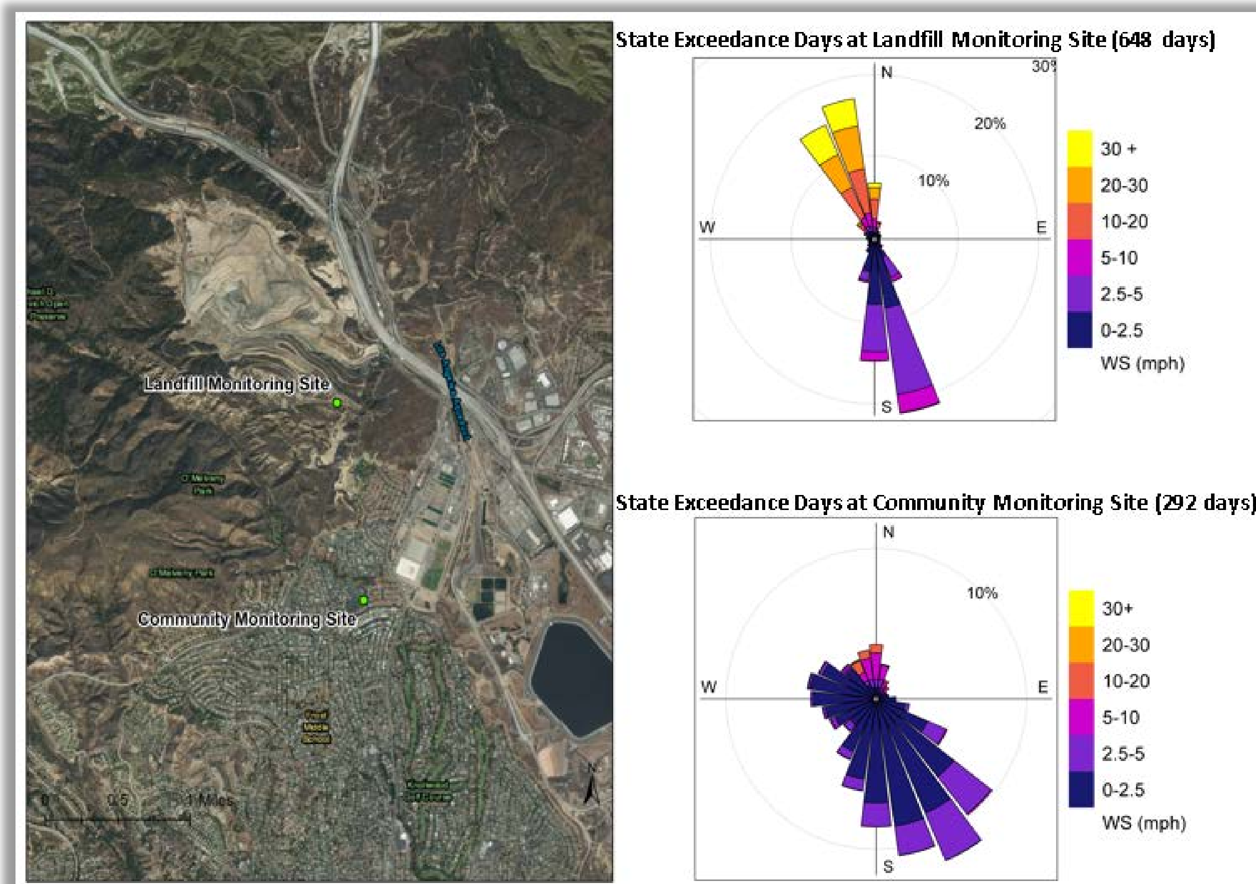


Figure 3-8. Wind rose from state 24-hr PM$_{10}$ exceedance days during 12 continuous monitoring years at the Landfill (top right) and Community (bottom right) monitoring sites. Wind data at the Community site are replaced with those from the Reseda site since Year 11 (as discussed in Section 5.1).

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 directly affected by emissions in the SoCAB and the nearby highly trafficked freeway system. The sites chosen for comparison, shown 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 and Community monitoring sites, and for the three regional locations, for 2008–2019. For the first three years of continuous monitoring, the SCAQMD monitor at downtown Los Angeles recorded, on average, the highest PM_{10} concentrations among the three regional sites, 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 the site was discontinued in summer 2014. The Federal Reference Method (FRM) monitor at Santa Clarita, on the northern edge of the air basin, recorded, on average, the lowest PM_{10} concentrations of the regional sites. From 2008 to 2010, Landfill and Community measurements tended to track between the Los Angeles and Santa Clarita data.

The monitoring years since 2011 deviated from this pattern, with the Landfill monitor usually exhibiting the highest average monthly concentrations in June through September. To help explain this pattern and emphasize the importance of the effect of meteorology on measured pollutant levels, the *Ninth Annual Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School (November 22, 2007–November 21, 2016)*, delivered to the Los Angeles City Planning Department in April 2017, provides meteorological data measured at the Landfill site for the summer seasons of 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. The dominance of low speed, south-southeasterly winds from June through September between 2011 and 2016 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 site are not solely attributable to Landfill activities. A deviation from the pattern occurred in 2017, with the Landfill monitor exhibiting the highest average monthly concentrations among the sites shown in Figure 4-1, consistently throughout the year. Uncharacteristic monthly concentration spikes occurred at the Landfill site in December 2016, April 2017, and October 2017. In addition, concentrations followed the similar elevated summer season pattern; however, the deviations in monthly average PM_{10} concentrations from the next highest monitor (SCAQMD monitor in downtown Los Angeles) were the largest on record. In 2018, the Landfill site again followed the elevated summer season pattern. In 2019, both the Landfill site and the Community site saw an abnormal increase in the monthly-averaged PM_{10} concentrations during the fall quarter. As discussed in above sections, this increase was due to wildfire activities. Figure 4-1 also shows a strong correlation between Community and Santa Clarita data.

Figure 4-2 shows the rolling annual average PM_{10} concentrations for the Landfill and Community monitoring sites, and for the three regional locations, for 2008 through 2019. The rolling average is calculated from a series of 12-month averages over a period of several years. While Figure 4-1 provides valuable insight on monthly and seasonal variations for each site, a rolling annual average allows for more concise site-by site comparison over the entire monitoring period. Focusing on the last seven years, the Landfill site compares well with the downtown Los Angeles site in Years 5 through 9. However, in Years 10 to Year 12, the average concentrations at the two sites deviate from each other, with the Landfill site showing a significant increase.

In Years 5 through 7, the PM_{10} concentrations are consistently higher at the Community site than at the regional monitor in Burbank and the Santa Clarita FRM; however, annual average concentrations are significantly lower at the Community site than at the downtown Los Angeles and Landfill sites. Furthermore, the concentrations at the Community site have been steadily decreasing since Year 7, and in Year 11 they fell below the annual average concentrations measured at Santa Clarita. This is an important finding in that, while PM_{10} concentrations measured at the Landfill site remain relatively high (with a recent trend upward), PM_{10} concentrations measured at the Community site are trending down.

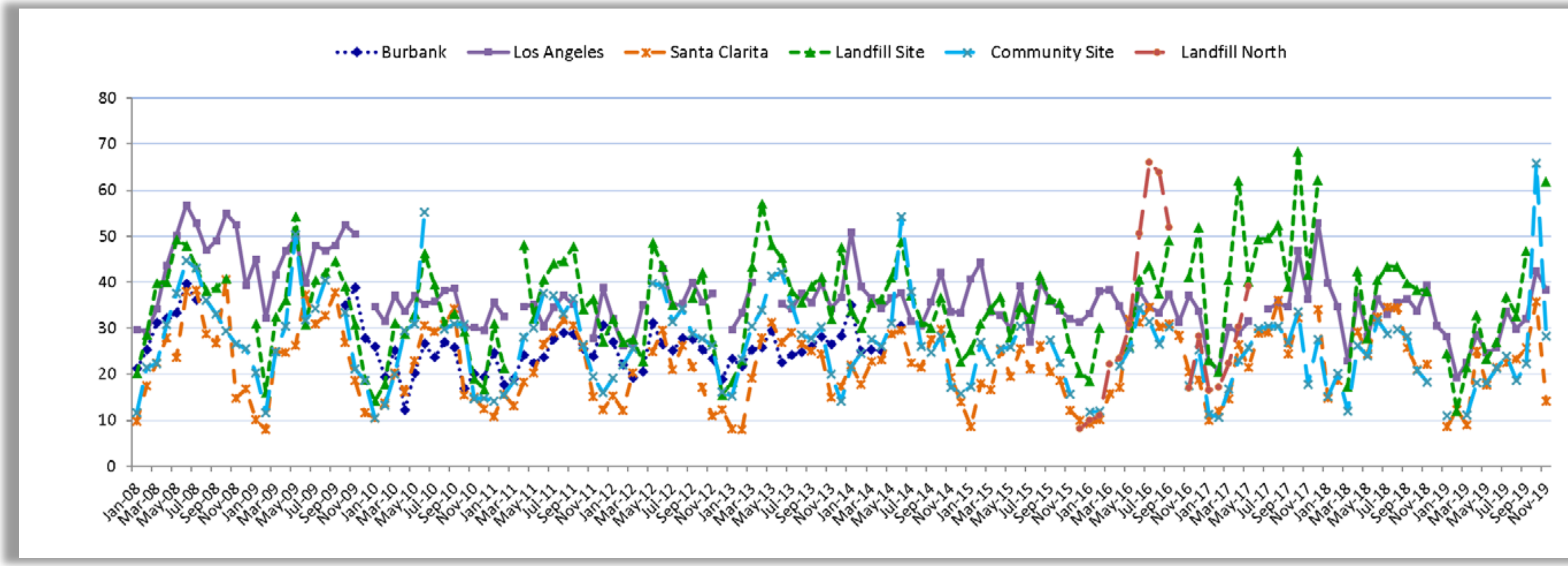


Figure 4-1. Monthly average PM_{10} concentrations for the Landfill, Landfill North, and Community sites, and three regional monitoring sites for 2008–2019. (Notes: Like the Landfill and Community sites, Burbank and Los Angeles sites report hourly concentrations, while the Santa Clarita site reports 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. For the Landfill North site, the figure shows data through Nov. 21, 2017.)

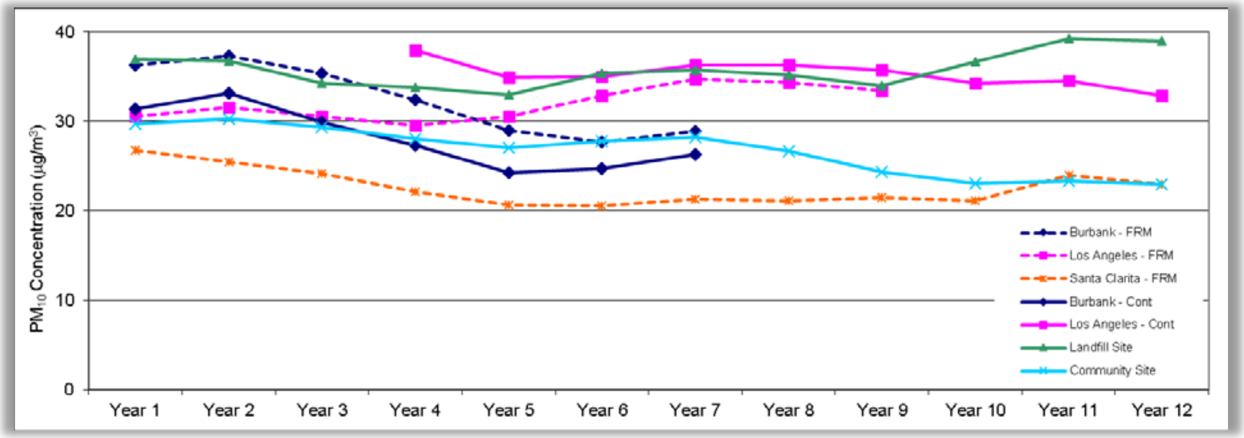


Figure 4-2. Rolling annual average PM_{10} concentrations for the Landfill and Community sites, and three regional monitoring sites for 2008–2019.

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

Both wind direction and landfill work activity levels affect PM_{10} and BC concentrations measured at the Landfill and Community monitoring sites. As described in Sections 3 and 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, landfill contributions to neighborhood-scale PM_{10} and BC concentrations are expected under northerly wind flow. 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 12-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 12-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 eleventh annual reports.

The *Ninth Annual Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School (November 22, 2007–November 21, 2016)*, provides a comparative analysis of the PM_{10} and BC levels at the Landfill and Landfill North sites in 2016. Because the Landfill North site operated for only one year, it is not included in subsequent analyses. However, subsection 5.6 of the Ninth Annual Report described the additional comparisons of PM_{10} and BC concentrations between the Landfill and Landfill North sites by wind direction and landfill work activity levels, and this information is reproduced in Section B.3 of this report (**Appendix B**).

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 2017, and individual wind roses for 2018 and 2019. It should be noted that wind data from the Community site since Year 11 (i.e., since November 22, 2017) were substituted with data from the nearby Reseda site. While data completeness for wind speed and wind direction at the Community site were 100% (as depicted in Table 2-1), a database issue[11] prevented the use of the Community wind data since Year 11. The Reseda data were chosen as a surrogate because (1) the Reseda site is operated by South Coast AQMD and follows strict data collection and quality standards; (2) the Reseda site is located just over 4 miles to the south of the Community site, and no topographical barriers exist between it and the Community site; and (3) historical wind patterns at the Reseda site are most representative of the historical patterns of the Community site (i.e., shows the strongest winds

[11] Wind data (WD) appears shifted from typical patterns and is currently suspect.

from the north and light, variable winds from other directions). To avoid confusion, the report will continue to refer to wind data from the Community site.

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.

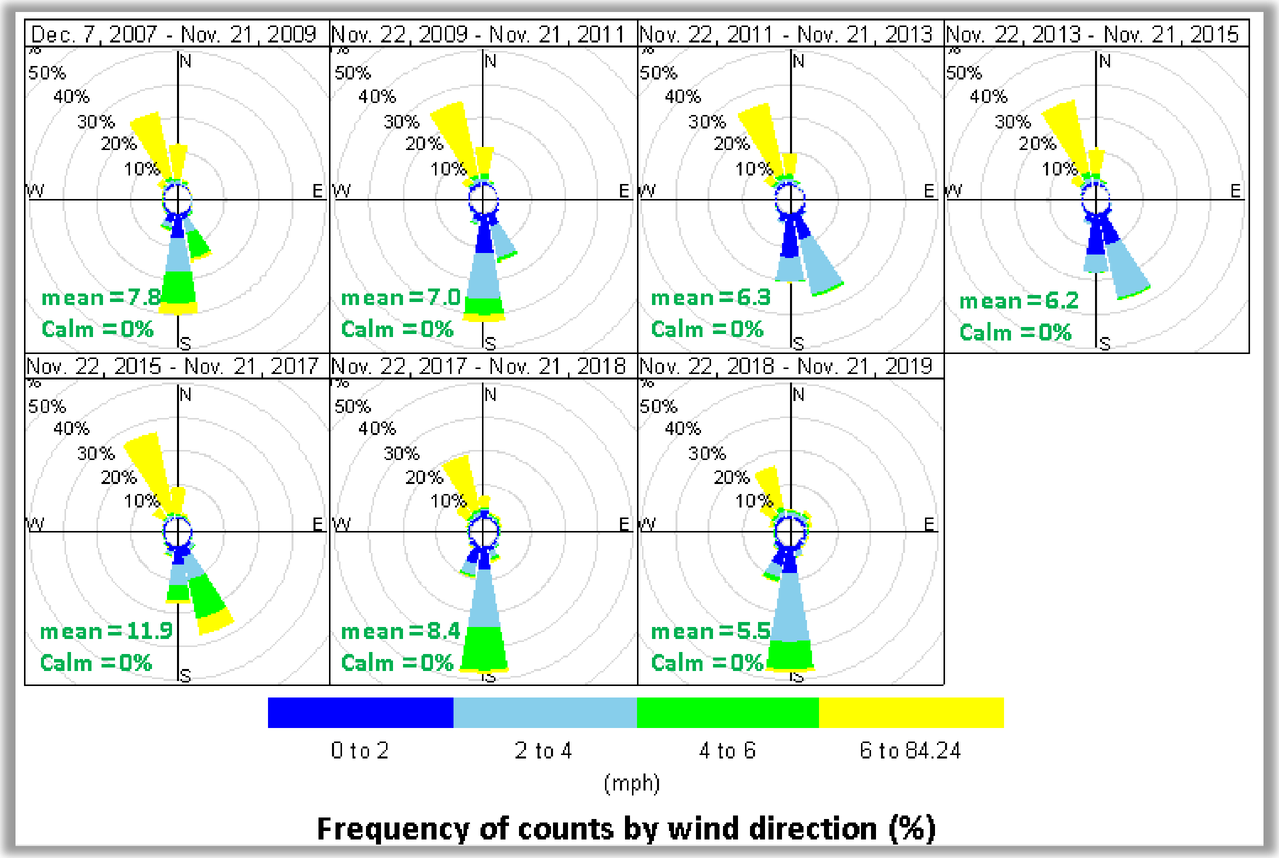


Figure 5-1. Landfill station wind roses over the 12 years of monitoring data. Winds are highly directional at the Landfill site. Wind data for monitoring Years 1 through 10 are shown in two-year groups, while the data for Year 11 and Year 12 are displayed as individual wind roses, respectively. Only data labeled “valid” or “suspect” are used.

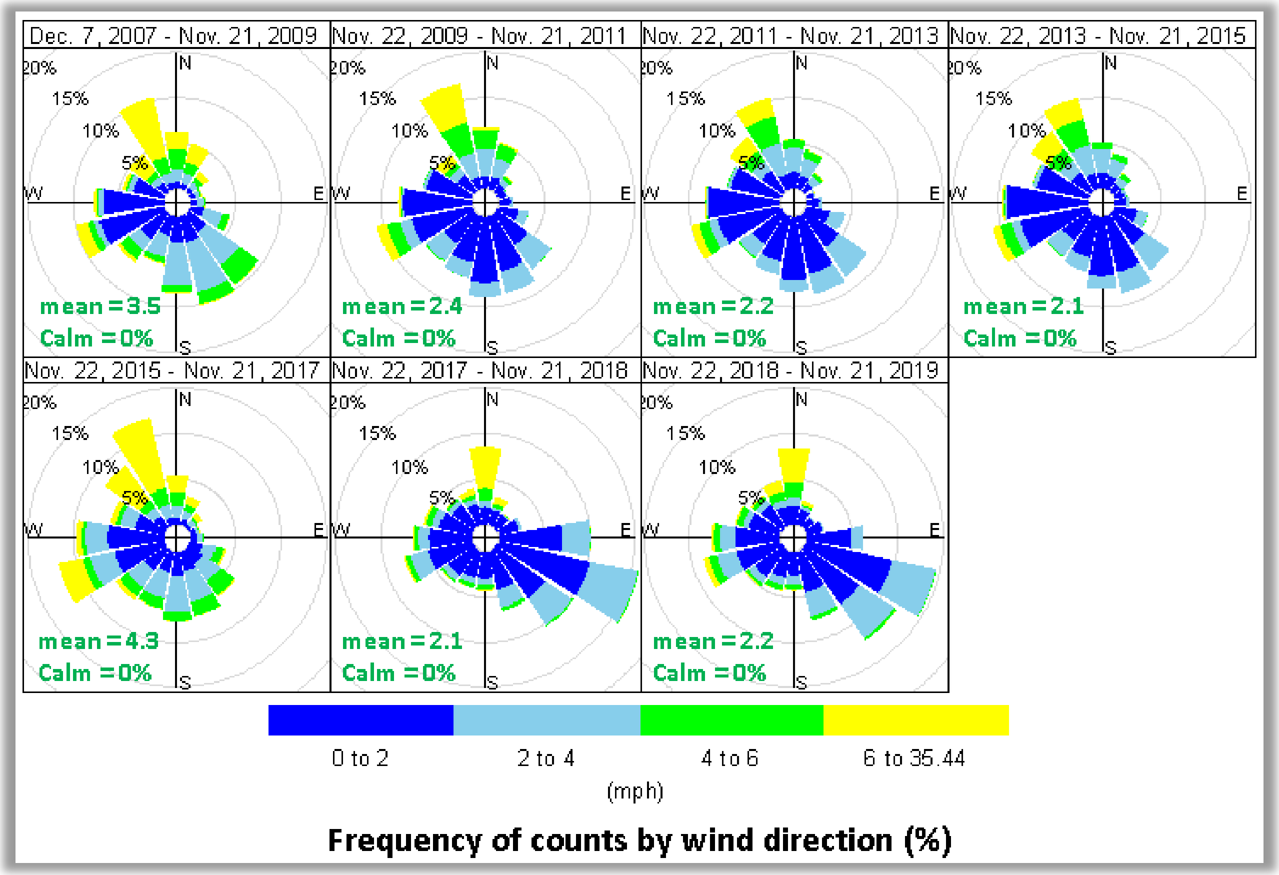


Figure 5-2. Community site wind roses over the 12 years of monitoring data. Wind data for monitoring Years 1 through 10 are shown in two-year groups, while the data for Year 11 (Reseda site) and Year 12 (Reseda site) are displayed as individual wind roses. Only data labeled “valid” or “suspect” are used. Wind data at the Community site were replaced with those from the Reseda site since Year 11.

Figure 5-3 shows a pollution rose and a pollution differential rose for hourly BC concentration at the Community site. A pollution rose is akin to a bar graph of concentrations associated with wind direction. As shown in Figure 5-3, the lowest hourly BC concentrations at the Community site are associated with winds from the northwest (as shown in the top graphic). In contrast, the pollution differential rose in the bottom graphic shows that the highest hourly BC concentrations at the Community site (when hourly BC concentrations are higher than those at the Landfill site) are associated with winds from the south.

