APPENDIX 3.3-A, APPENDIX E: LOCALIZED IMPACTS FROM CONSTRUCTION

APPENDIX E: LOCALIZED IMPACTS FROM CONSTRUCTION

1 INTRODUCTION

The San Francisco to San Jose Project Section (Project Section, or project) would involve a variety of construction activities in numerous locations, extending from the 4th and King Street Station in San Francisco to Scott Boulevard in Santa Clara. Because the alignment would pass through urban areas and would require only a limited number of construction techniques (at grade or embankment), the entire length of the alignment was modeled for both construction techniques. In addition, for short-term (less than 24-hour) emissions, one construction activity may occur adjacent to another construction source type and could lead to combined emissions greater than either source alone. Here analysts modeled representative sections of track for each construction activity within each project subsection for the short-term (less than 24-hour) air quality effects. Based on the construction activities and engineering design, the following construction source types were evaluated for the potential to cause localized air quality effects:

- At-grade
- Embankment (berm)

For each of these types of construction activities, maximum activities were determined, and air quality effects were evaluated. This appendix provides additional detail regarding the methods described in the *San Francisco to San Jose Project Section Air Quality and Greenhouse Gases Technical Report* (Air Quality and Greenhouse Gases Technical Report) to which this appendix is attached. This detail includes identification of the pollutants of concern, air quality modeling of the construction sites, determination of the modeled emission rates for the air dispersion modeling, and development of air quality modeling inputs and model output. Air dispersion modeling results were used to predict the ambient effects of criteria pollutant emissions and evaluate these effects with respect to the national ambient air quality standards (NAAQS) and California ambient air quality standards (CAAQS). Health risk calculations were also performed to evaluate the incremental cancer risks and acute and chronic noncancer health effects on residential receptors located near the construction work areas.

2 POLLUTANTS OF CONCERN

Criteria pollutants and toxic air contaminants (TAC)[1] were assessed for localized effects. The following criteria pollutants were considered in this analysis of potential localized effects:[2]

- Carbon monoxide (CO)
- Nitrogen dioxide (NO_2)
- Particulate matter smaller than or equal to 2.5 microns ($PM_{2.5}$)
- Particulate matter smaller than or equal to 10 microns (PM_{10})
- Sulfur dioxide (SO_2)

TACs were analyzed for potential localized effects in terms of health risk. Sources of TACs include construction equipment exhaust and fugitive dust from concrete batch plant processes. The California Air Resources Board (CARB) and the California Office of Environmental Health Hazard Assessment (OEHHA) have identified TACs that may be emitted from these sources. Construction equipment exhaust may contain diesel particulate matter (DPM), and fugitive dust emissions from concrete batch plants may contain a number of toxic pollutants (in particular, heavy metals and sulfates). DPM has been identified by CARB as a TAC based on its potential to cause cancer and other adverse health problems, including respiratory illnesses and increased risk of heart disease. Finally, some criteria pollutants pose acute and chronic health risks (such as NO_2 and SO_2). These pollutants are analyzed for both health effects and their effects relative to air quality standards.

Analyses were conducted that considered chronic (long-term) carcinogenic, chronic noncarcinogenic, and acute (short-term) health risks. These analyses were conducted following Bay Area Air Quality Management District (BAAQMD) guidance. OEHHA modeling guidance was followed for the health risk assessment. Further details on the cancer risk from DPM are discussed in Section 7.10, Construction Health Risk Assessment, of the Air Quality and Greenhouse Gases Technical Report.

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[1] TACs (sometimes referred to as hazardous air pollutants) are non-criteria pollutants that pose health risk.

[2] Ozone and its precursors (reactive organic gases or volatile organic compounds) are classified as regional effects due to the atmospheric transport and chemical conversions that take place over long distances and time scales. Therefore, they were not analyzed in terms of localized effects. Lead emissions were not considered because the mass emissions are negligible and thus unlikely to exceed the ambient air quality standards. Lead was quantified as part of the TACs since it has health toxicity factors.