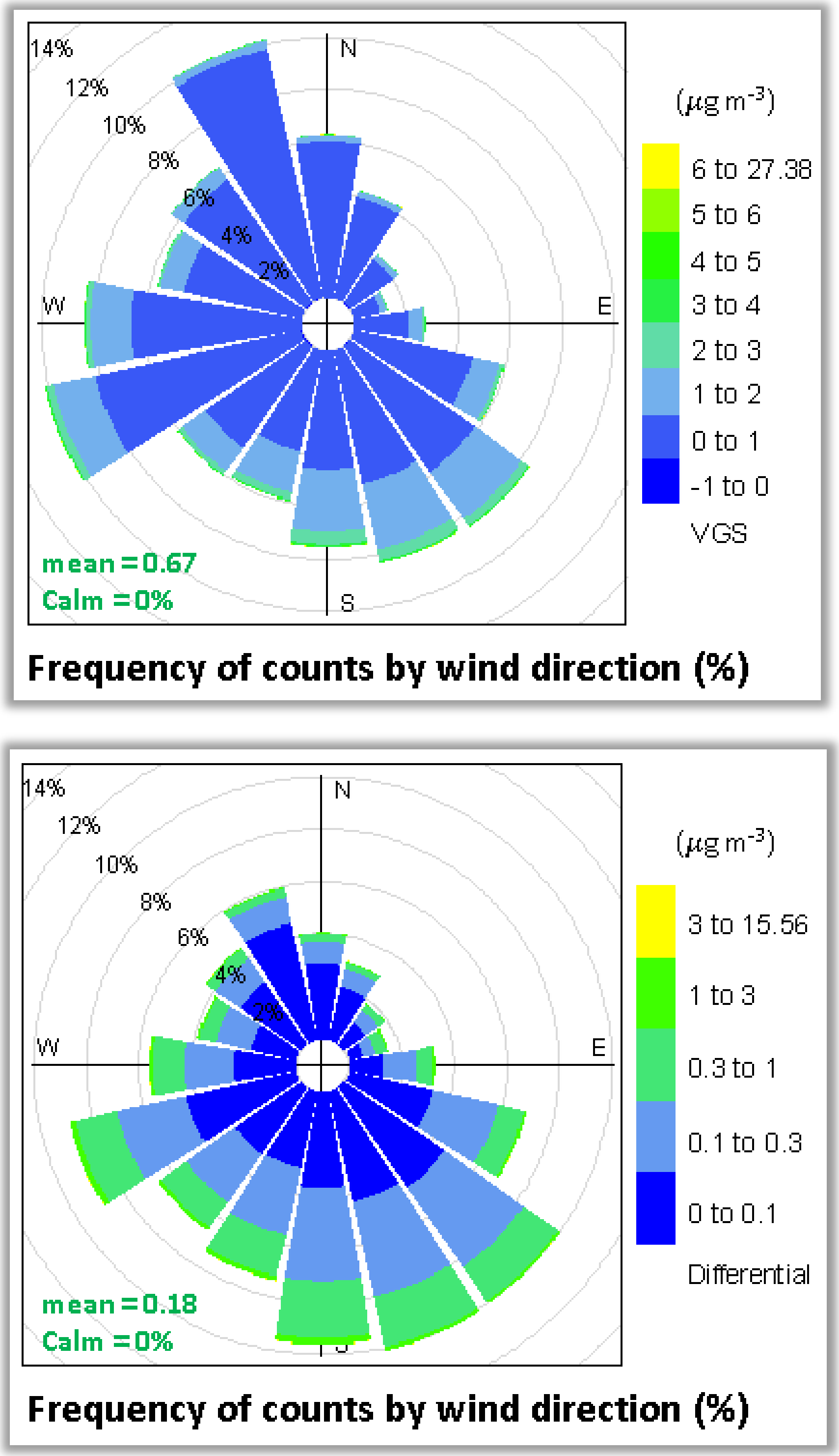


Figure 5-3. Top panel: pollution rose of hourly black carbon concentration at the Community site; bottom panel: pollution differential rose of excess hourly black carbon concentration at the Community site (compared to that at the Landfill site). Data are from December 7, 2007 through November 21, 2019. Data are used only when both black carbon and wind direction are labeled “valid.”

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 a second wind sector to represent the area from which pollutants travel from the SoCAB. **Figure 5-4** 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.

Figure 5-5 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).

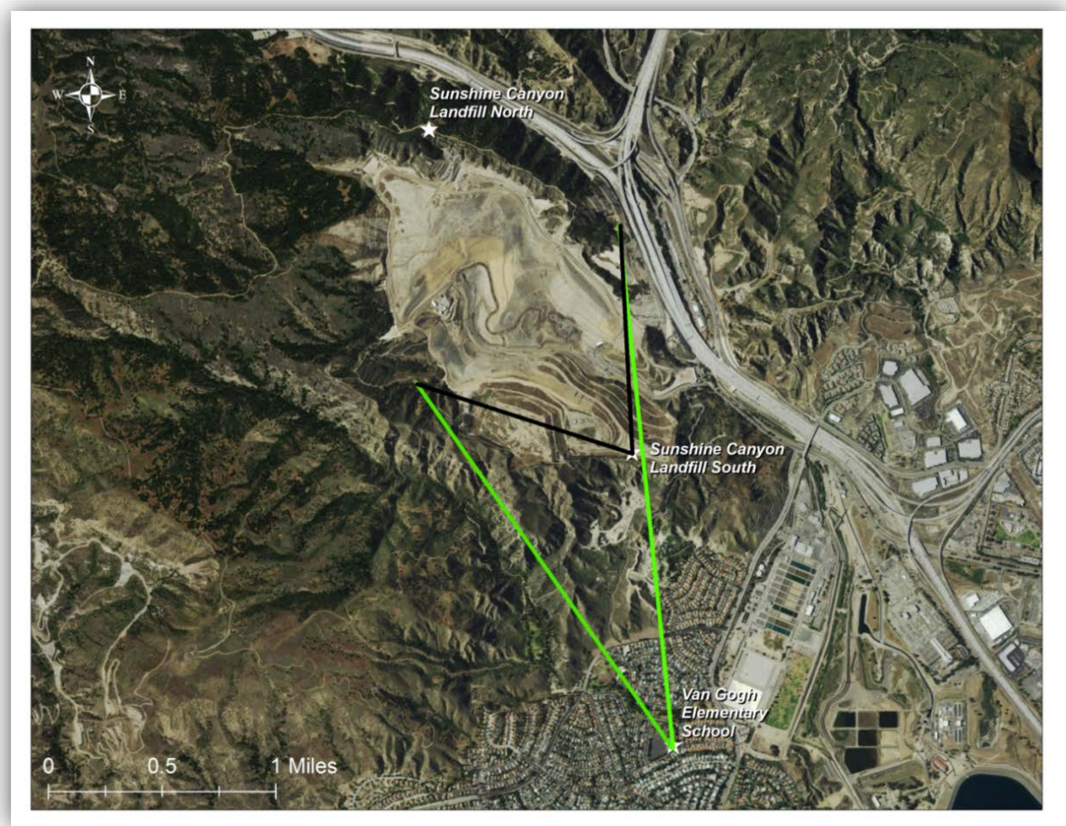


Figure 5-4. Aerial image of the Sunshine Canyon Landfill and the surrounding area, showing the wind direction sectors representing the landfill source used to select data for analysis from the Landfill monitor (in black) and the Community monitor (in green).

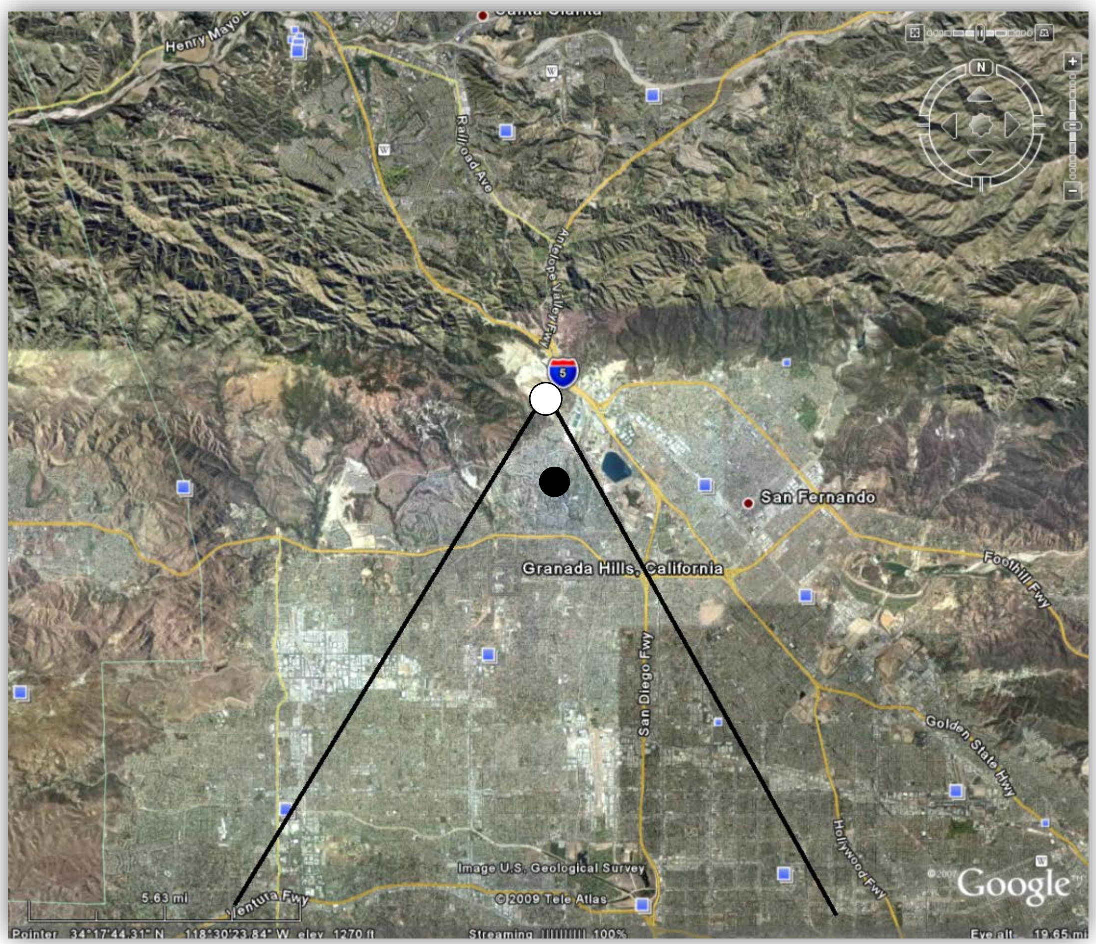


Figure 5-5. Aerial image of the Sunshine Canyon Landfill and the northern portion of the SoCAB, showing the wind direction sector representing the SoCAB source used to select data for analysis to compare with the landfill wind direction sectors depicted in Figure 5-4. The white dot represents the Landfill 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. 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 5-6 provides a visual key for interpreting a notched box-whisker plot. **Figures 5-7 through 5-10** show notched box-whisker plots that summarize the 12-year and Year 12 (2019) 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. **Figures 5-11 through 5-14** illustrate median PM_{10} concentrations and 95% confidence intervals for working and non-working days and for working and non-working hours for each wind sector.

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. Figures 5-11 through 5-14 illustrate median PM_{10} concentrations and 95% confidence intervals for working and non-working days and for working and non-working hours for each wind sector. **Figure 5-15** depicts the hourly average PM_{10} concentrations at the Burbank and Los Angeles regional monitoring sites for working and non-working days and for working and non-working hours within those days in notched box-whisker plots.

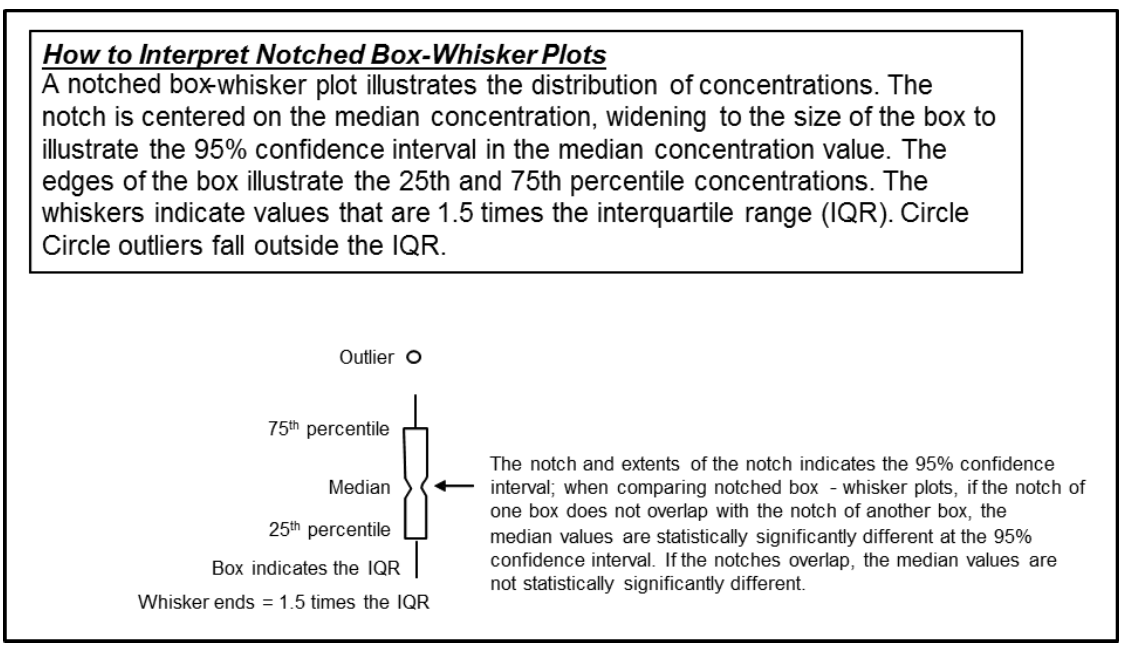


Figure 5-6. Instructions for interpreting notched box-whisker plots.

The following general conclusions are based on the results depicted in the following Figures (5-7 through 5-14). Note that these conclusions are nearly identical to those reached in the Eleventh Annual Report (delivered in July 2019), as are the proportions cited in the following bullets:

- During the highest activity levels (working hours on working days):
  - When the wind is from the SoCAB, the Landfill and Community monitors typically measure similar concentrations of PM_{10}. In Year 12, when the wind is from the SoCAB, the Landfill monitor measures higher concentrations of PM_{10} than the Community monitor.
  - At the Community site, the median concentration of PM_{10} when the wind is from the SoCAB is typically more than two times higher than when the wind is from the landfill. In Year 12, the same pattern is present; however, the median concentration of PM_{10} at the Community site is approximately 1.4 times higher when wind is from SoCAB than when wind is from the landfill.
  - When wind is from the landfill, the median PM_{10} concentration at the Community site is approximately 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. This is true when investigating PM_{10} concentrations over the entire 12-year period. In Year 12, the median PM_{10} concentration at the Community site is less than one-third of that measured at the landfill itself.
  - At the Community site, the median concentration of PM_{10} on working days is slightly higher than that on non-working days when the wind is from either the landfill or the SoCAB (over the entire 12-year period). This pattern is similar to median PM_{10} concentrations at the regional sites (Burbank and Los Angeles) for working and non-working days/hours, suggesting an influence of regional day-of-week and working hours' concentration patterns on the Community site.
- During non-working hours on working days:
  - When the wind is from the SoCAB, the Community monitor measures higher PM_{10} concentrations than when wind is from the landfill. This is true when investigating PM_{10} concentrations over the entire 12-year period and for Year 12 only.
  - When the wind is from the landfill over the course of the 12-year monitoring period, PM_{10} concentrations are lower at both monitoring sites than when the wind is from the SoCAB, with the Community monitor characterized by lower concentrations than the Landfill monitor. This pattern illustrates a localized landfill contribution during times of low activity (nighttime) at the Landfill site.
  - In Year 12, when the wind is from the landfill, PM_{10} concentrations at the Landfill monitoring site are similar to when the wind is from the SoCAB, suggesting an increase in landfill activity (as discussed in previous sections of this report). Nevertheless, PM_{10} concentrations measured at the Community monitor remain lower than the Landfill monitor whether wind is from the landfill or SoCAB.

- During the lowest activity levels:
  - The median PM_{10} concentrations are lower on non-working days versus working days, but the extent of the difference is influenced by wind direction. At the Landfill site, the median PM_{10} concentrations in daytime (working hours) showed a greater proportional decrease on non-working days when wind direction was from the landfill than on non-working days when wind came from the SoCAB, reflecting the larger regional PM_{10} influence of the SoCAB on non-working days.
  - At the Community site, the median PM_{10} concentrations in daytime (working hours) showed a lesser proportional decrease on non-working days versus working days and wind direction was less of a factor. Furthermore, lower PM_{10} concentrations during non-working days versus working days at the Community coincide with work day/non-work day PM_{10} concentrations patterns at the regional sites (Burbank and Los Angeles).

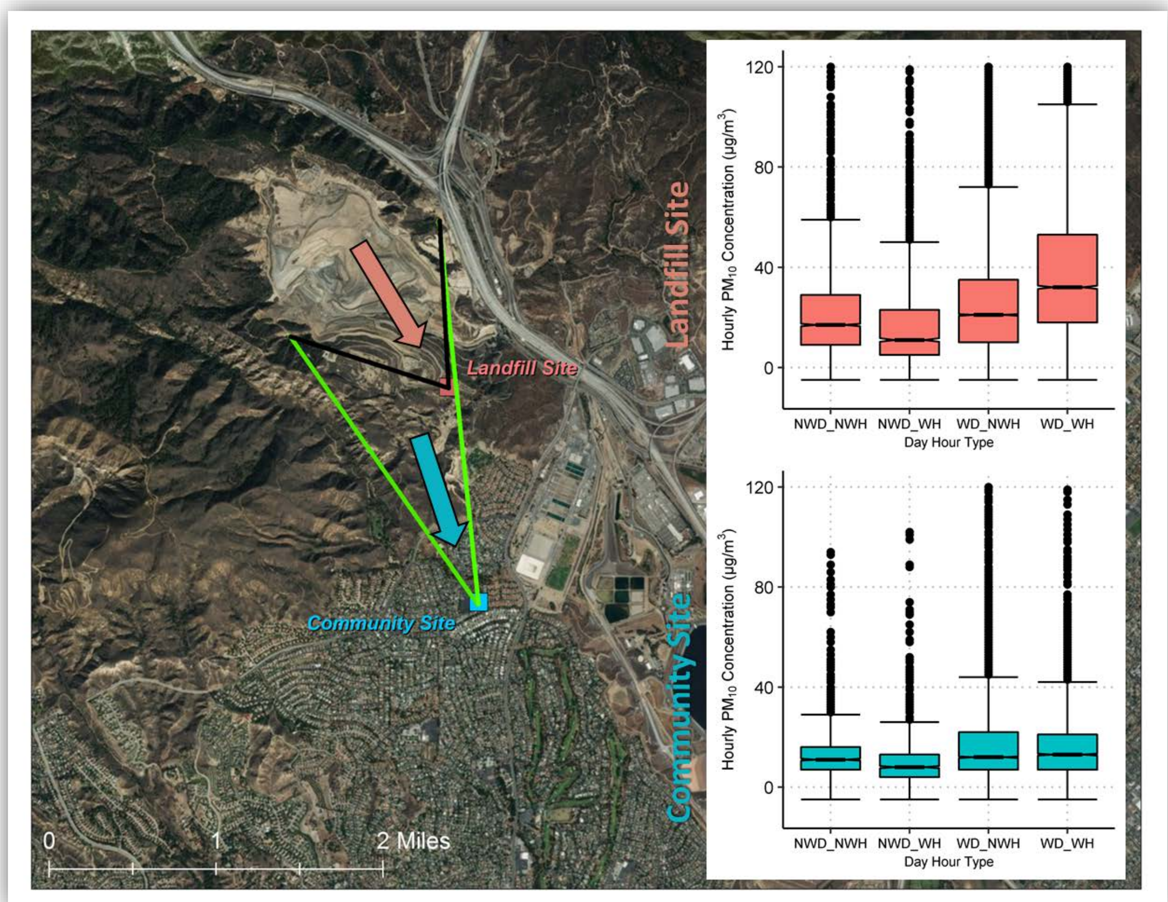


Figure 5-7. Notched box whisker plots of 12-year hourly PM_{10} concentrations for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 120 µg/m^3 are not displayed.

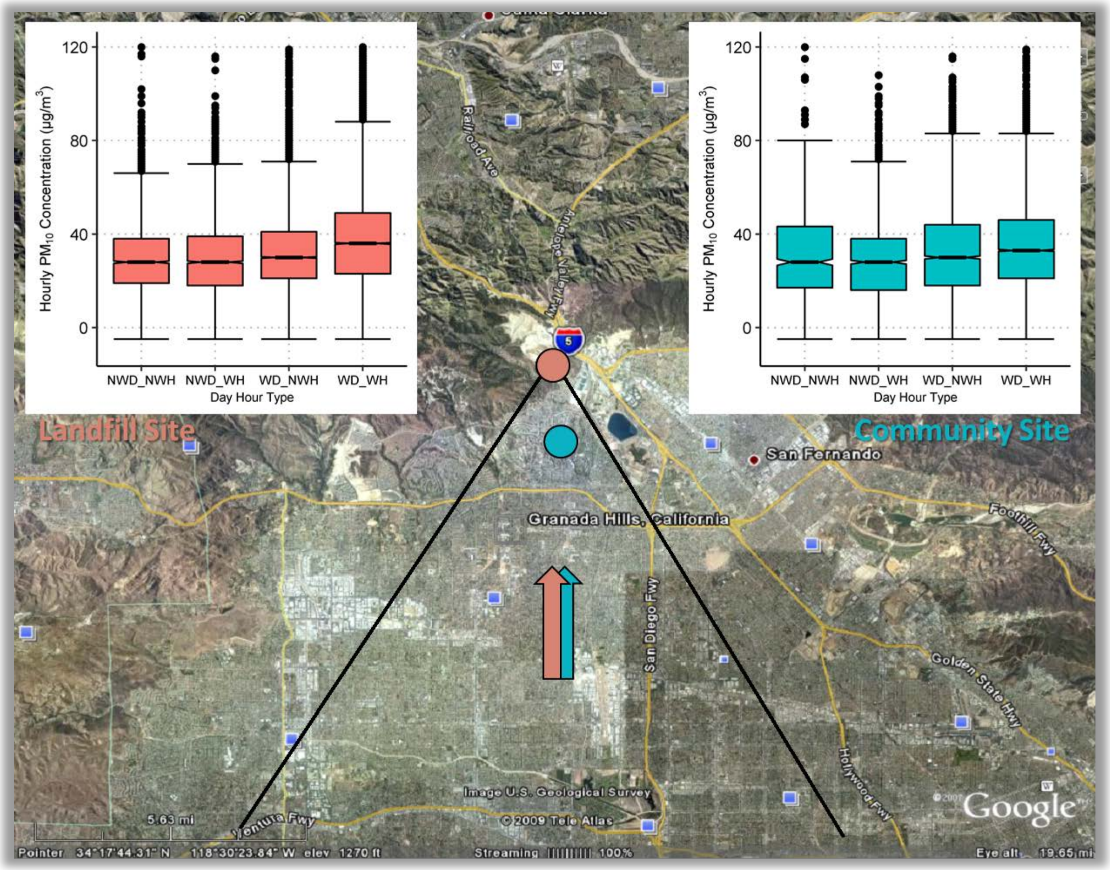


Figure 5-8. Notched box whisker plots of 12-year hourly PM_{10} concentrations for southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 120 μg/m^3 are not displayed.