3 MODELED CONSTRUCTION SITES

As described in Section 7.10 of the Air Quality and Greenhouse Gases Technical Report, the following construction source types were evaluated for the potential to cause localized air quality effects:

- At-grade construction of the rail segment
- Berm construction of the rail segment
- High-speed rail (HSR) stations
- Light maintenance facility

Not all subsections of the Project Section would include all construction source types, but in each subsection, at least one modeling analysis was performed for at least one construction activity. A brief description of the approach and study area for each construction source type is provided in this section. More detailed modeling source parameters are provided in Section 6.4.8 of the Air Quality and Greenhouse Gases Technical Report. In addition to analysis of each of these two construction source types, an analysis was conducted for potential effects from those short-term activities that could be co-located and occur simultaneously in each subsection. This approach assured that the maximum effects would be found, given the likelihood that construction activities could occur simultaneously at the same location.

Berm construction of the rail segment—The construction emissions associated with berm construction include phases such as utility relocation, earth excavation, concrete work preparation, retaining wall construction, form work, and railbed construction. Long-term (annual) emissions associated with berm construction were analyzed for the entire Project Section; however for short-term emissions (maximum daily emissions) modeling over the entire Project Section would not be realistic because combinations of adjacent construction activity types do not occur over the entire length of each subsection. Therefore, localized effects for short-term emissions in each subsection were evaluated for 1,000-foot sections of track where concurrent activity types could take place. Anywhere from one to three track orientations were modeled depending on alignment with receptors located either adjacent or close to the rail line right-of-way.

At-grade construction of the rail segment—The construction emissions associated with at-grade construction include phases such as utility relocation, demolition, cast-in-place drilled pier construction, excavation for slurry wall, base slab formwork, and pouring o concrete slab and walls. As in the case for berm construction, the at-grade construction were modeled for the entire Project Section for long-term (annual) activity; however for short-term emissions (maximum daily emissions) modeling over the entire Project Section would not be practical because combinations of adjacent construction activity types would not occur over the length of each subsection. Therefore, localized effects for short-term emissions in each subsection were evaluated for 1,000-foot sections of track where concurrent construction activity types could take place. Anywhere from one to three track orientations were modeled depending on alignment, with receptors located either adjacent or close to the rail line right-of-way.

4 CONSTRUCTION EMISSIONS AND EMISSION RATES

Air quality analyses were performed for two types of construction emission scenarios: (1) long-term (annual) emissions that characterized maximum annual average activity for each construction year (2021–2025) and source type of construction by subsection and (2) short-term emissions that characterized the maximum daily emissions for each subsection and source type of construction. All emissions analysis accounted for impact avoidance and minimization features described in Section 2.4, Impact Avoidance and Minimization Features, of the Air Quality and Greenhouse Gases Technical Report. The methods for modeling of each source type and determination of the maximum emission rate addressed both long-term and short-term emissions.

4.1 Long-Term (Annual) Emissions

Long-term construction emissions were modeled as follows.

- Characterize berm and at-grade emissions as area sources.
- Determine the annual emissions for each source type and calculate the maximum annual criteria pollutant emissions for each of the 5 years (2021–2025).
- Use the information from the engineering construction analysis for the linear distance of construction for each source type and calculate the source-type emissions for the particular linear length for the AERMOD-modeled subsection.
- Express the emissions in units of grams per second (g/s) using an activity level of 250 days a year and 8 hours a day.
- Determine the maximum on-site emission density for each pollutant using the maximum year emission rate.
- Include the off-site activity (e.g., haul trucks) and include adjacent emission density for each modeled area source using a width of 12 feet. Maximum ballast-hauling emissions are included in the off-site modeling.

4.2 Short-Term (Less than 24-hour) Emissions

Short-term (less than 24-hour) construction emissions were modeled as follows.

- Determine the maximum daily emissions for each construction activity subsection (e.g., berm activity concrete work and retaining walls may be done concurrently, as well as formwork and earthwork)
- For each subsection, determine the maximum daily emissions from among the 5 years (2021–2025)
- Each construction subsection is resolved to 1,000 linear feet within the engineering construction analysis. To determine the emissions density for the AERMOD air dispersion modeling (Section 5, Dispersion Modeling), divide the maximum daily emissions for each subsection by the total number of 1,000-foot segments.
- Express the emissions from pounds per day to g/s assuming 8 hours a day
- Determine the emission density for each modeled subsection, model the subsection, and combine concentration results for activities that may occur in parallel.

5 DISPERSION MODELING

Because the construction activities of the Project Section have the potential to cause adverse health effects, detailed dispersion modeling analyses were conducted to determine whether these effects would be significant. The U.S. Environmental Protection Agency's (USEPA) AERMOD atmospheric dispersion model was used to simulate physical conditions and predict pollutant concentrations near the construction work areas using historical meteorological data. This allowed for an assessment of the local air quality effects from the construction emissions.