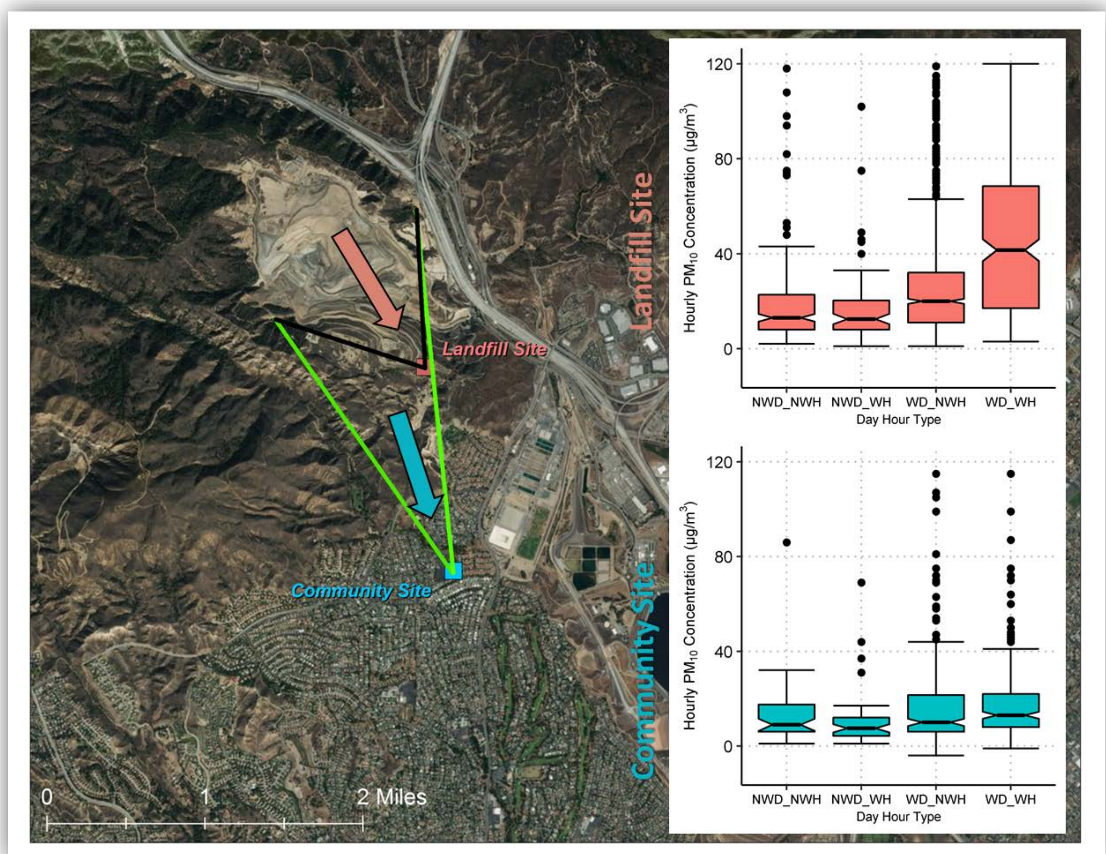


Figure 5-9. Notched box whisker plots of Year 12 (2019) hourly PM_{10} concentrations for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 120 µg/m^3 are not displayed.

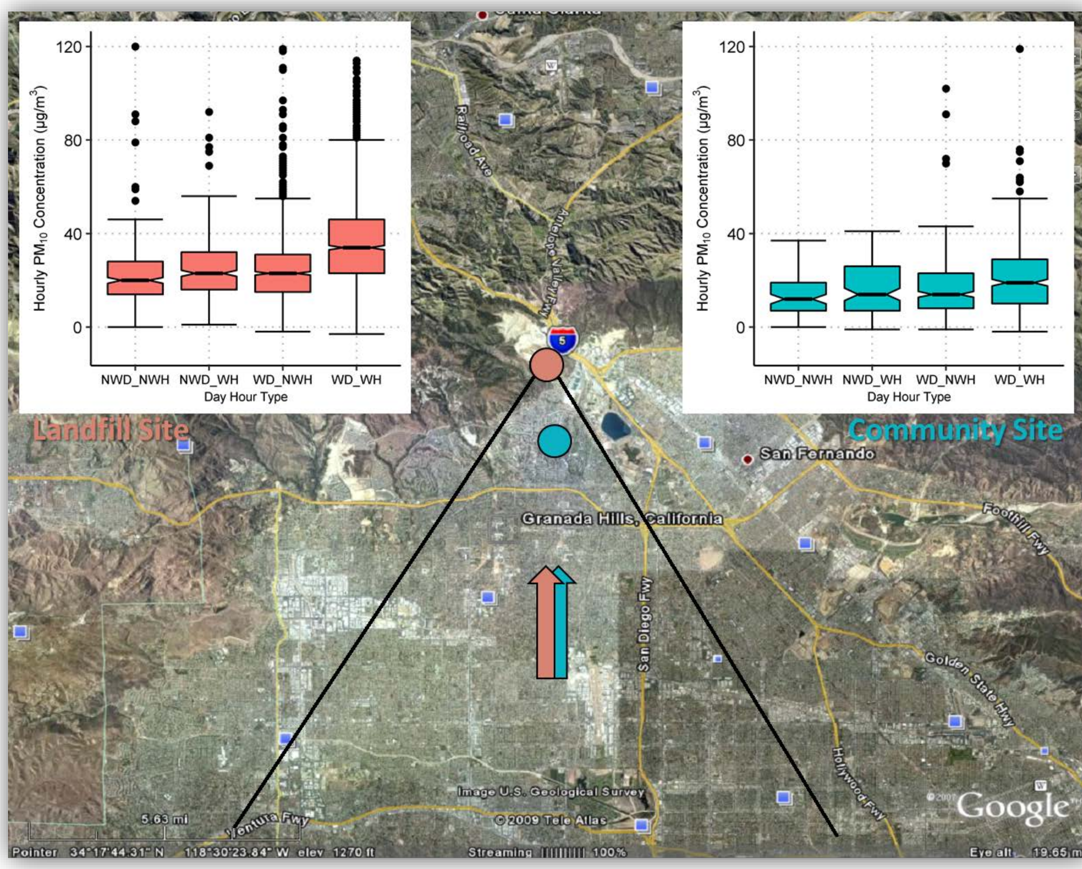


Figure 5-10. Notched box whisker plots of Year 12 (2019) hourly PM_{10} concentrations for Southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 120 µg/m^3 are not displayed.

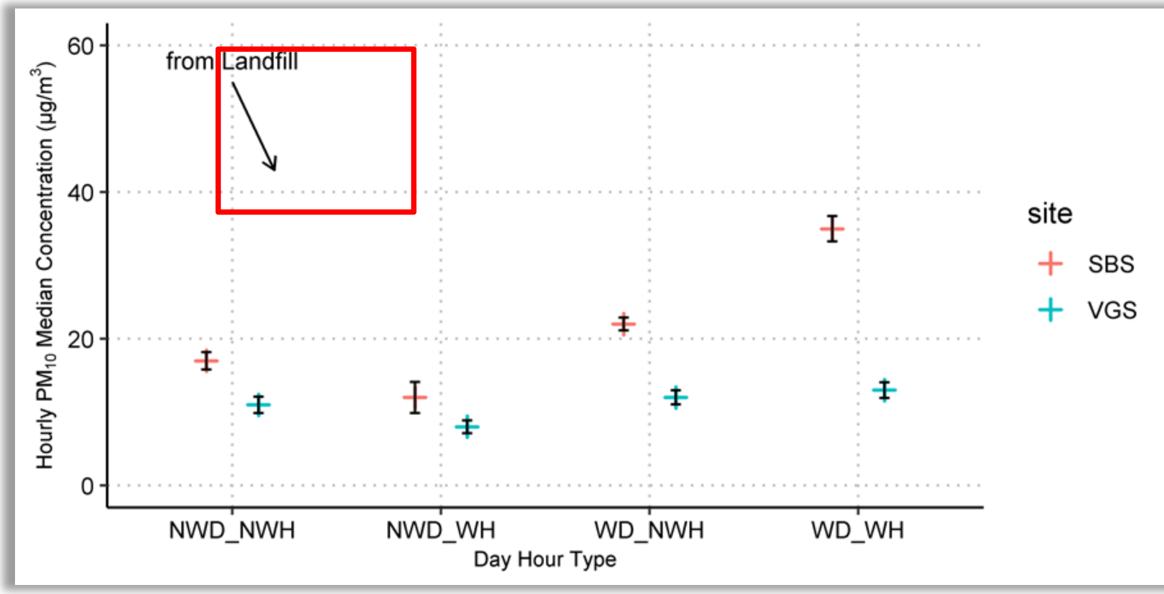


Figure 5-11. Twelve-year hourly PM_{10} median concentrations for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black.

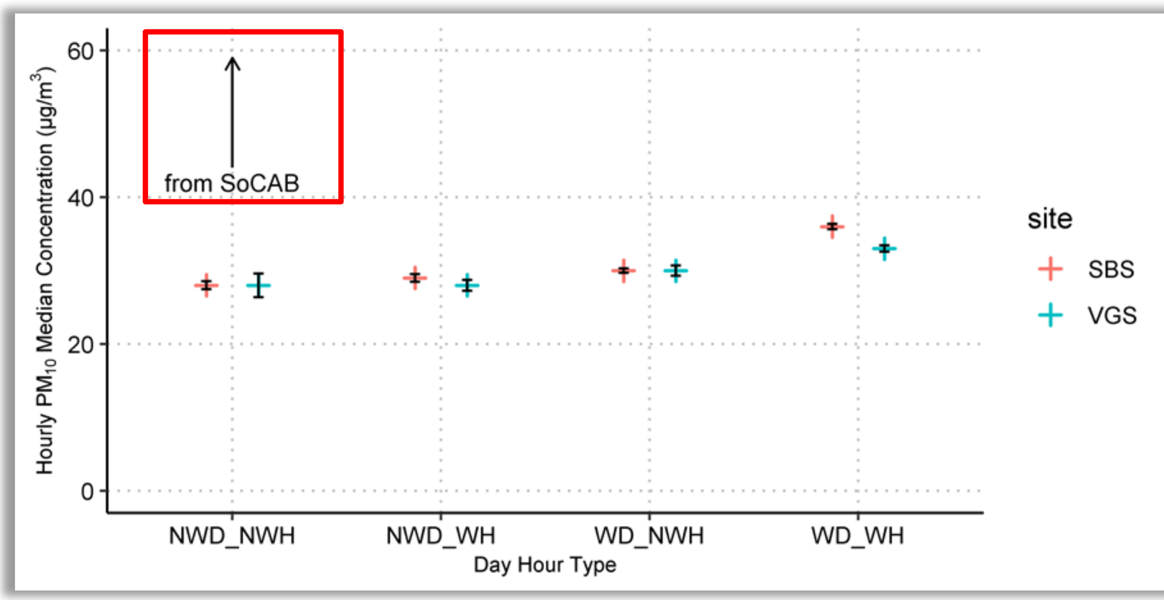


Figure 5-12. Twelve-year hourly PM_{10} median concentrations for northerly ("From SoCAB) wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black.

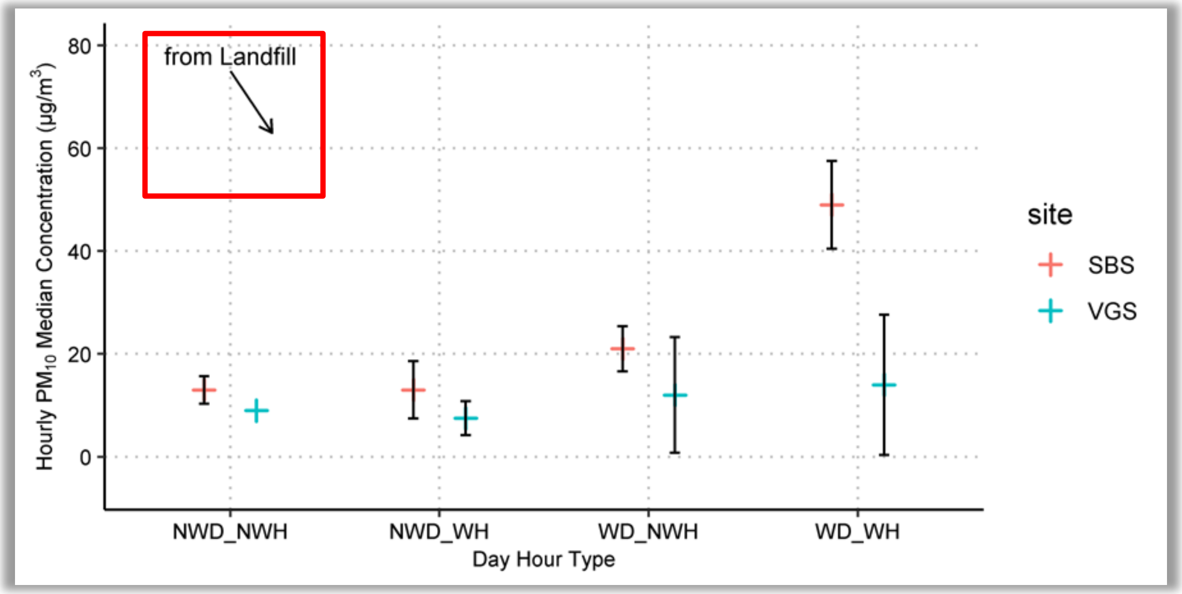


Figure 5-13. Year 12 (2019) hourly PM_{10} median concentrations for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black. Note that confidence intervals are a function of the number of data points; fewer data points lead to a wider interval and less certainty about where the median falls.

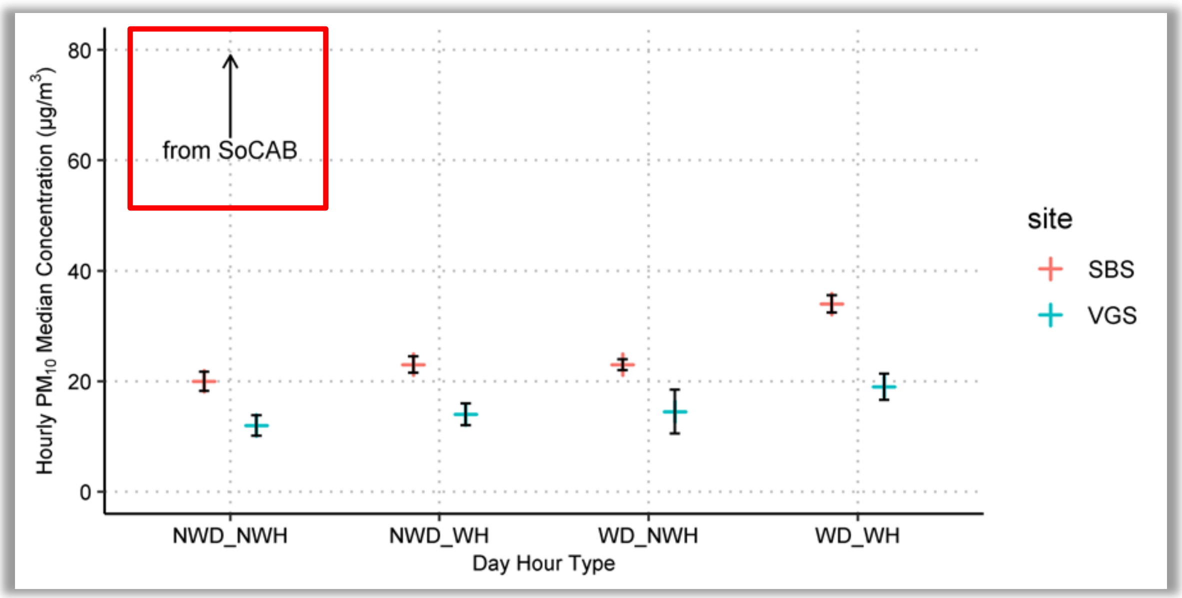


Figure 5-14. Year 12 (2019) hourly PM_{10} median concentrations for northerly ("From SoCAB) wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black.

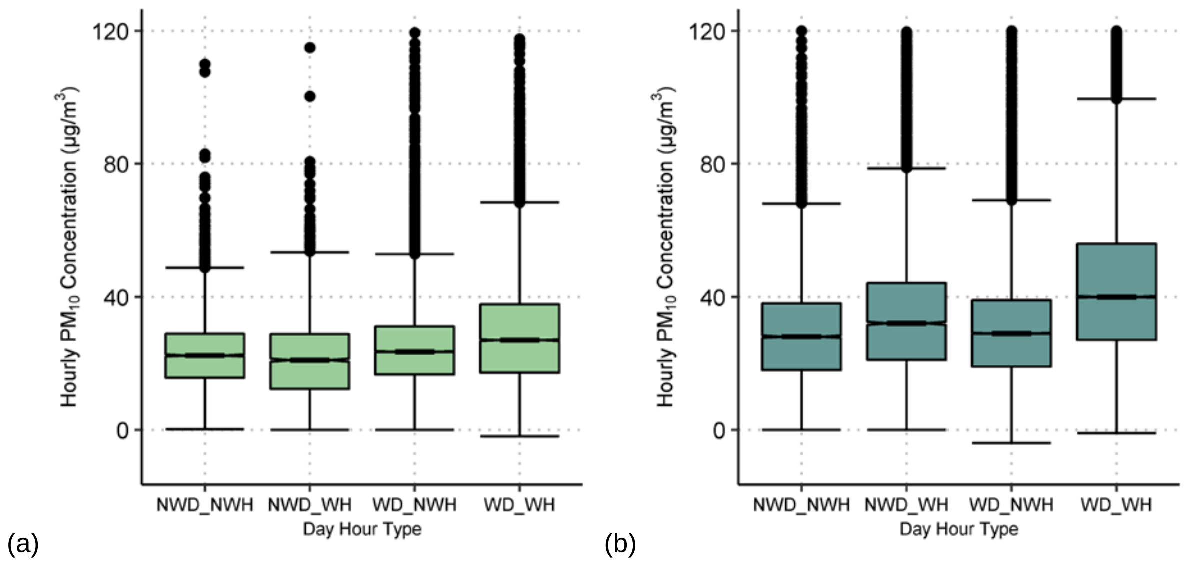


Figure 5-15. Hourly PM_{10} median concentrations for (a) Burbank (2008-2014) and (b) Los Angeles (2008-2019) for working (WD) and non-working days (NWD) and for working (WH) and non-working hours (NWH).

5.5 BC Concentrations

Figures 5-16 through 5-19 summarize the 12-year and Year 12 (2019) 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. Similar to the PM_{10} concentration section above, **Figures 5-20 through 5-23** illustrate median BC concentrations and 95% confidence intervals for working and non-working days and for working and non-working hours for each wind sector. The following general conclusions are based on the statistical values presented in Figures 5-16 through 5-23:

- During the highest activity levels (working hours on working days):
  - The median concentration of BC measured at both the Landfill and Community monitors are significantly higher when the winds are from the SoCAB than when they are from the landfill. This is true over the 12-year monitoring period and in Year 12 only.
  - Over the 12-year monitoring period, when the wind is from the SoCAB, the Community monitor measures higher levels of BC concentrations than the Landfill monitor. In Year 12, when the wind is from the SoCAB or the landfill, the Landfill monitor measures higher BC concentrations.
  - When the wind is from the SoCAB, the Community monitor measures more than four times the median concentration of BC as when the wind is from the landfill over the 12-year monitoring period. In Year 12, when the wind is from the SoCAB, the Community monitor measures more than two times the median concentration than 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. This is true over the 12-year monitoring period and in Year 12 only.

- During the lowest activity levels (non-working days):
  - The median concentrations of BC are lower on non-working days than on working days in all categories, but the extent of the difference is influenced by wind direction. The proportional decrease in concentrations on non-working days was larger for BC than for PM_{10}. Compared to the median BC concentrations during non-working hours on working days, the median BC concentrations during non-working hours on non-working days decreased by a factor of 3 (Community site) to 1.4 (Landfill site) when winds were from the landfill, and decreased by about a factor of roughly 1.2 (both sites) 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 from the Landfill monitor. However, the large metropolitan area of the SoCAB remains the dominant source of DPM. Furthermore, increased BC measurements at the Community monitor on working days versus non-working days (regardless of wind direction) coincides with known metropolitan area DPM source activity patterns.

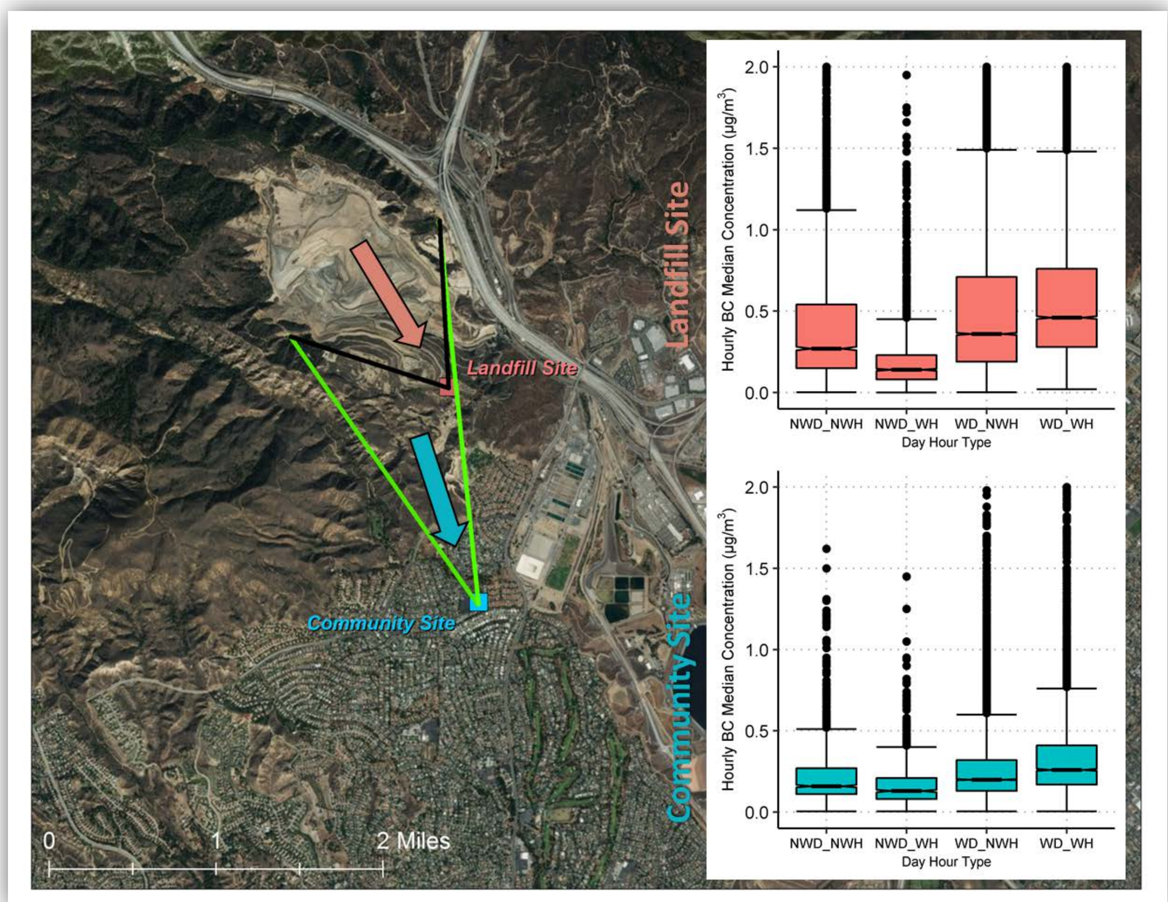


Figure 5-16. Notched box whisker plots of 12-year hourly average BC concentrations for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 2 µg/m^3 are not displayed.

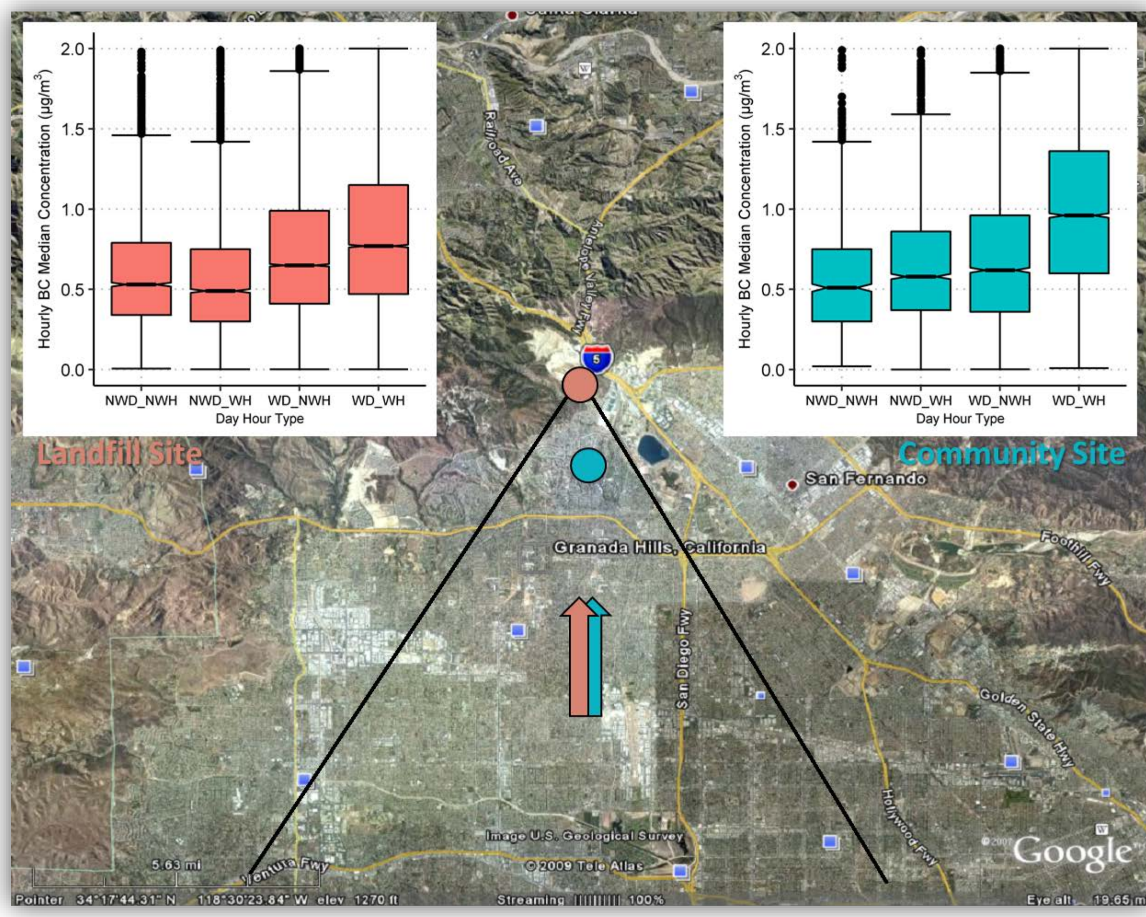


Figure 5-17. Notched box whisker plots of 12-year hourly average BC concentrations for Southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 2 µg/m^3 are not displayed.

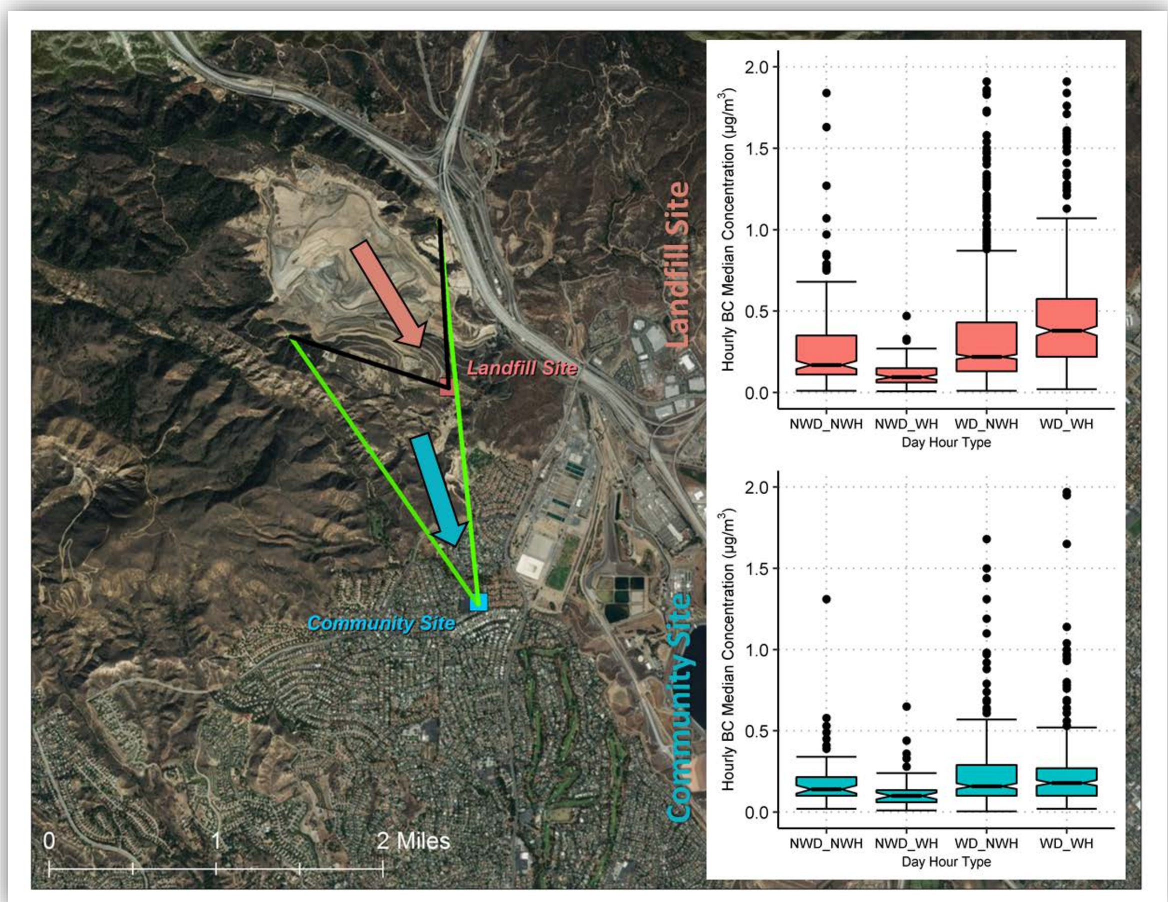


Figure 5-18. Notched box whisker plots of Year 12 (2019) hourly average BC concentrations for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 2 µg/m^3 are not displayed.

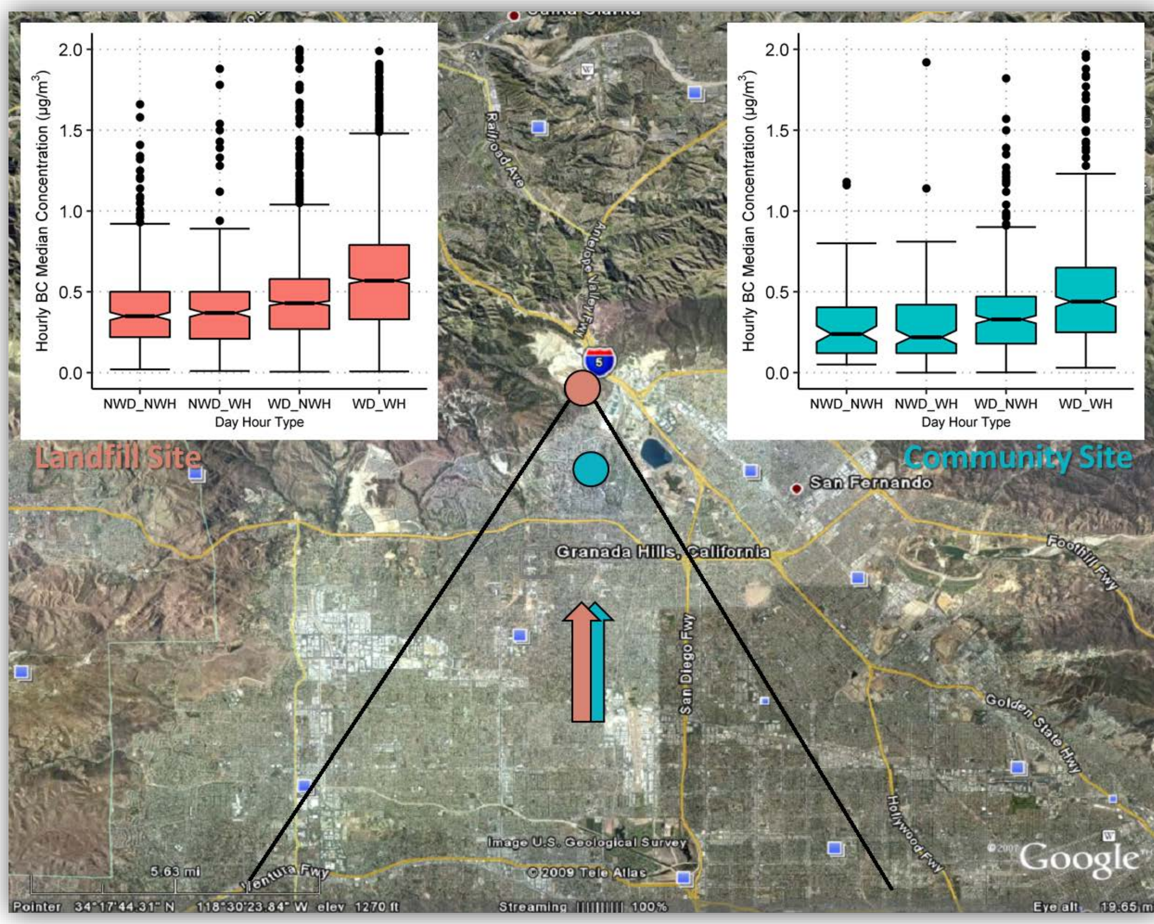


Figure 5-19. Notched box whisker plots of Year 12 (2019) hourly average BC concentrations for Southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. Outliers over 2 µg/m^3 are not displayed.

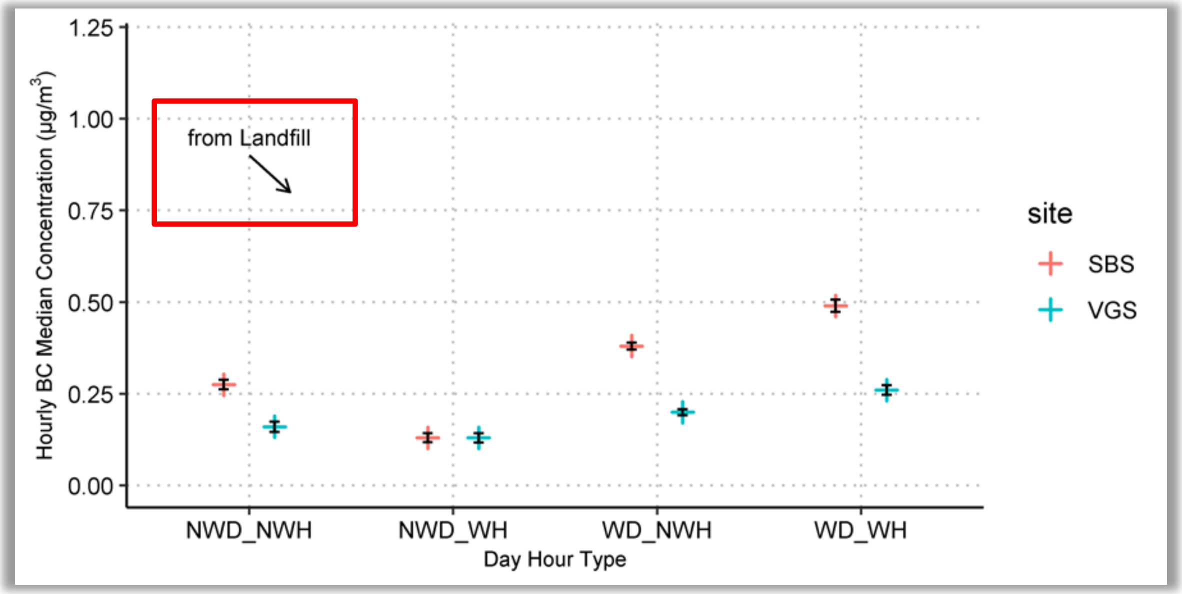


Figure 5-20. Twelve-year hourly median BC concentrations for northerly (“From Landfill”) wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black.

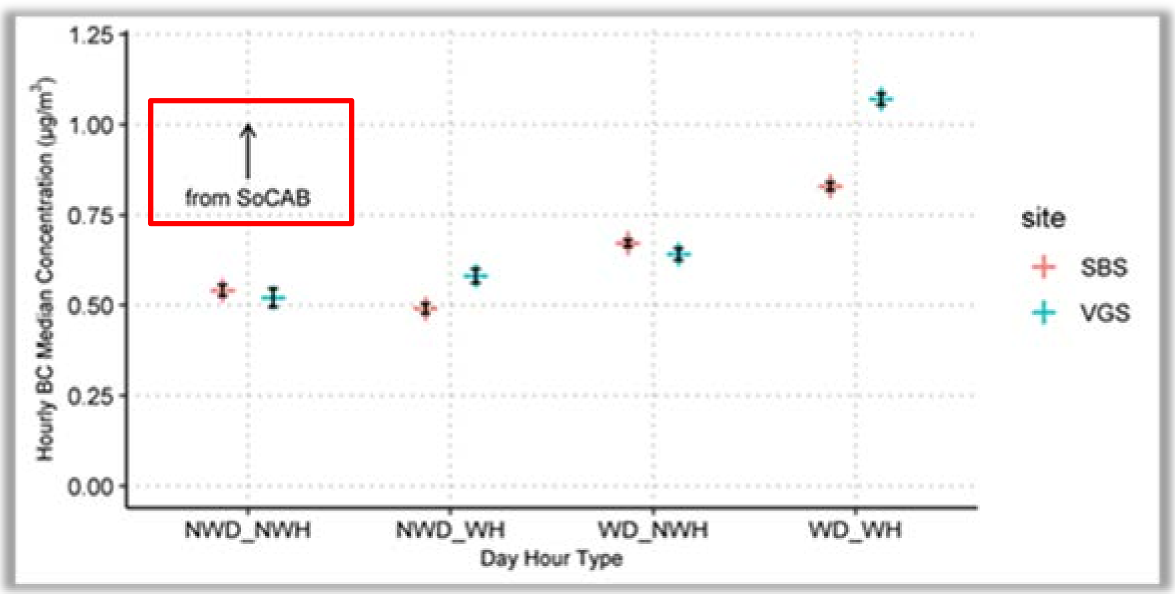


Figure 5-21. Twelve-year hourly median BC concentrations for northerly (“From SOCAB”) wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black.

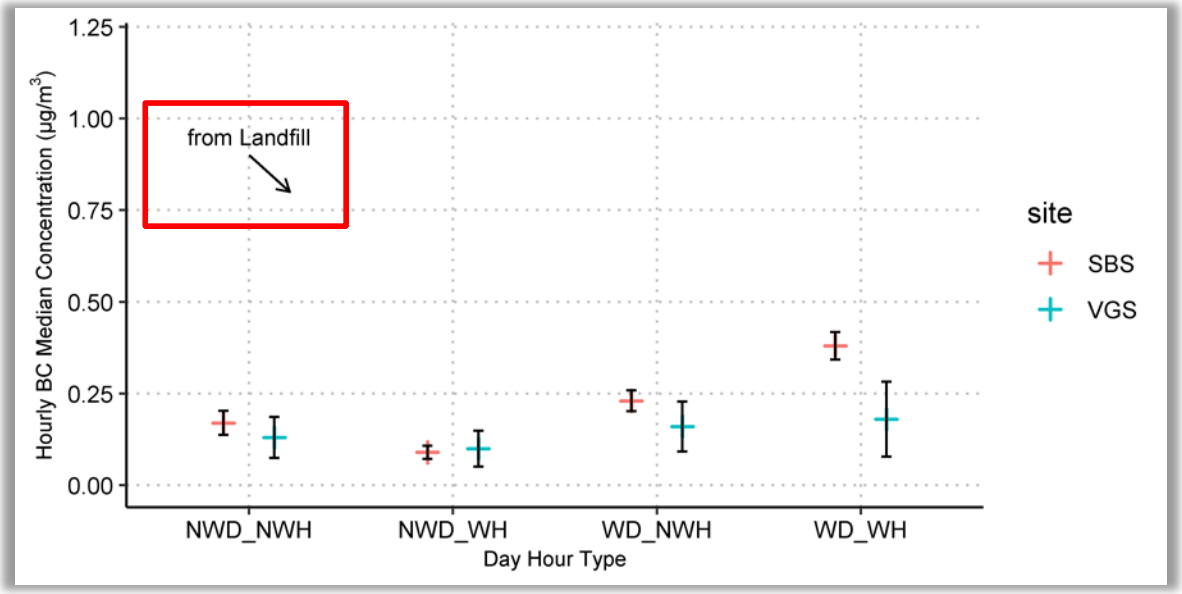


Figure 5-22. Year 12 (2019) hourly median BC concentrations for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black.

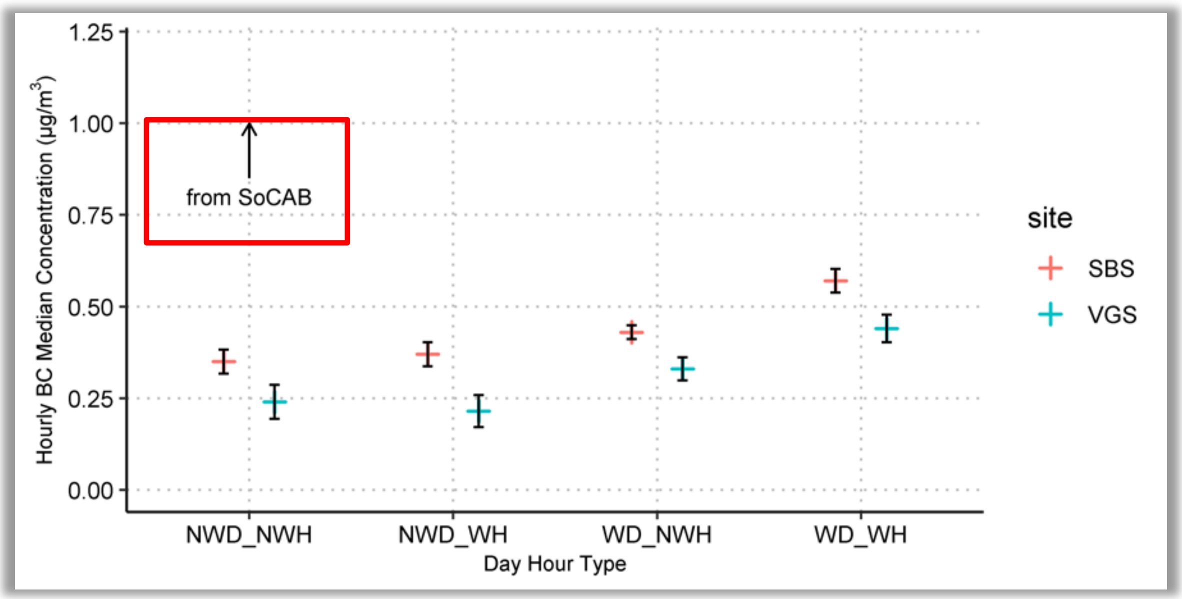


Figure 5-23. Year 12 (2019) hourly median BC concentrations for northerly ("From SOCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) within those days for the Landfill (red) and Community (blue) monitor sites. 95% confidence intervals are shown in black.

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, primarily because there is no way to *directly* calculate an appropriate metric. Critically, 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.