AERMOD is the USEPA's recommended air dispersion model for near-field modeling from vented and unvented (fugitive) sources. The model uses hourly meteorological observations and emission rates to determine hourly average concentrations from which other averaging periods (3-hour, 24-hour, annual averages) are determined. The detailed information on the methods and data used to conduct the air dispersion modeling is summarized here and in Section 6.4.8, Construction Health Risk Assessment, and Section 6.4.9, Other Localized Construction Effects, of the Air Quality and Greenhouse Gases Technical Report.

5.1 Inputs

5.1.1 Model and Inputs

AERMOD (version 18081) was used to conduct the modeling analysis. All calculation inputs are identical between the simulations used in the health risk assessments and for air quality (those used for comparison of the NAAQS and CAAQS), except for site-specific health risk receptor placement, which was located at the nearest residential locations. The modeling used terrain height information in the analysis. No removal through deposition of air contaminants was considered, and the FASTAREA computation method was used for all area sources. AERMOD's urban dispersion option was used in the analysis for all locations.

5.1.2 Meteorological Data

AERMOD requires meteorological data as input into the model. These data are typically processed using AERMET and AERSURFACE, preprocessors to AERMOD. AERMET requires surface meteorological data, upper air meteorological data, and surface parameter data (supplied from AERSURFACE).

The BAAQMD has available meteorological preprocessed data based on observations from San Jose International Airport for surface observations and Metropolitan Oakland International Airport for upper air data. Five years of meteorological data (2009–2013) were used in a portion of the Mountain View to Santa Clara analysis.

The BAAQMD had meteorological data available from an instrumented tower located in Mission Bay for the period 2008–2012. Use of this data required AERMET processing for use in the AERMOD model.

5.1.2.1 Mission Bay

Meteorological data used in the creation of the Mission Bay AERMET data for input to AERMOD are shown in Table 1.

Table 1 Meteorological Data for AERMET Processing at the Mission Bay Site

Site ID	Site Name	Latitude (deg N)	Longitude (deg W)	Elevation (m)	Source of Data
5803	Mission Bay	37.773	-122.395	2.0	BAAQMD
23234/KSFO	San Francisco Int'l Airport	37.362	-112.365	2.4	ftp://ftp.ncdc.noaa.gov/pub/data/noaa/

Site ID	Site Name	Latitude (deg N)	Longitude (deg W)	Elevation (m)	Source of Data
23230/OAK	Metropolitan Oakland Int'l Airport	37.75	-122.220	6	http://esrl.noaa.gov/raobs/
045378	Martinez Water Treatment Plant	38.017	-122.167	0.1	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca5378

Sources: BAAQMD 2017; NOAA 2017a, 2017b; WRCC 2017
BAAQMD = Bay Area Air Quality Management District
deg N = degrees north
deg W = degrees west
Int'l = International
m = meters

The surface data for the Mission Bay site were obtained from BAAQMD in the ONSITE format required by AERMET for the period 2008–2012. These data were used to represent the surface meteorological condition portion of AERMET. Upon the suggestion of the BAAQMD (Cordova 2015; BAAQMD 2016), data from San Francisco International Airport were used for cloud cover when processing the ONSITE data, the precipitation data from the Martinez Water Treatment Plant were used to determine surface moisture conditions to be used in AERSURFACE, and the data from the Oakland upper-air site at Metropolitan Oakland International Airport were used to represent conditions aloft.

AERSURFACE Processing

The National Land Cover Dataset 1992 (NLCD92) (Vogelmann et al. 2001) was downloaded[3] and used with AERSURFACE (version 13016) to provide the surface parameters needed for the third stage of AERMET. The coordinates of the Mission Bay BAAQMD meteorological site were used to determine surface characteristics in AERSURFACE. AERSURFACE was run with specifications that the area was not arid and that the site was not at an airport. Per the BAAQMD's recommendation (Cordova 2015; BAAQMD 2016), four sectors were used for Mission Bay processing to account for variations in land cover near the measurement site:

- SECTOR 1: 10-51 degrees
- SECTOR 2: 51-124 degrees
- SECTOR 3: 124-287 degrees
- SECTOR 4: 287-10 degrees

The study radius for surface roughness was set at 1 kilometer. The monthly seasonal profile used is based on data from the BAAQMD Mission Bay meteorological monitoring site and is shown in Table 2.