In Year 9 (2016) the data collected at the Landfill North site provided the opportunity for a more direct measurement of contributions of PM_{10} and BC from landfill operations. 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 or from the SoCAB were compared by subtracting the Landfill North site values from the Landfill site values to obtain the differences for each wind direction (i.e., from the landfill or from the SoCAB). A similar analysis was conducted for the Landfill and Community sites to determine whether 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 or from the SoCAB were compared by subtracting the Landfill site values from the Community site values to obtain the differences by wind direction (i.e., from the landfill or from the SoCAB). Results from the Year 9 difference analysis can be found in Appendix B, but the key takeaway is that the directly measured contribution is more than two times higher than the estimated contribution resulting from the previous data analysis method (which began in the Second Annual Report in 2009[12]). The previous estimation method is difficult to clearly describe and resulted in a lower contribution estimate of the impact of landfill operations on neighborhood-scale ambient air quality than the direct measurement method did; therefore, this report uses the same approach as the direct measurement method by comparing the difference between the Landfill and Community sites under the two wind sectors (i.e., from the SoCAB and from the landfill).

The following general conclusions are based on the PM_{10} difference values presented in **Figures 6-1 through 6-4**:

- The greatest difference in PM_{10} concentrations between the Landfill and Community sites was observed during periods of highest activity levels (i.e., working hours on working days). Over the 12-year monitoring period, the median PM_{10} difference was 22 µg/m^3 (mean difference of 37 µg/m^3) lower at the Community site when the winds were from the landfill. In Year 12, the median PM_{10} difference was 35 µg/m^3 (mean difference of 33 µg/m^3) lower at the Community site when the winds were from the landfill.
- When wind was from the landfill, PM_{10} levels at the Community site were lower than those at the Landfill site for all working categories over the 12 years. Additionally, PM_{10} concentrations measured at the Community site were lower in each working category when compared to regional PM_{10} measurements (as shown in Figure 5-15). A landfill contribution to PM_{10} concentrations at the Community site was not evident under these wind conditions over the 12 years.
- When the wind was from the SoCAB, the PM_{10} values at the Community site were slightly higher than the values at the Landfill site in the non-working hour categories. The PM_{10} values were below those at the Landfill site for the highest activity level, indicating a regional contribution of PM_{10} from the SoCAB to the Community site. On days in the highest activity level category, the regional contribution of PM_{10} combined with local landfill contributions to increase PM_{10} concentrations at the Landfill site. In Year 12, PM_{10} levels at the Community site were lower than those at the Landfill site when wind was from SoCAB for all working categories, indicating the combination of increased landfill activity and regional PM_{10} contribution.

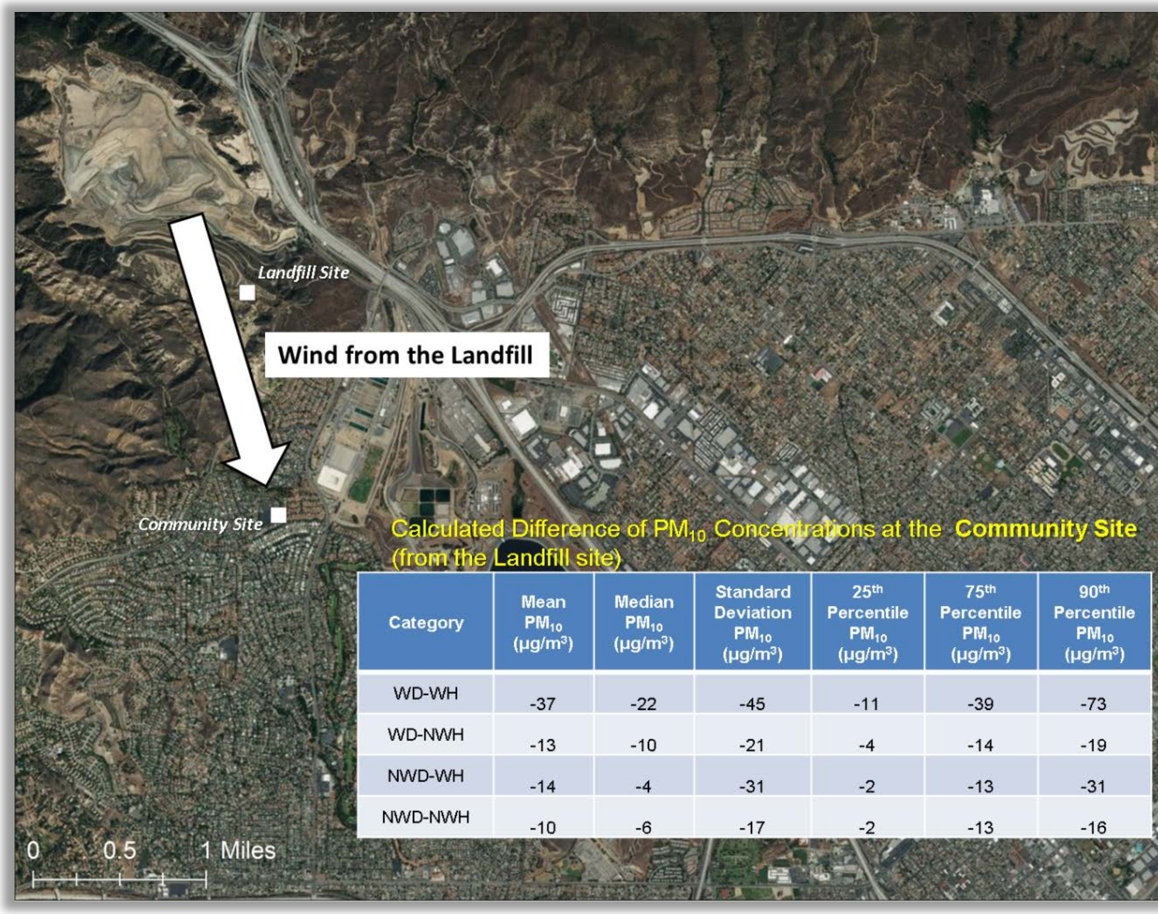
The following general conclusions are based on the BC difference values presented in **Figures 6-5 through 6-8**:

- During the highest activity levels (working hours on working days), the greatest BC differences were observed. Over the 12-year monitoring period, the median BC difference was 0.230 µg/m^3 (mean difference of 0.336 µg/m^3) lower at the Community site when the winds were from the landfill. For all other working categories, BC concentrations were lower at the Community site when winds were from the landfill, suggesting that a landfill contribution to BC levels at the Community site was not evident (as evident for PM_{10}). During the highest activity levels over Year 12, the median BC

[12] 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.

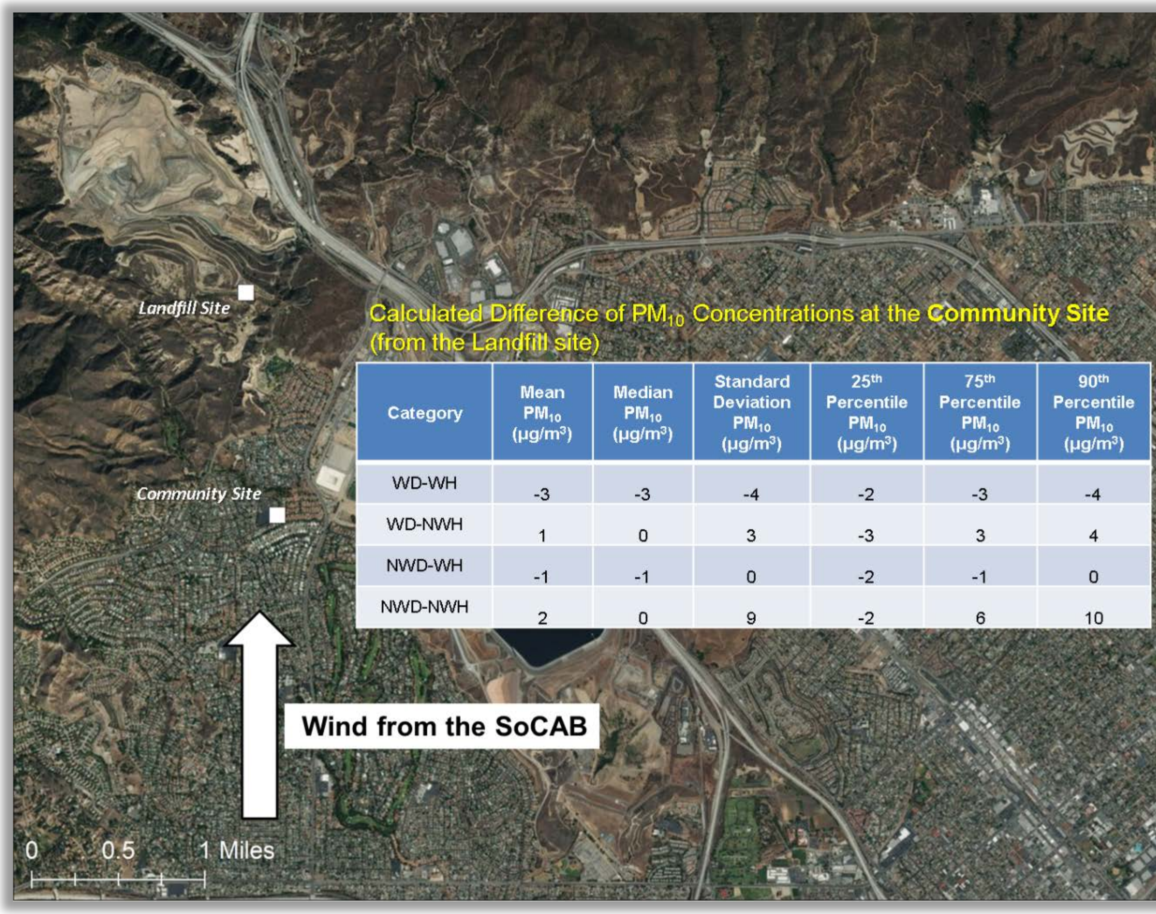
difference was 0.200 µg/m^3 (mean difference of 0.134 µg/m^3) lower at the Community site when the winds were from the landfill.

- BC concentrations were higher at the Community site than at the Landfill site when the wind was from the SoCAB in the working hour categories, but they were slightly lower during non-working hour categories. This suggests increased regional BC concentrations contributing to BC levels at the Community site.



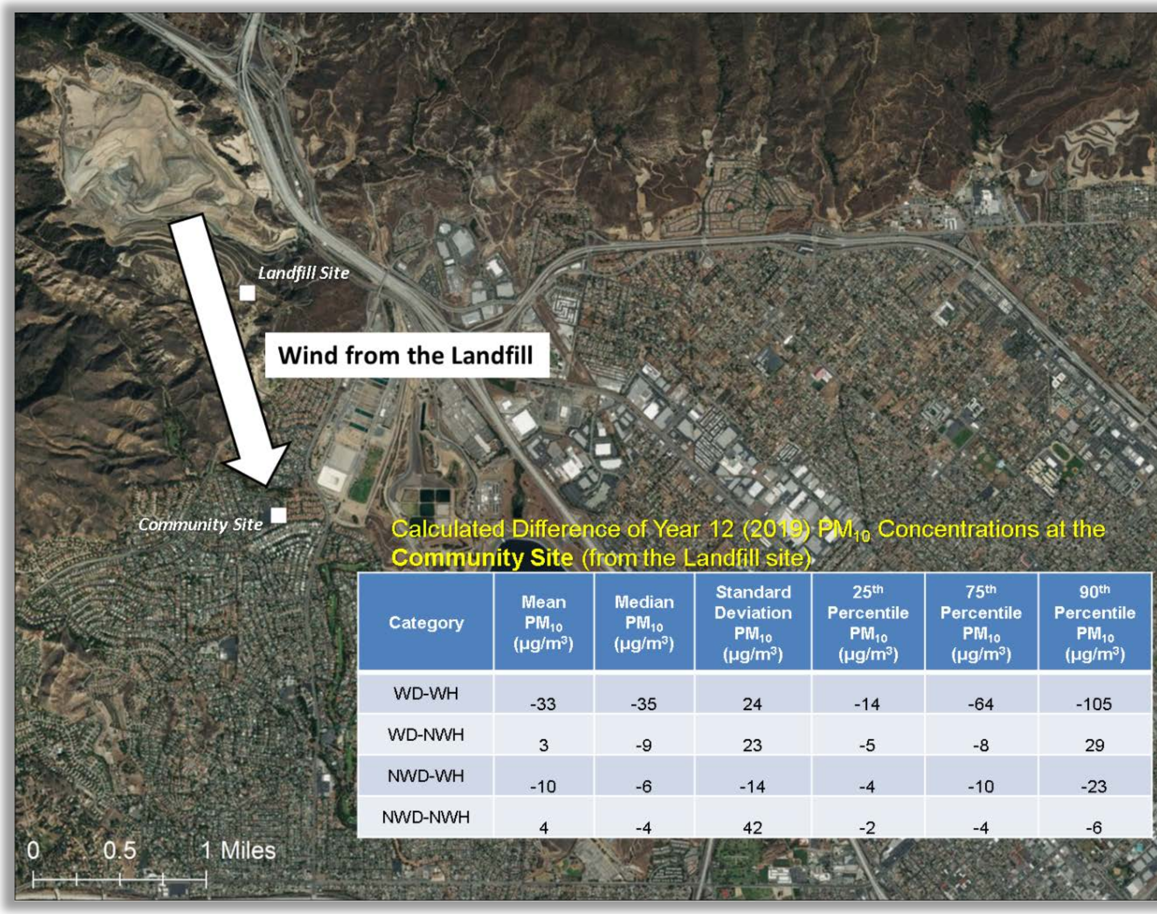
Category	Mean PM_{10} (µg/m^3)	Median PM_{10} (µg/m^3)	Standard Deviation PM_{10} (µg/m^3)	25th Percentile PM_{10} (µg/m^3)	75th Percentile PM_{10} (µg/m^3)	90th Percentile PM_{10} (µg/m^3)
WD-WH	-37	-22	-45	-11	-39	-73
WD-NWH	-13	-10	-21	-4	-14	-19
NWD-WH	-14	-4	-31	-2	-13	-31
NWD-NWH	-10	-6	-17	-2	-13	-16

Figure 6-1. Median, mean, and standard deviation of PM_{10} concentration differences at the Community site versus the Landfill site for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the 12-year monitoring period dataset. Negative values represent lower PM_{10} concentrations at the Community site.



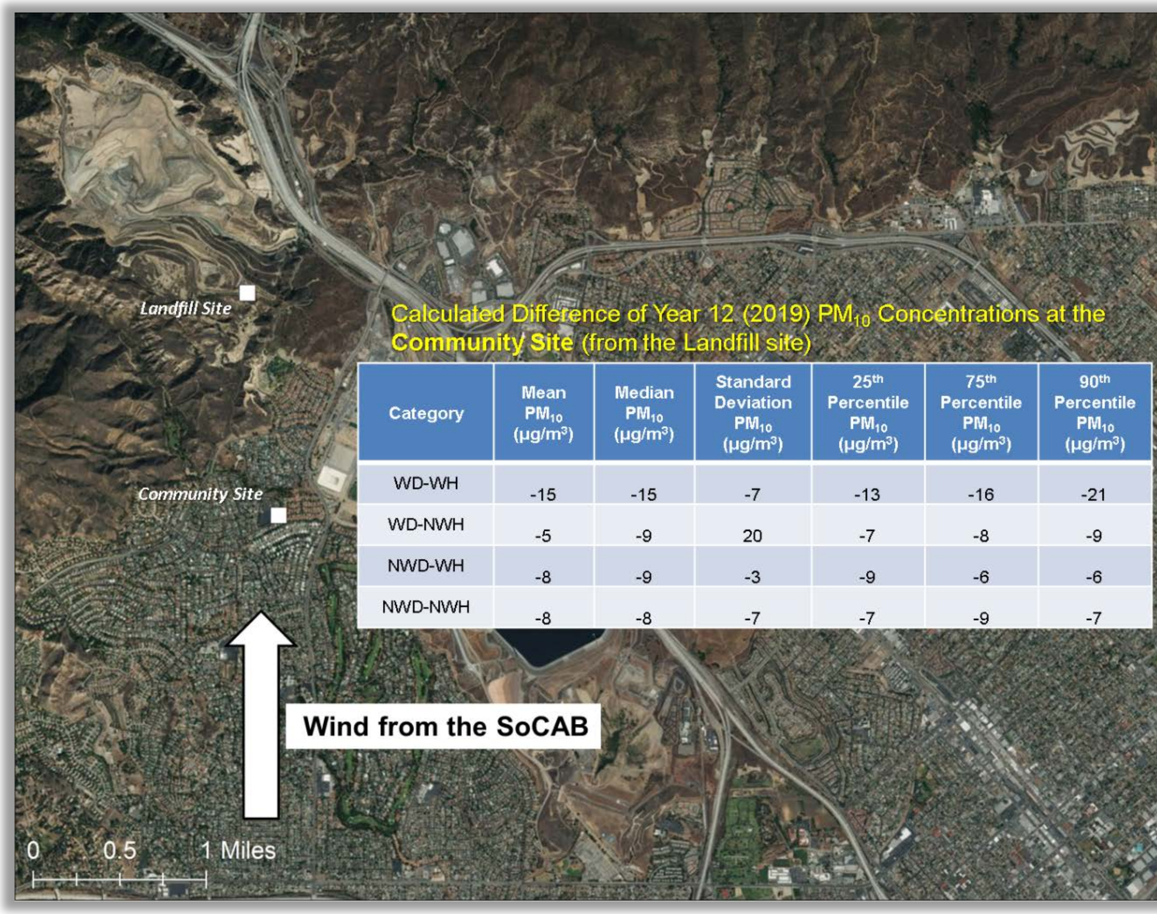
Category	Mean PM_{10} (µg/m³)	Median PM_{10} (µg/m³)	Standard Deviation PM_{10} (µg/m³)	25th Percentile PM_{10} (µg/m³)	75th Percentile PM_{10} (µg/m³)	90th Percentile PM_{10} (µg/m³)
WD-WH	-3	-3	-4	-2	-3	-4
WD-NWH	1	0	3	-3	3	4
NWD-WH	-1	-1	0	-2	-1	0
NWD-NWH	2	0	9	-2	6	10

Figure 6-2. Median, mean, and standard deviation of PM_{10} concentration differences at the Community site versus the Landfill site for southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the 12-year monitoring period dataset. Negative values represent lower PM_{10} concentrations at the Community site, while positive values represent higher PM_{10} concentrations.



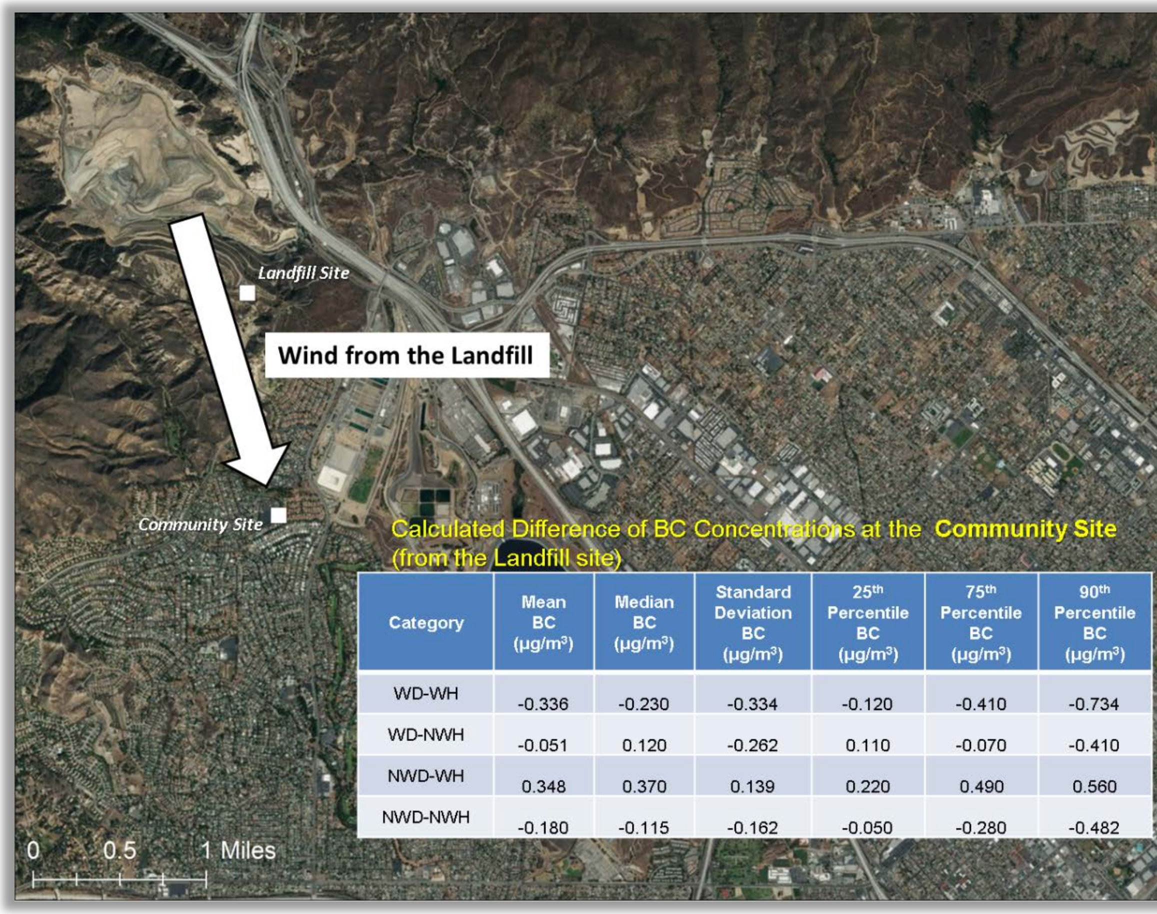
Category	Mean PM_{10} (µg/m^3)	Median PM_{10} (µg/m^3)	Standard Deviation PM_{10} (µg/m^3)	25th Percentile PM_{10} (µg/m^3)	75th Percentile PM_{10} (µg/m^3)	90th Percentile PM_{10} (µg/m^3)
WD-WH	-33	-35	24	-14	-64	-105
WD-NWH	3	-9	23	-5	-8	29
NWD-WH	-10	-6	-14	-4	-10	-23
NWD-NWH	4	-4	42	-2	-4	-6

Figure 6-3. Median, mean, and standard deviation of PM_{10} concentration differences at the Community site versus the Landfill site for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the Year 12 (2019) dataset. Negative values represent lower PM_{10} concentrations at the Community site.