Table 2 Monthly Seasonal Profile at the Mission Bay Site

Months	Season
November, December, January	Late autumn after frost and harvest or winter with no snow
February, March	Transitional spring with partial green coverage or short annuals
April, May, June, July	Midsummer with lush vegetation
August, September, October	Autumn with unharvested cropland

AERSURFACE was run separately specifying dry, average, and wet surface moisture, and the results were later used to create composite surface characteristics for the third stage of AERMET.

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[3] Available at: http://landcover.usgs.gov/natllandcover.php

Determination of Dry, Average, and Wet Months

Based on recommendations from the BAAQMD (Cordova 2015; BAAQMD 2016) and information provided in the AERSURFACE users' guide, each month in the modeling period was classified as either dry, average, or wet, and this information was later used in Stage 3 of AERMET. The rainfall data for the Martinez Water Treatment Plant for the 30-year period ending 2016 were gathered, and 30-year monthly averages were computed for each month. The monthly statistics for a given month were not used in the average if more than 5 days of data were missing in a given month. The next step was to compute the ratio of the monthly precipitation total for a given month during the modeling period and the corresponding 30-year monthly average. If the ratio was less than 0.5, the month was designated as dry. If the ratio was greater than or equal to 0.5 but less than 2, the month was designated as average. If the ratio was greater than or equal to 2, the month was designated as wet.

Three of the months (May 2011, October 2011, and January 2012) were missing sufficient data to compute the averages and ratios. For these months, averages and/or persistence of the categories of the surrounding months were used to designate the month in question. Table 3 shows the moisture classification of the region.

Table 3 Precipitation at the Martinez Water Plant Climate Site

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008	7.79	1.98	0.03	0.05	0.01	0	0	0	0	0.15	2.13	2.02
2009	1.05	6.18	2.62	1.39	0.66	0	0	0	0.11	4	0.64	2.72
2010	6.43	2.4	2.01	3.19	1.08	0	0	0	0	1.01	2.21	5.5
2011	1.52	4.63	6.99	0.21	-----	2.52	0	0	0	-----	1.08	0.06
2012	-----	1.07	5.16	2.94	0	0.03	0	0	0	1.25	0.24	6.51
30-year mean (1987–2016)	3.62	3.51	2.40	1.24	0.61	0.16	0.00	0.03	0.11	0.90	1.96	3.91
Ratio to 30-Year Mean												
2008	2.15	0.56	0.01	0.04	0.02	0.00	0.00	0.00	0.00	0.17	1.09	0.52
2009	0.29	1.76	1.09	1.12	1.09	0.00	0.00	0.00	1.01	4.44	0.33	0.70
2010	1.78	0.68	0.84	2.57	-----	0.00	0.00	0.00	0.00	1.12	1.13	1.41
2011	0.42	1.32	2.91	0.17	7.93	15.68	0.00	0.00	0.00	-----	0.55	0.02
2012	-----	0.30	2.15	2.37	0.00	0.19	0.00	0.00	0.00	1.39	0.12	1.67
Moisture Classification												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008	wet	avg	dry	dry	dry	dry	dry	dry	dry	dry	avg	avg
2009	dry	avg	avg	avg	avg	dry	dry	dry	avg	wet	dry	avg
2010	avg	avg	avg	wet	avg	dry	dry	dry	dry	avg	avg	avg
2011	dry	avg	wet	dry	avg	wet	dry	dry	dry	dry	avg	dry
2012	dry	dry	wet	wet	dry	dry	dry	dry	dry	avg	dry	avg

Source: WRCC 2017
avg = average
in = inches

AERMET

Version 16126 of AERMET was used to process the meteorological data. The first step used data from the Oakland upper-air soundings with the MODIFY option turned on. San Francisco International Airport data were used for the SURFACE portion of the processing, and Mission Bay on-site data were used for the ONSITE portion. The missing flags were set per BAAQMD recommendations (Cordova 2015; BAAQMD 2016) and are shown in Tables 4 and 5.

Table 4 AERMET Single-Value and Date/Time Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
OSDY	Day		-9	1	<=	31
OSMP	Month		-9	1	<=	12
OSYR	Year		-9	0	<=	99
OSHR	Hour		-9	0	<=	24
PAMT	Precipitation	cm	999	0	<=	100
INSO	Insolation	watts/square meter	9999	0	<	1250

Sources: Cordova 2015; BAAQMD 2016; USEPA 2016
cm = centimeters

Table 5 AERMET Multi-Value Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
TT01	Temperature	degrees Centigrade	99	-30	<	46
WS01	Wind speed	meters/second	999	0	<	50
WD01	Wind direction	degrees from north	999	0	<=	360
RH01	Relative humidity	percent	999	0	<=	100
DP01	Dew-point temperature	degrees Centigrade	99	-65	<	35
SA01	Standard deviation horizontal wind	degrees	999	0	<	104

Sources: Cordova 2015; BAAQD 2016; USEPA 2016

The second step was a simple merging of the quality assurance files produced from step one. The third step was to set the following option per BAAQMD suggestion (Cordova 2015; BAAQMD 2016):

- METHOD TEMP SUB_TT was turned on; therefore, temperature substitution from the NWS site was performed.

This final step was repeated separately for each of the 5 years. The surface characteristics portions of the input files were created by using the AERSURFACE output corresponding to the moisture characteristics of each month and year. The output message and report files were checked for error messages. The error messages were examined and the errors were corrected when possible. Warning messages were also reviewed. In some cases, changes in inputs were made based on warnings (e.g., discrepancies in elevations provided in site list files and in the actual data). In other cases, they were left unchanged (e.g., variations in elevations throughout the data files). Other warnings regarding missing data and substituted data were noted, but no changes were made to the data.

5.1.2.1 San Francisco Sewage Treatment Plant

The BAAQMD had representative meteorological data available from an instrumented tower located at the San Francisco Sewage Treatment Plant for the periods 2010–2011 and 2014–2016. Use of this data required AERMET processing for use in the AERMOD model. Meteorological data used in the creation of the San Francisco Sewage Treatment Plant AERMET data for input to AERMOD are shown in Table 6.

Table 6 Meteorological Data for AERMET Processing at the San Francisco Sewage Treatment Plant Site

Site ID	Site Name	Latitude (deg N)	Longitude (deg W)	Elevation (m)	Source of Data
5802	SF Sanitary Fill	37.709	-122.399	24.4	BAAQMD
23234/KSFO	San Francisco Int'l Airport	37.362	-112.365	2.4	ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
23230/OAK	Metropolitan Oakland Int'l Airport	37.75	-122.220	6	http://esrl.noaa.gov/raobs/
047769	San Francisco Int'l Airport	37.362	-112.365	6	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7769

Sources: BAAQMD 2017; NOAA 2017a, 2017b; WRCC 2017
BAAQMD = Bay Area Air Quality Management District
deg N = degrees north
deg W = degrees west
Int'l = International
m = meters
SF = San Francisco

The surface data for the San Francisco Sewage Treatment Plant site were obtained from BAAQMD in the ONSITE format required by AERMET for the periods 2004 and 2007–2009. The data were used to represent the surface meteorological condition portion of AERMET. Data completion collected from 2005–2009 were not sufficient for processing into a complete meteorological dataset. Upon the suggestion of the BAAQMD (Cordova 2015; BAAQMD 2016), data from San Francisco International Airport were used for cloud cover when processing the ONSITE data and for the precipitation data from used to determine surface moisture conditions to be used in AERSURFACE, and the data from the Oakland upper-air site at Metropolitan Oakland International Airport were used to represent conditions aloft.

AERSURFACE Processing

The NLCD92 (Vogelmann et al. 2001) was downloaded and used with AERSURFACE (version 13016) to provide the surface parameters for the third stage of AERMET. The coordinates of the San Francisco Sewage Treatment Plant BAAQMD meteorological site were used to determine surface characteristics in AERSURFACE. AERSURFACE was run with specifications that the area was not arid and that the site was not at an airport. To account for variations in land cover near the San Francisco Sewage Treatment Plant site, measurement data were processed using twelve 30-degree sectors per the BAAQMD's recommendation (Cordova 2015; BAAQMD 2016).

The study radius for surface roughness was set at 1 kilometer. The monthly seasonal profile used is shown in Table 7.