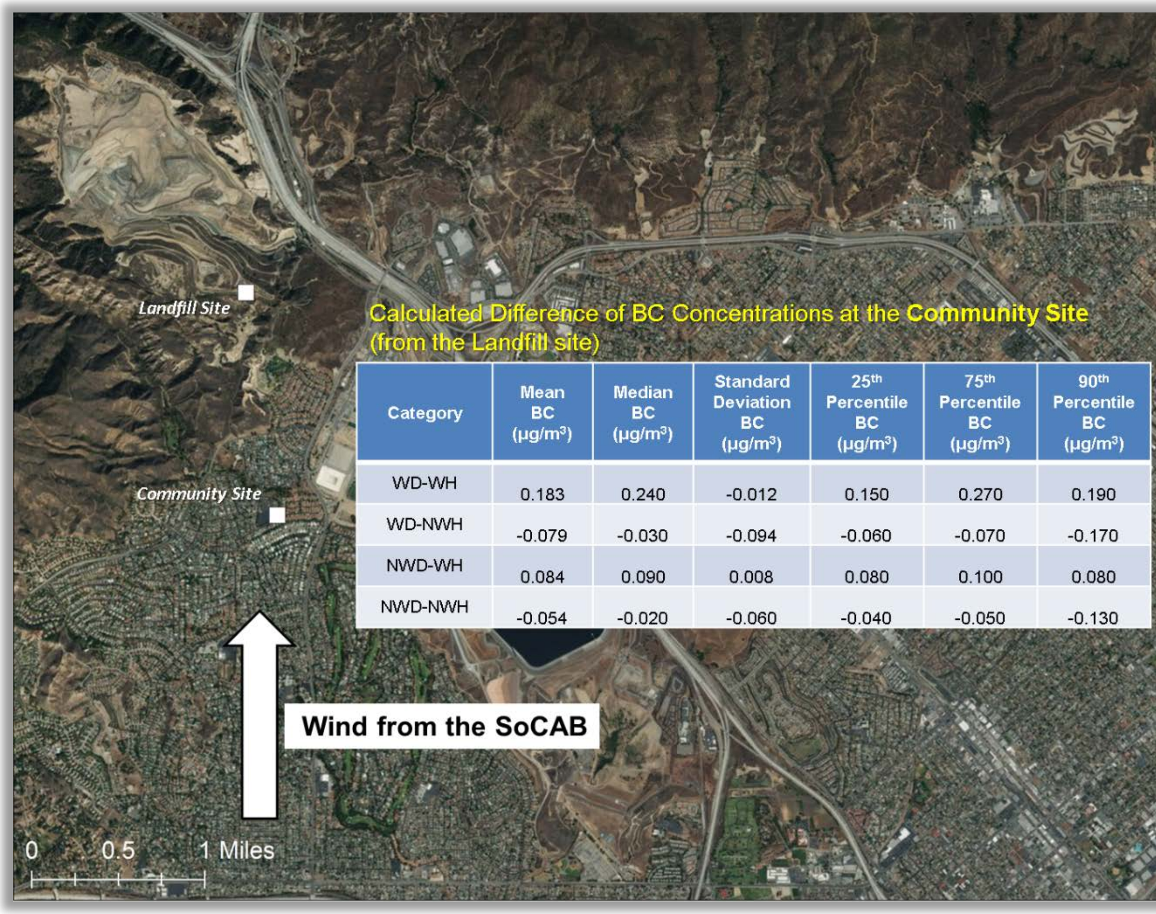
Category	Mean PM_{10} (µg/m³)	Median PM_{10} (µg/m³)	Standard Deviation PM_{10} (µg/m³)	25th Percentile PM_{10} (µg/m³)	75th Percentile PM_{10} (µg/m³)	90th Percentile PM_{10} (µg/m³)
WD-WH	-15	-15	-7	-13	-16	-21
WD-NWH	-5	-9	20	-7	-8	-9
NWD-WH	-8	-9	-3	-9	-6	-6
NWD-NWH	-8	-8	-7	-7	-9	-7

Figure 6-4. Median, mean, and standard deviation of PM_{10} concentration differences at the Community site versus the Landfill site for southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the Year 12 (2019) dataset. Negative values represent lower PM_{10} concentrations at the Community site.



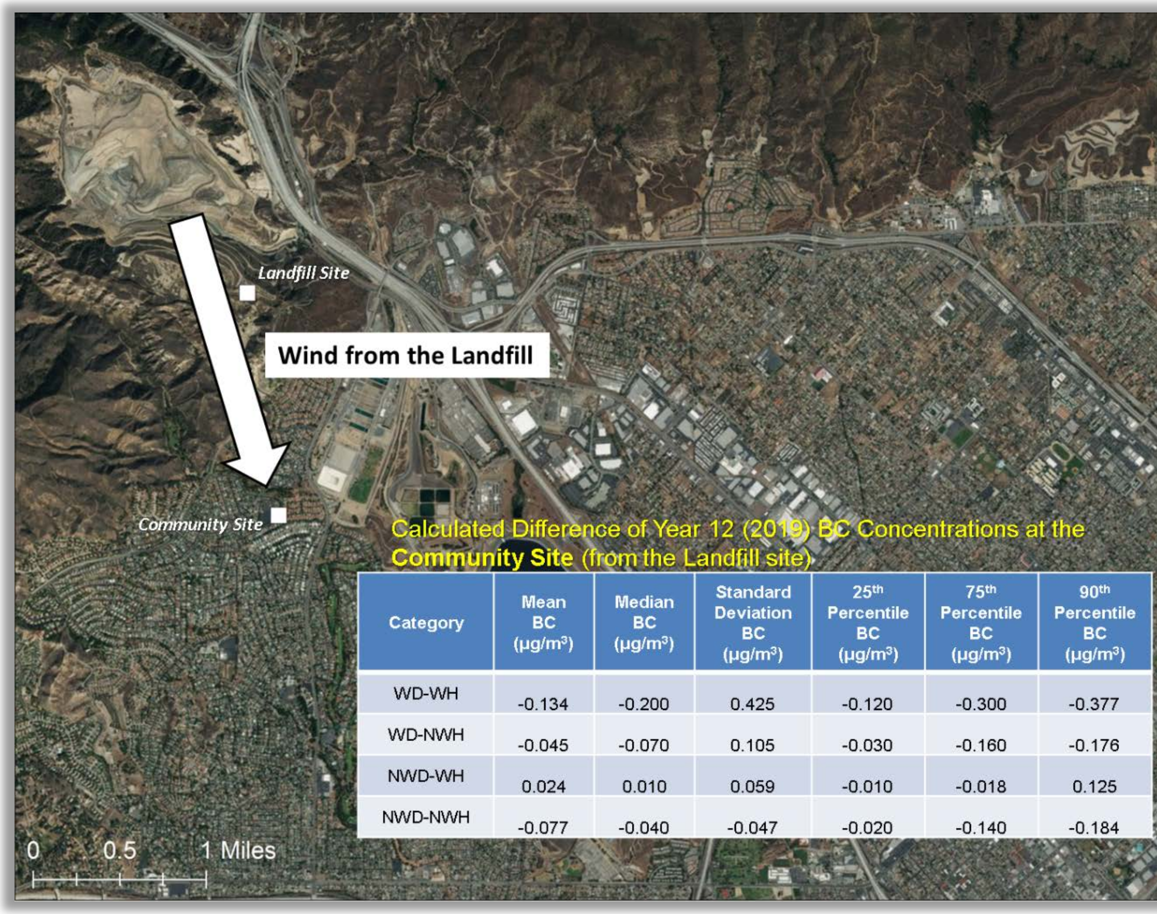
Category	Mean BC (µg/m³)	Median BC (µg/m³)	Standard Deviation BC (µg/m³)	25th Percentile BC (µg/m³)	75th Percentile BC (µg/m³)	90th Percentile BC (µg/m³)
WD-WH	-0.336	-0.230	-0.334	-0.120	-0.410	-0.734
WD-NWH	-0.051	0.120	-0.262	0.110	-0.070	-0.410
NWD-WH	0.348	0.370	0.139	0.220	0.490	0.560
NWD-NWH	-0.180	-0.115	-0.162	-0.050	-0.280	-0.482

Figure 6-5. Median, mean, and standard deviation of BC concentration differences at the Community site versus the Landfill site for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the 12-year monitoring period dataset. Negative values represent lower BC concentrations at the Community site.



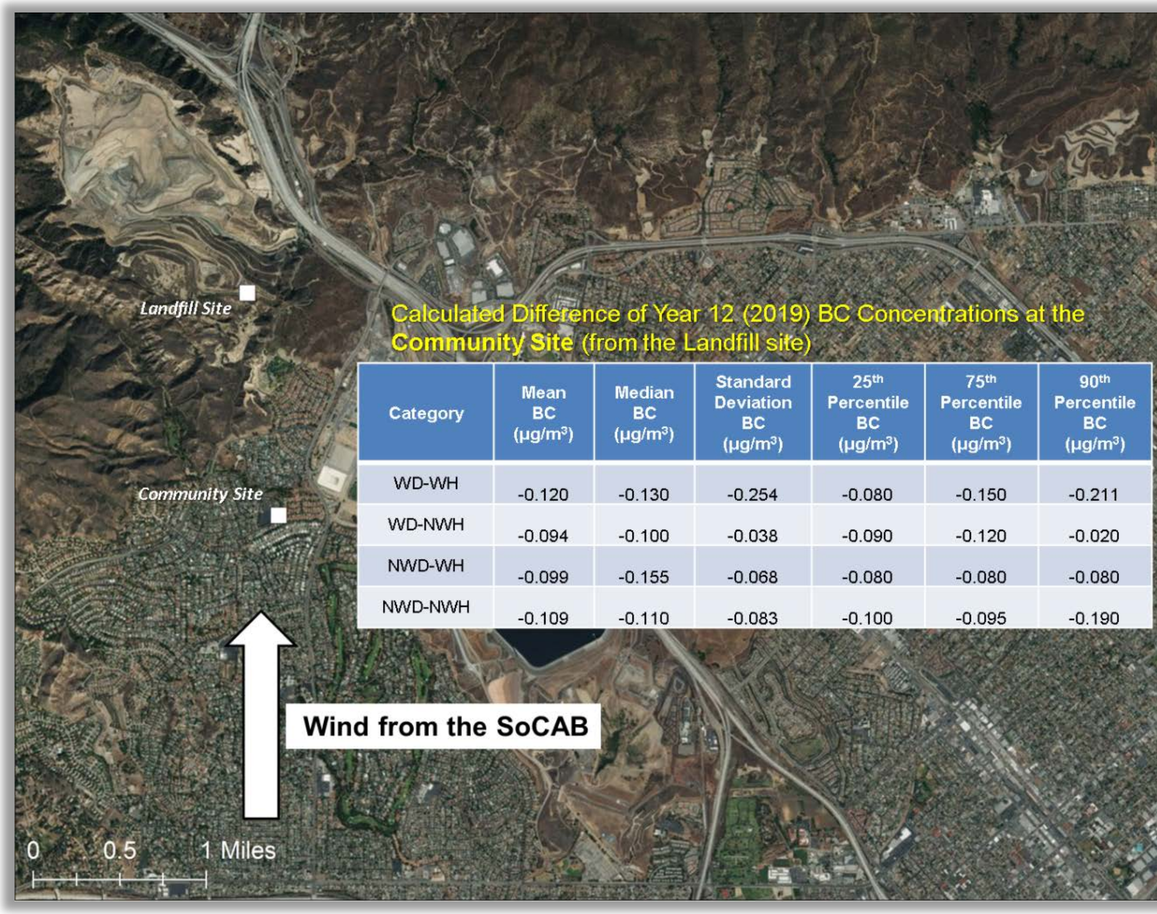
Category	Mean BC (µg/m³)	Median BC (µg/m³)	Standard Deviation BC (µg/m³)	25th Percentile BC (µg/m³)	75th Percentile BC (µg/m³)	90th Percentile BC (µg/m³)
WD-WH	0.183	0.240	-0.012	0.150	0.270	0.190
WD-NWH	-0.079	-0.030	-0.094	-0.060	-0.070	-0.170
NWD-WH	0.084	0.090	0.008	0.080	0.100	0.080
NWD-NWH	-0.054	-0.020	-0.060	-0.040	-0.050	-0.130

Figure 6-6. Median, mean, and standard deviation of BC concentration differences at the Community site versus the Landfill site for southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the 12-year monitoring period dataset. Positive values represent higher BC concentrations at the Community site.



Category	Mean BC (µg/m³)	Median BC (µg/m³)	Standard Deviation BC (µg/m³)	25th Percentile BC (µg/m³)	75th Percentile BC (µg/m³)	90th Percentile BC (µg/m³)
WD-WH	-0.134	-0.200	0.425	-0.120	-0.300	-0.377
WD-NWH	-0.045	-0.070	0.105	-0.030	-0.160	-0.176
NWD-WH	0.024	0.010	0.059	-0.010	-0.018	0.125
NWD-NWH	-0.077	-0.040	-0.047	-0.020	-0.140	-0.184

Figure 6-7. Median, mean, and standard deviation of BC concentration differences at the Community site versus the Landfill site for northerly ("From Landfill") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the Year 12 (2019) dataset. Negative values represent lower BC concentrations at the Community site, while positive values represent higher BC concentrations.



Category	Mean BC (μg/m³)	Median BC (μg/m³)	Standard Deviation BC (μg/m³)	25th Percentile BC (μg/m³)	75th Percentile BC (μg/m³)	90th Percentile BC (μg/m³)
WD-WH	-0.120	-0.130	-0.254	-0.080	-0.150	-0.211
WD-NWH	-0.094	-0.100	-0.038	-0.090	-0.120	-0.020
NWD-WH	-0.099	-0.155	-0.068	-0.080	-0.080	-0.080
NWD-NWH	-0.109	-0.110	-0.083	-0.100	-0.095	-0.190

Figure 6-8. Median, mean, and standard deviation of BC concentration differences at the Community site versus the Landfill site for southerly ("From SoCAB") wind sectors (as displayed in Figure 5-4) for working days (WD) and non-working days (NWD) and for working hours (WH) and non-working hours (NWH) based on the Year 12 (2019) dataset. Positive values represent higher BC concentrations at the Community site.

7. 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 to monthly intervals because experience 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 11. **Tables 7-1 and 7-2** summarize all visits during Year 12 for the monitoring sites.

Table 7-1. Sunshine Canyon Landfill monitoring site visits and field maintenance and operations in Year 12.

Date of Site Visit	Description of Work
December 27, 2018	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
February 13, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Performed leak check on BAM sampler. Performed flow check on Aethalometer and BAM samplers.
February 19, 2019	Replaced anemometer serial #139487 with serial #99220. Wind Direction was above 360 degrees.
March 15, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
April 1, 2019	Replaced BAM tape. Restarted BAM and ran self-test. Self-test passed.

Date of Site Visit	Description of Work
April 22, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
May 2, 2019	Semi-annual BAM head and sample pipe cleaning. Checked surface meteorological equipment.
May 23, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers. Noted sprayer on south rim next to trailer saturating the air with moisture, possibly affecting sample concentrations.
May 30, 2019	Checked Aethalometer s/n 739-0609, which shut down on 5/29/19 at 12:00 for an unknown reason. Restarted Aethalometer and performed self-check. Self-check passed, no apparent problems noted.
June 18, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
June 20, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies, and replaced the BAM tape. Cleaned BAM roller and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
July 25, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
August 21, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
September 3, 2019	Changed BAM tape. Ran self-test on BAM after respooling roll and passed.

Date of Site Visit	Description of Work
September 20, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
October 24, 2019	Powered back up after fire recovery. Restarted Aethalometer and BAM. Collected PM10 and BC data. Unable to check Aethalometer and BAM flow from roof due to high winds. Cleaned BAM roller, vane, and nozzle. Checked BAM tape supply.
October 30, 2019	BAM temperature input was missing and flow stopped. Possible BAM sensor problem, but unable to reach sensor on roof due to high winds. Checked and retensioned BAM terminal inputs. Restarted BAM.
November 20, 2019	Changed BAM tape. Ran self-test on BAM after respooling roll, tensioned, and passed.
December 18, 2019*	Collected PM_{10} and BC data. Spooled new roll of tape for Aethalometer. Restarted Aethalometer. Checked BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.

* The next site visit that occurred after the current year is included in this report. The information from this site visit is used to assess the quality of the last portion of data from the current year.

Table 7-2. Community monitoring site visits and field maintenance and operations in Year 12.

Date of Site Visit	Description of Work
November 26, 2018	Computer infected; removed and sent to STI.
December 6, 2018	Technician on site for data recovery, computer still out. Noted Aethalometer tape advance and optical light errors. Restarted Aethalometer, tape advanced successfully.
December 10, 2018	Noted Aethalometer tape advance and optical light errors. Removed Aethalometer and shipped to Magee for repair. Replaced with spare AE22 Aethalometer.
January 18, 2018	Restarted DR DAS. Edited reporter for database to save field log files.

Date of Site Visit	Description of Work
February 13, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
March 15, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
April 1, 2019	Replaced BAM tape. Found BAM touch screen unilluminated and unresponsive. Power-cycled unit.
April 22, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
April 25, 2019	Site cleanup. Trash removed from trailer. Leaves and debris bagged and removed from inside perimeter fence. Tall grass weed-whacked from fence, swept site pad. Disassembled Aethalometer sample inlet housing and cleaned. Sample inlet pipe cleaned with Met One kit, and O-rings replaced. Reassembled sample inlet housing, ran self-test and passed. BAM down from 12:04 to 13:55 PST due to cleaning.
April 26, 2019	Performed semi-annual met calibration. Flagged wind speed and wind direction data from 12:15 to 16:30 PST.
May 2, 2019	Changed wind anemometer. Tower down 11:59 PST 5305AQ s/n 99221, replaced by 5305AQ s/n 78342.
May 23, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
June 20, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Replaced Aethalometer AE22 sn 335-0109 with recently serviced AE22 s/n 336-0109. Data start at 11:00 PST. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.

Date of Site Visit	Description of Work
July 25, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
August 21, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
September 3, 2019	Changed BAM tape. Ran self-test on BAM after respooling roll and passed.
September 20, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Respooled new Aethalometer tape roll. Checked BAM tape supply and performed leak check. Performed flow check on Aethalometer and BAM samplers. Cleaned BAM roller, vane, and nozzle.
October 24, 2019	Collected PM_{10} and BC data. Restarted Aethalometer. Cleaned Aethalometer roller and cabinet. Cleaned BAM roller, vane, and nozzle. Checked BAM and Aethalometer tape supply. Performed flow check on Aethalometer and BAM samplers. Performed leak check on BAM. Trailer AC unit is not cooling.
November 8, 2019	Reset meteorology data logger. Meteorology power cycled and tested. Data gap for meteorology inputs represent data loss due to the logger down.
November 20, 2019	Changed Aethalometer tape. Spooled new roll, tensioned, and ran self-test for Aethalometer.
December 18, 2019*	Collected PM_{10} and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.

* The next site visit that occurred after the current year is included in this report. The information from this site visit is used to assess the quality of the last portion of data from the current year.

Appendix A: Regional Concentrations of BC

This Appendix contains an analysis of regional concentrations of BC that was previously included in past annual reports. MATES V data are not available to public at the time of the 12th Annual Report, but should be available for the 13th Annual Report.

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.[1] 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.

[1] Year 10 data are not included in this analysis but will be used in analyses of the MATES V study (http://www.aqmd.gov/home/air-quality/air-quality-studies/health-studies/mates-v).

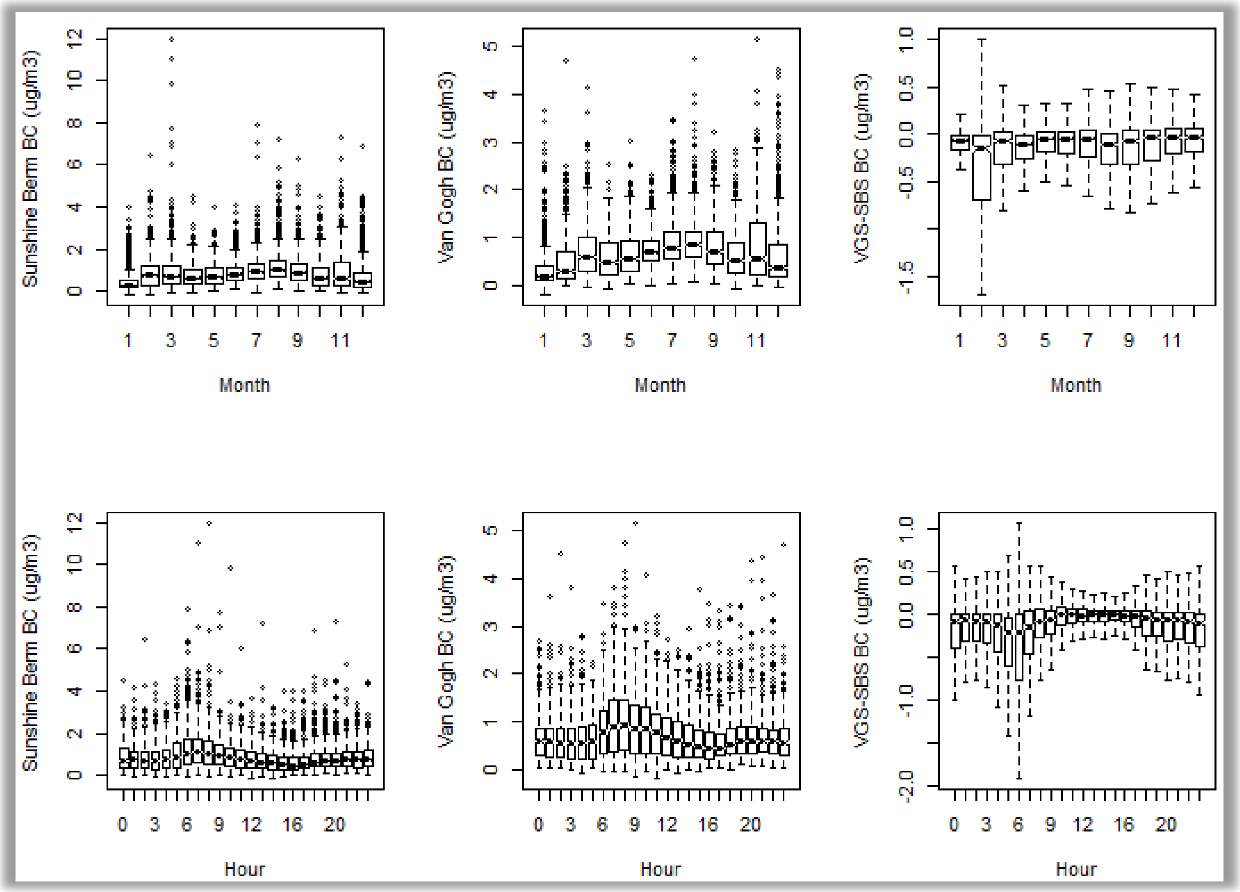


Figure A-1. Concentrations of black carbon at the two stations by month (top three figures) and time of day (bottom three figures) for the time period of the MATES IV study (July 2012–June 2013). Differentials are shown on the far right; concentrations below zero indicate that concentrations were higher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

To place the data in a regional context, Landfill and Community BC concentrations during the MATES IV period (July 2012–June 2013) are shown in comparison to MATES IV BC 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, the Landfill site) and Van Gogh site (VGS, the Community site) 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.

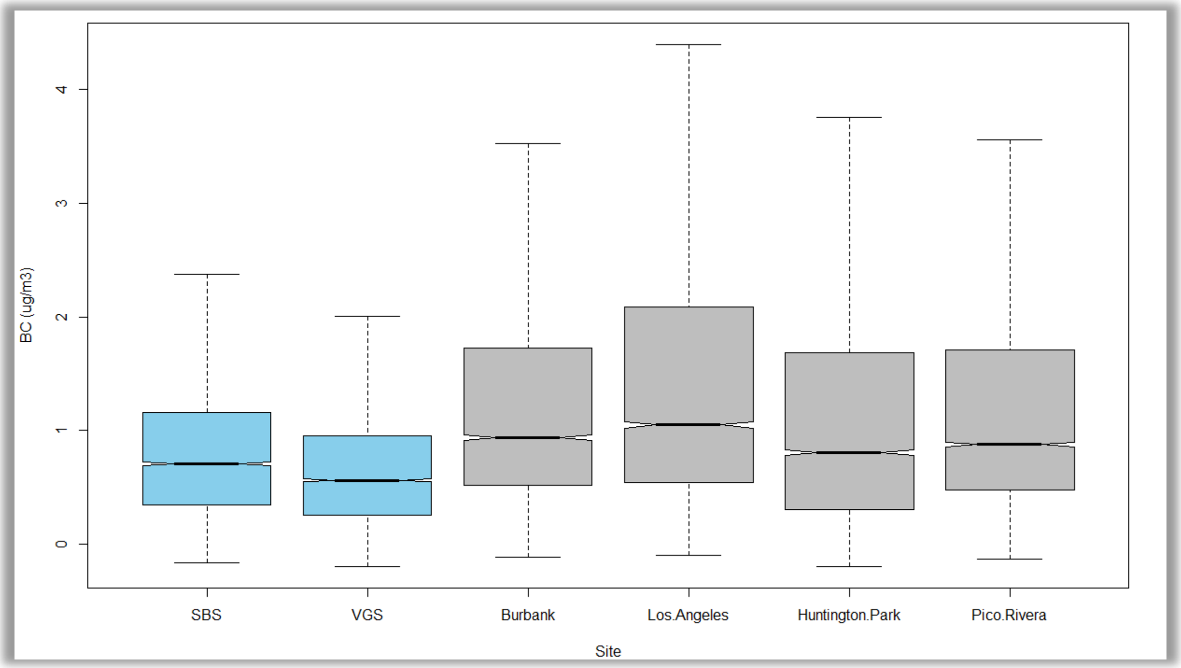


Figure A-2. A comparison of regional BC concentrations from July 2012 through June 2013 at landfill sites (blue) and MATES IV monitoring stations (gray). In MATES IV documentation, Los Angeles is referred to as "Central LA."

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). Section B.3 provides information about the Landfill North site, as previously reported in Section 5.6 of the Ninth Annual Report.

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 of BC and PM_{10} in Year 12 (November 22, 2018, through November 21, 2019) are consistent with the previous eleven years. The mean hourly PM_{10} data at both sites during Year 12 are the lowest among their counterparts during the previous eleven 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. Figure B-2 shows the percent of time during which winds at the Landfill and Community sites originated from each wind direction sector, South Coast Air Basin, Landfill, or Other during each month of the 12 years.

Figures B-3 through B-5 show seasonal wind roses of hourly wind data collected at the Landfill 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-3 and B-4). 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 (not shown). The prevailing wind direction at the Community site varies during all seasons (Figure B-5).

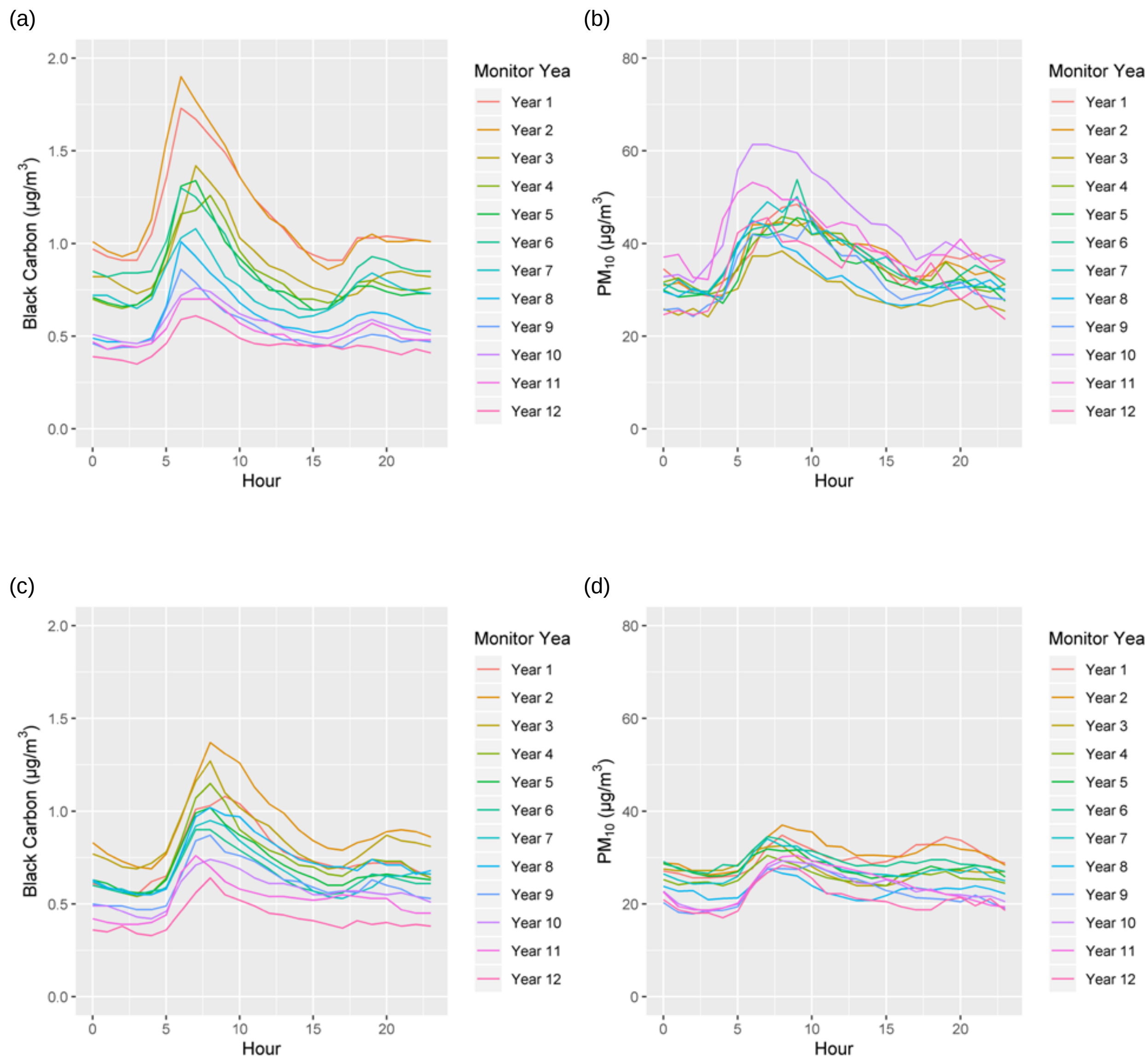


Figure B-1. Mean BC and PM_{10} concentrations by hour for the 12 monitoring years at the Landfill (a, b) and Community (c, d) sites.

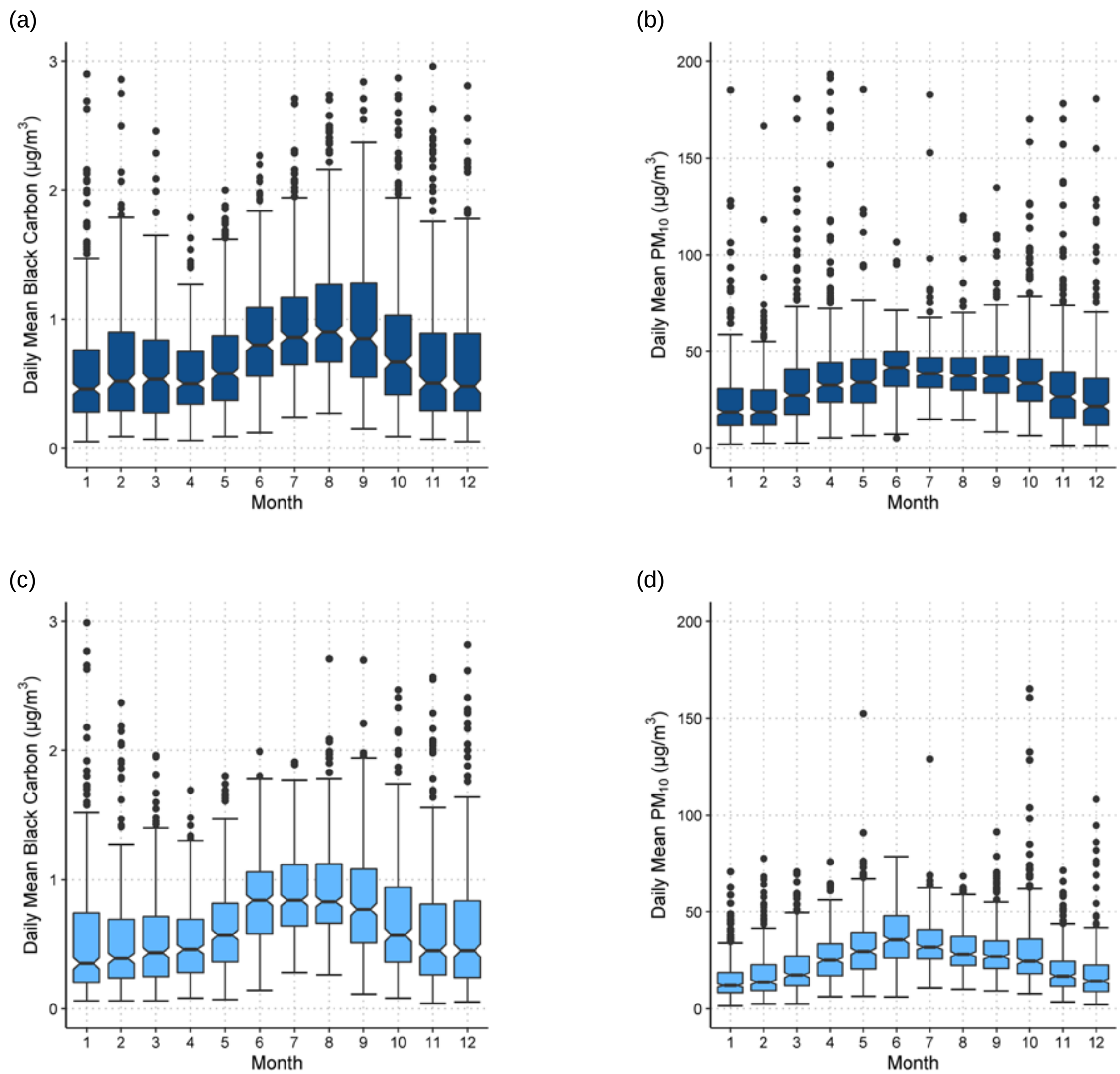
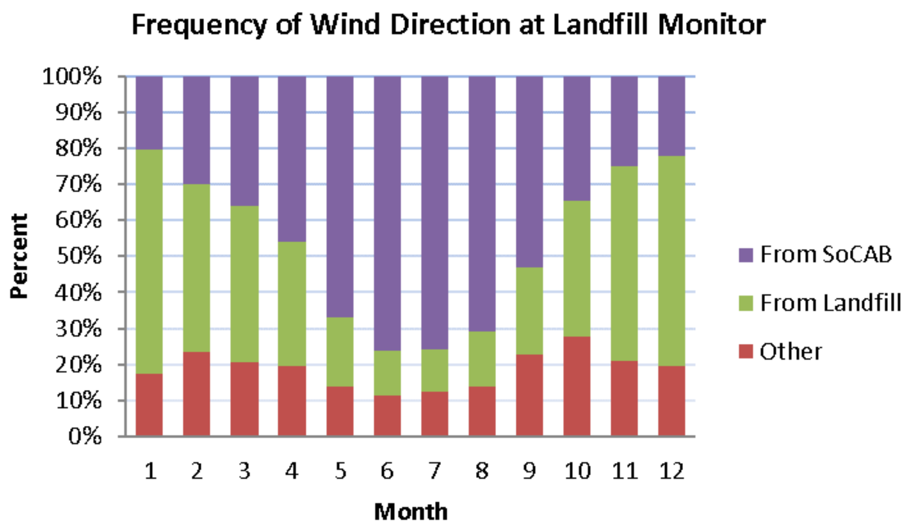


Figure B-2. Distribution of daily mean BC and PM_{10} concentrations by month across all 12 monitor years (2007–2019) at the Landfill (a, b) and Community (c, d) sites. BC outlier data greater than 3 µg/m^3 and PM_{10} outlier data greater than 200 µg/m^3 are excluded.

(a)



(b)

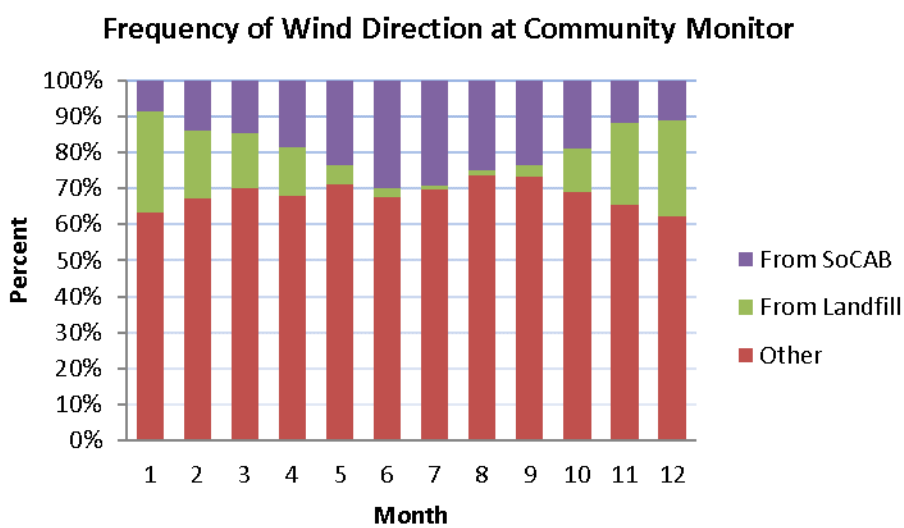


Figure B-3. Percent of time during which winds at the Landfill (a) and Community (b) monitoring sites originated from each wind direction sector (South Coast Air Basin, Landfill, Other) during each month across all 12 years (2007–2019).

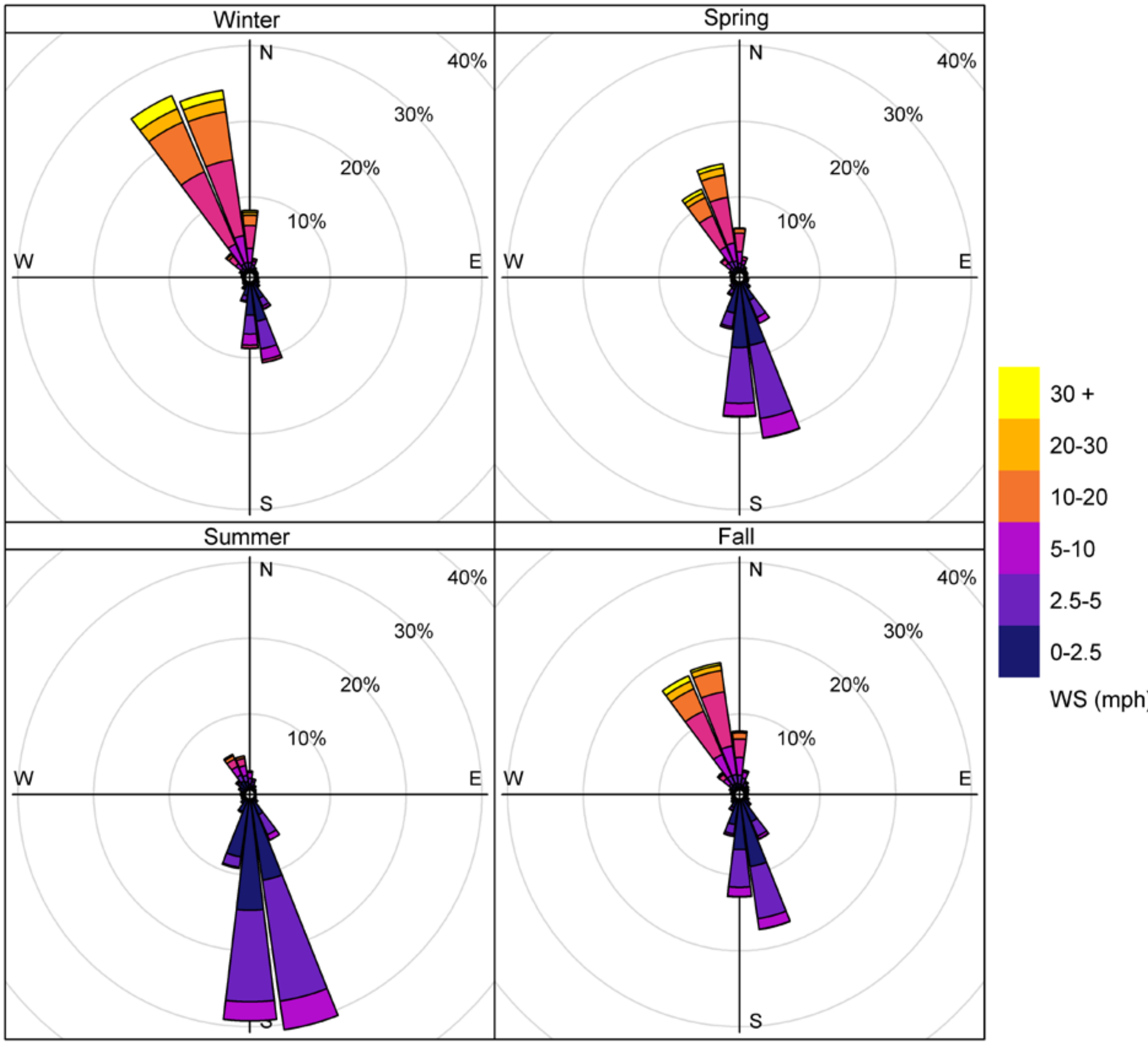


Figure B-4. Seasonal wind roses based on hourly data collected at the Landfill monitor during 2007-2019.

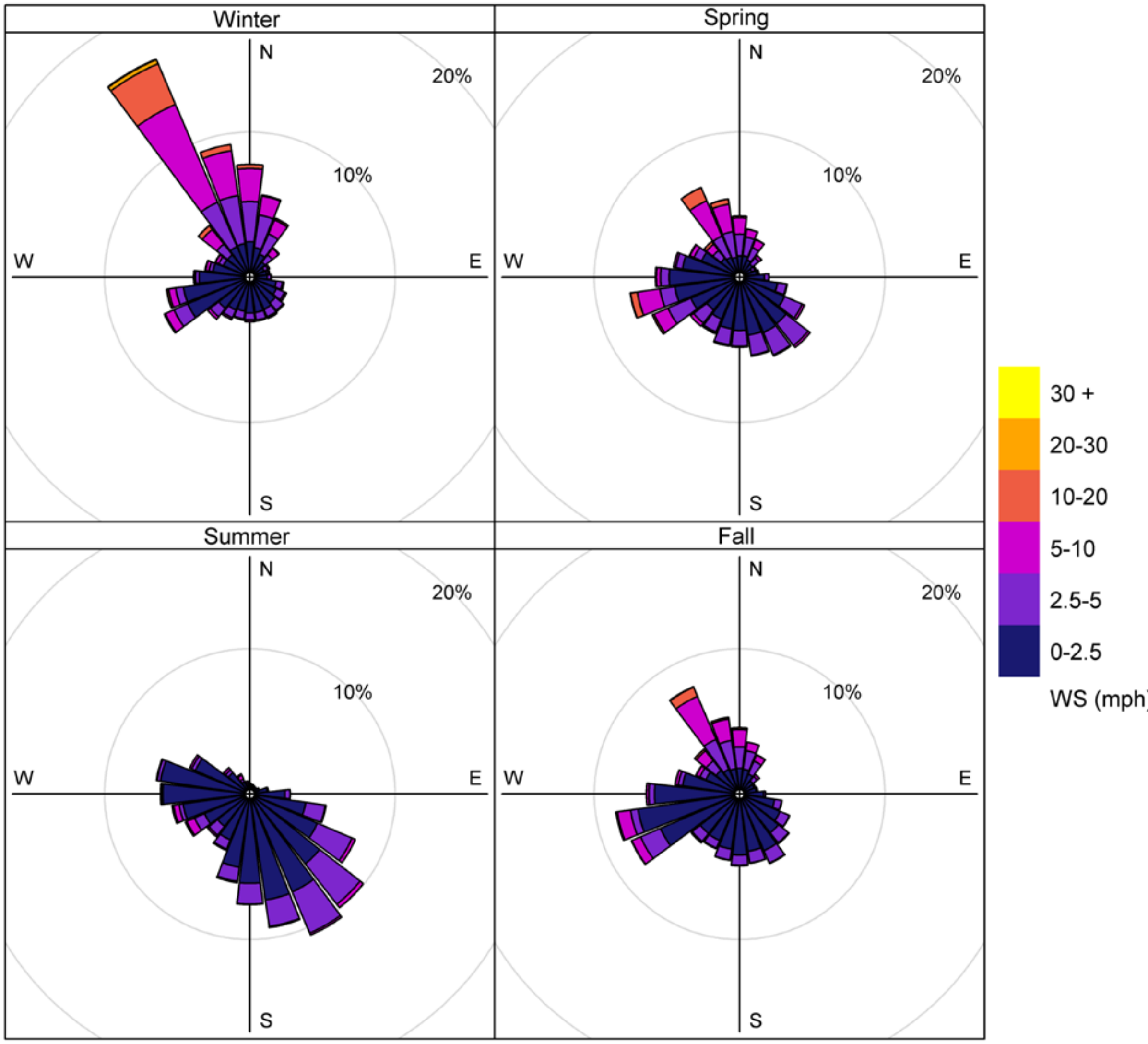


Figure B-5. Seasonal wind roses based on hourly data collected at the Community monitor during 2007-2019. Data since the 11th report year are replaced with wind data from the Reseda site.

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

As shown in **Figure B-6**, 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-7**, 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.

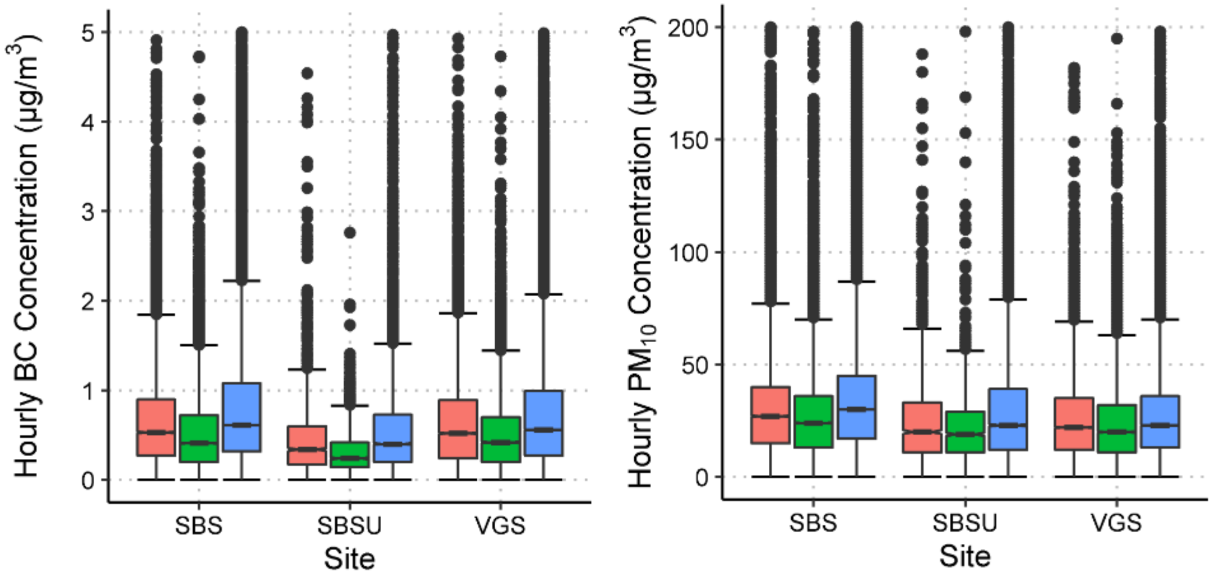


Figure B-6. Hourly BC (left) and PM_{10} (right) concentrations at the Landfill (SBS), Landfill North (SBSU), and Community (VGS) monitoring sites on weekdays (blue), Saturdays (pink), and Sundays (green) from November 22, 2007, through November 21, 2019. Note that this plot includes the Landfill North site, which closed in May 2017. BC data greater than 5 µg/m^3 and PM_{10} data greater than 200 µg/m^3 are excluded.

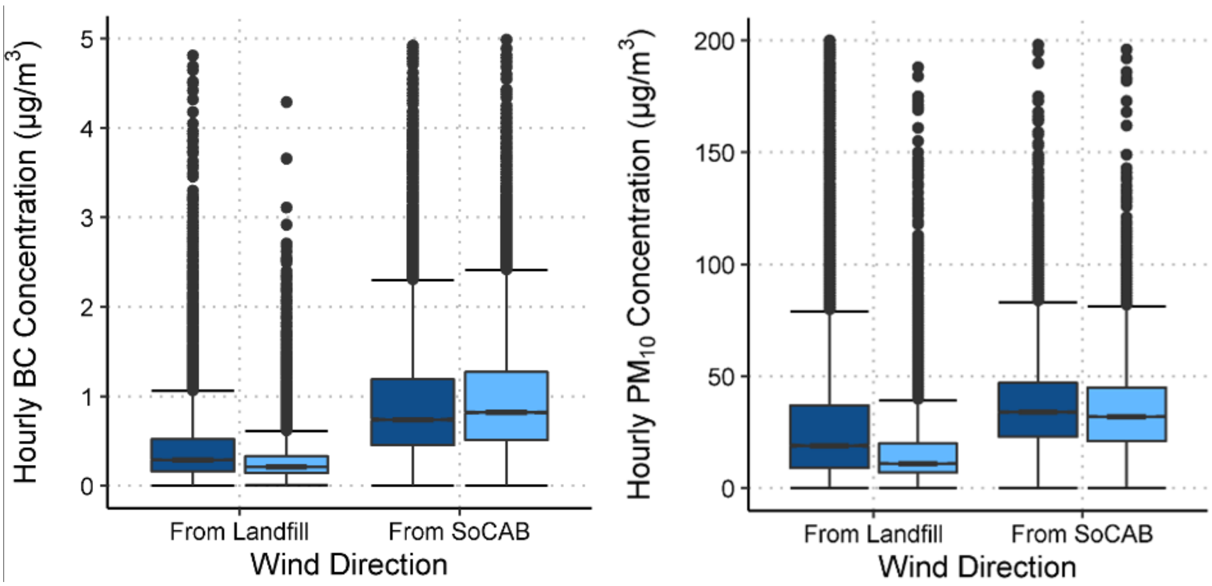


Figure B-7. BC (left) and PM_{10} (right) concentrations at the Landfill (dark blue) and Community (light blue) monitors during November 22, 2007, through November 21, 2019, when winds originate from the Landfill versus when they originate from the SoCAB. Results are based on hourly data points where 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.

B.3 PM_{10} and BC: Landfill vs. Landfill North and Community Sites

The data collected at the new Landfill North site in the ninth and tenth monitoring years 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 B-8 and B-9, respectively.

The following general conclusions are based on the median PM_{10} difference values presented in **Figure B-8**:

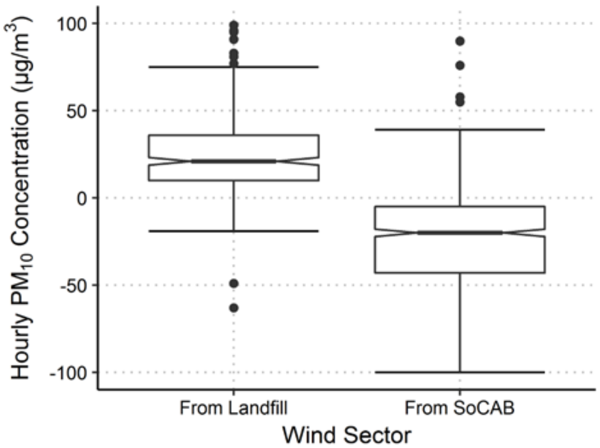
- The greatest difference between the Landfill and Landfill North sites was observed during the periods of highest activity (i.e., working hours on working days, panel (a)). The PM_{10} differences were 22 and -26 μg/m^3 when the winds were from the landfill and from the SoCAB respectively, suggesting 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.

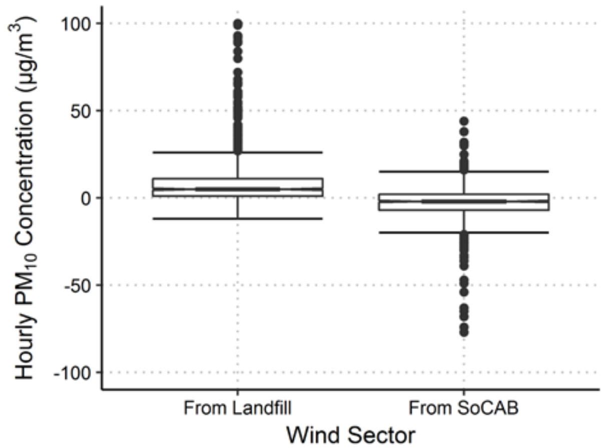
The following general conclusions are based on the median BC difference values presented in **Figure B-9**:

- 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)).

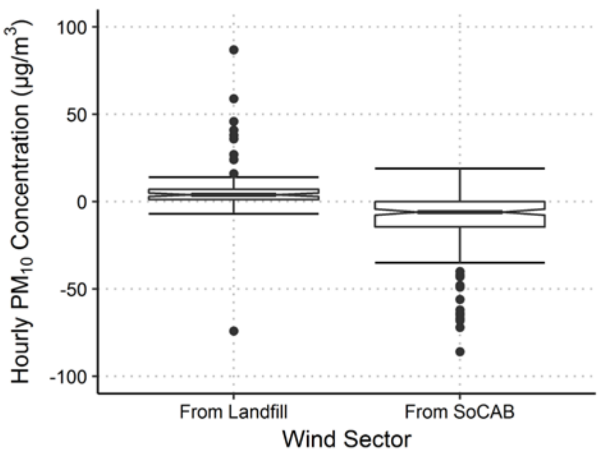
Figure B-10 provides an illustration of landfill impact on PM_{10} and BC concentrations at the downwind site when wind is from either the landfill or the SoCAB as measured at the Landfill site during working hours on working days.



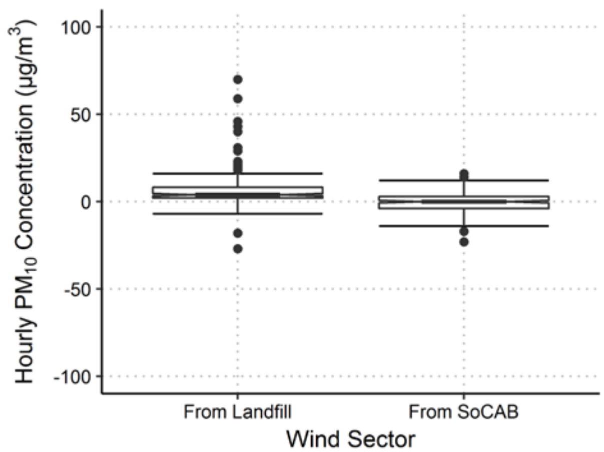
(a) Working hours on working days



(b) Non-working hours on working days

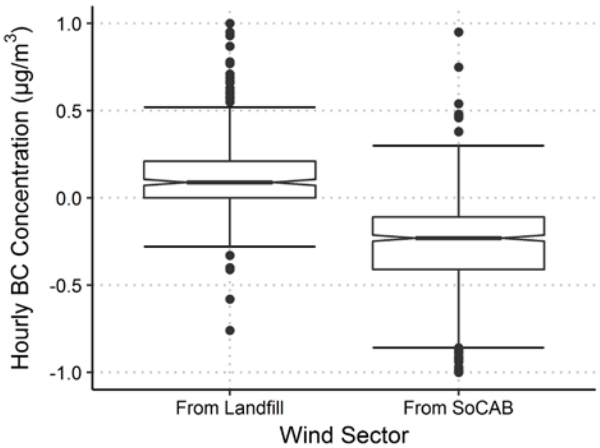


(c) Working hours on non-working days

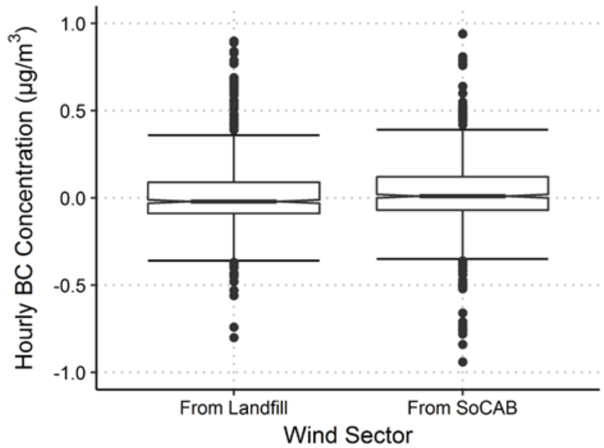


(d) Non-working hours on non-working days

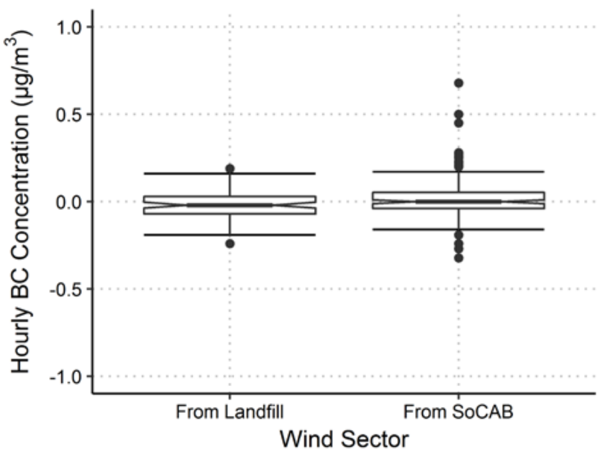
Figure B-8. Notched box plots of the differences in PM_{10} concentrations between the Landfill North and the Landfill sites (Landfill site values – Landfill North site values) for northerly and southerly wind sectors for working and non-working days and for working and non-working hours within those days. Outliers over ±100 $\mu g/m^3$ are not displayed.



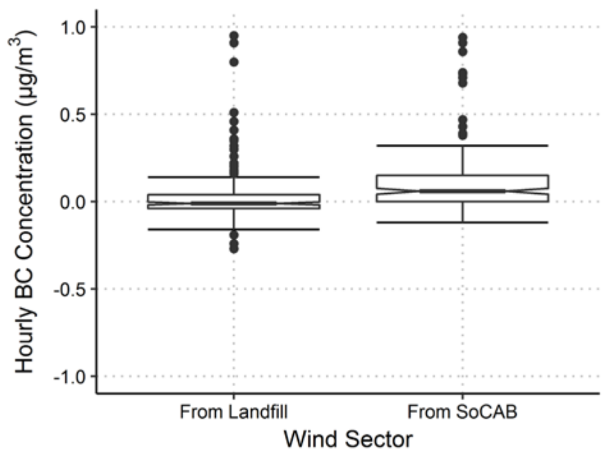
(a) Working hours on working days



(b) Non-working hours on working days



(c) Working hours on non-working days



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

Figure B-9. 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.

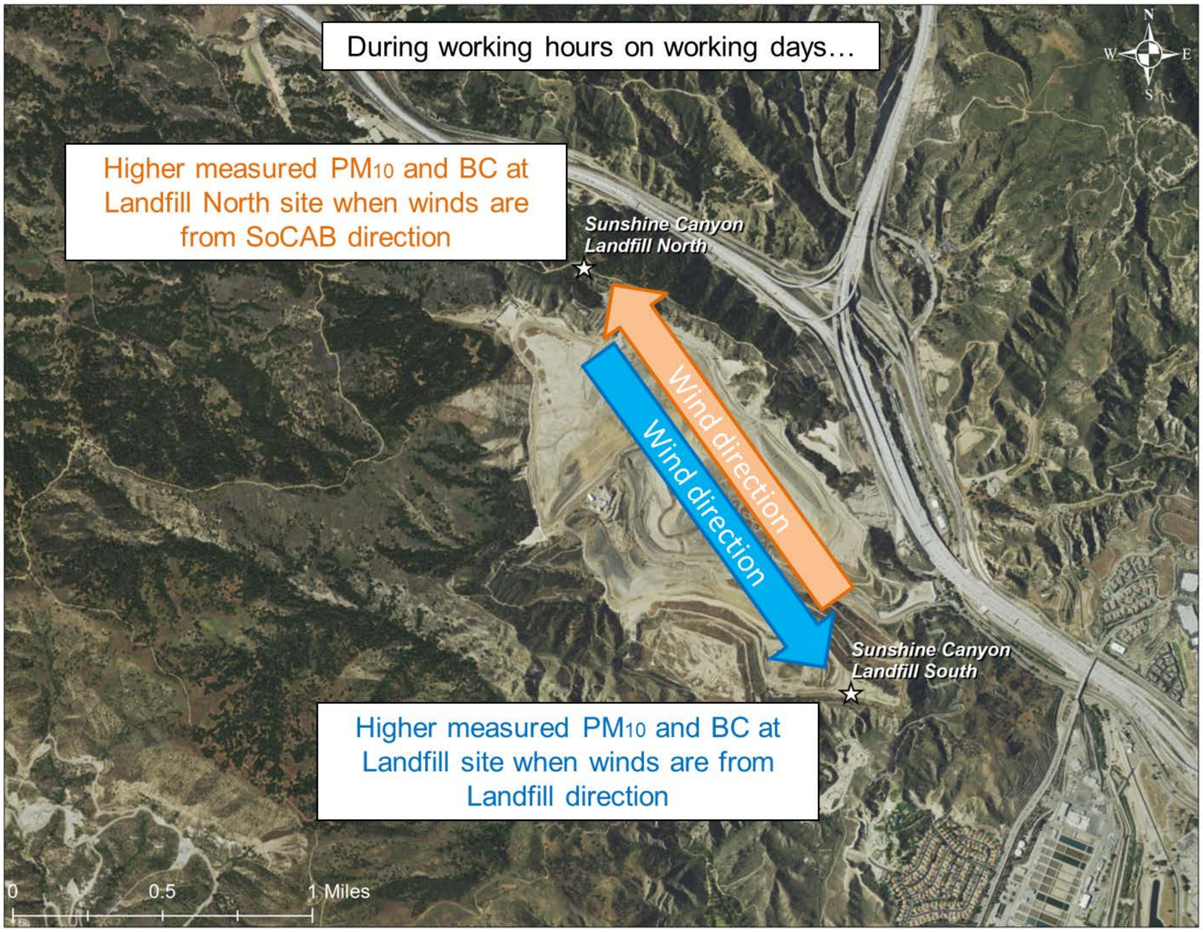


Figure B-10. Map depicting the localized impact of the landfill on PM_{10} and BC concentrations when the wind is from the landfill or the SoCAB as measured at the Landfill site during working hours on working days.

Appendix C: Comparison of Ambient Air Toxics Concentrations to the Final Supplemental Environmental Impact Report

The City's Final Supplemental Environmental Impact Report (FSEIR) reported emissions estimates of pollutants likely to result from landfill operations, modeled by the Industrial Source Complex Short Term (ISCST3) regulatory model. The reported pollutants included a number of hazardous air pollutants (HAPs) but did not include criteria pollutants such as $PM_{2.5}$ or DPM. One year of HAPs measurements were collected at the Landfill and Community sites on a one-in-six day EPA sampling schedule from July 2016 through June 2017. Target HAPs included key air toxics in the MATES IV protocol, such as benzene, tetrachloroethene, 1,3-butadiene, carbon tetrachloride, dichloromethane, ethylbenzene, xylenes, toluene, and trichloroethene, as well as tracers of landfill emissions such as chlorobenzene, dichlorobenzenes, and vinyl chloride.[1]

Table C-1 shows the average concentrations (ppb) measured at both sites during the HAPs measurement campaign. It also shows the average difference between the two sites and the percent difference; in both cases, a negative number indicates the Community site had a higher average concentration than the Landfill site. The FSEIR annual increment shows the modeled annual increment of each pollutant at the "Maximum exposed individual" residence in units of ppb. In almost all cases, the concentration differences and increments are small in absolute terms, with concentrations at or below a few parts per trillion (ppt). The increment is typically much less than 10% of the Community site average. Given the method detection limit of the sampling and analytical methodology of ~6-10 ppt, differences of a few ppt are too small to reliably detect because the sensitivity of the instrument is a few times larger than the value we are trying to detect. The overall concentrations of HAPs in the Sunshine Canyon area are lower than those in most other places in the Los Angeles basin.

[1] McCarthy M.C., O'Brien T.E., Vaughn D.L., Penfold B.M., and Hafner H.R. (2017) Sunshine Canyon VOC and carbonyl monitoring report. Final report prepared for the City of Los Angeles Planning Department, Los Angeles, CA, and the Los Angeles County Department of Regional Planning, Los Angeles, CA, by Sonoma Technology, Inc., Petaluma, CA, STI-916007-6823-FR, November.

Table C-1. Summary statistics for average concentrations (ppb) and differences between the two monitoring sites for HAPs with at least one measurement above detection at the Landfill and Community sites from July 2016 through June 2017. Negative differences indicate values at the Community site are higher than those at the Landfill site. N/A indicates that the HAP is not modeled or reported in the FSEIR.

Parameter	Landfill Site Avg. (ppb)	Community Site Avg. (ppb)	Average Difference (ppb)	% Difference	FSEIR annual increment (ppb)
1,2-Dibromoethane	0.009	0.005	0.003	47.2	0.0000013
1,2-Dichlorobenzene	0.009	0.008	0.001	13.6	0.0018[a]
1,2-Dichloropropane	0.005	0.005	0	-1.9	N/A
1,3-Dichlorobenzene	0.007	0.006	0.001	11.6	0.0018[a]
1,4-Dichlorobenzene	0.013	0.014	0	-3.3	0.0018[a]
Benzene	0.171	0.154	0.017	10.2	0.0019
Benzyl chloride	0.005	0.005	0	-1	0.00029
Carbon tetrachloride	0.104	0.106	-0.003	-2.4	0.000013
Chlorobenzene	0.006	0.006	0	-2.2	0.00060
Chloroform	0.017	0.022	-0.006	-28.4	0.0001
Dichloromethane	0.059	0.057	0.002	3.5	0.0043
Ethylbenzene	0.051	0.06	-0.009	-15.4	N/A
Formaldehyde	2.166	2.087	0.079	3.7	N/A
m,p-Xylenes	0.17	0.195	-0.026	-14	0.033[b]
o-Xylene	0.051	0.06	-0.009	-16.5	0.033[b]
Styrene	0.028	0.025	0.003	13.1	N/A
Tetrachloroethene	0.019	0.012	0.007	44.4	0.0022
Toluene	0.295	0.285	0.01	3.5	0.042
Trichloroethene	0.007	0.006	0.001	16.1	0.000066

[a] FSEIR reported only dichlorobenzene without specifying the isomer; here, we report the sum of dichlorobenzene isomers as shown in FSEIR, but it may be more appropriate to divide the reported 0.0018 ppb increment by 3 to indicate the individual isomer contributions if they occur in equal portions.
[b] FSEIR reported the sum of o, m, and p-xylene isomers as 0.033 ppb. A better estimate is the contribution is 2/3 m- and p-xylene, and 1/3 o-xylene.