Table 7 Monthly Seasonal Profile at the San Francisco Sewage Treatment Plant Site

Months	Season
November, December, January	Late autumn after frost and harvest or winter with no snow
February, March	Transitional spring with partial green coverage or short annuals
April, May, June, July	Midsummer with lush vegetation
August, September, October	Autumn with unharvested cropland

AERSURFACE was run separately specifying dry, average, and wet surface moisture, and the results were later used to create composite surface characteristics for the third stage of AERMET.

Determination of Dry, Average, and Wet Months

Based on recommendations from BAAQMD (Cordova 2015; BAAQMD 2016) and information provided in the AERSURFACE users' guide, each month in the modeling period was classified as either dry, average, or wet, and this information was later used in Stage 3 of AERMET. The rainfall data for the San Francisco International Airport for the 30-year period ending 2016 were gathered, and 30-year monthly averages were computed for each month. The monthly statistics for a given month were not used in the average if more than 5 days of data were missing in a given month. The next step was to compute the ratio of the monthly precipitation total for a given month during the modeling period and the corresponding 30-year monthly average. If the ratio was less than 0.5, the month was designated as dry. If the ratio was greater than or equal to 0.5 but less than 2, the month was designated as average. If the ratio was greater than or equal to 2, the month was designated as wet. Table 8 shows the moisture classification of the region.

Table 8 Precipitation at the San Francisco International Airport Site

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2004	3.02	4.57	0.67	0.1	0.07	0	0	0	0.04	3.19	1.22	6.42
2007	0.65	4.14	0.27	1.14	0.09	0	0.01	0	0.15	1.97	0.58	2.65
2008	7.83	2.04	0.23	0.03	0	0	0	0.01	0	0.32	1.82	2.36
2009	0.69	6.4	2.35	0.27	0.36	0.04	0	0	0.27	2.96	0.2	3.07
30-year mean (1987–2016)	3.59	3.70	2.55	1.27	0.47	0.16	0.00	0.04	0.11	0.88	1.98	4.24
Ratio to 30-Year Mean												
2004	0.84	1.23	0.26	0.08	0.15	0.00	0.00	0.00	0.36	3.63	0.62	1.51
2007	0.18	1.12	0.11	0.90	0.19	0.00	15.00	0.00	1.33	2.24	0.29	0.63
2008	2.18	0.55	0.09	0.02	0.00	0.00	0.00	0.28	0.00	0.36	0.92	0.56
2009	0.19	1.73	0.92	0.21	0.77	0.25	0.00	0.00	2.40	3.37	0.10	0.72
Moisture Classification												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2004	avg	avg	dry	dry	dry	dry	dry	dry	dry	wet	avg	avg
2007	dry	avg	dry	avg	dry	dry	wet	dry	avg	wet	dry	avg

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008	wet	avg	dry	dry	dry	dry	dry	dry	dry	dry	avg	avg
2009	dry	avg	avg	dry	avg	dry	dry	dry	wet	wet	dry	avg

Source: WRCC 2017
avg = average
in = inches

AERMET

Version 16126 of AERMET was used to process the meteorological data. The first step used data from the Oakland upper-air soundings with the MODIFY option turned on. San Francisco International Airport data were used for the SURFACE portion of the processing, and San Francisco Sanitary Landfill on-site data were used for the ONSITE portion. The missing flags were set per BAAQMD recommendations (Cordova 2015; BAAQMD 2016) and are shown in Tables 9 and 10.

Table 9 AERMET Single-Value and Date/Time Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
OSDY	Day		-9	1	<=	31
OSMP	Month		-9	1	<=	12
OSYR	Year		-9	0	<=	99
OSHR	Hour		-9	0	<=	24
PAMT	Precipitation	cm	999	0	<=	100
INSO	Insolation	watts/square meter	9999	0	<	1250

Sources: Cordova 2015; BAAQMD 2016; USEPA 2016
cm = centimeters

Table 10 AERMET Multi-Value Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
TT01	Temperature	degrees Centigrade	99	-30	<	46
WS01	Wind speed	meters / second	999	0	<	50
WD01	Wind direction	degrees from north	999	0	<=	360
RH01	Relative humidity	percent	999	0	<=	100
DP01	Dew-point temperature	degrees Centigrade	99	-65	<	35
SA01	Standard deviation, horizontal wind	degrees	999	0	<	104

Source: Cordova 2015; BAAQD 2016; USEPA 2016

The second step was a simple merging of the quality assurance files produced from step one. The third step was to set the following option per BAAQMD suggestion (Cordova 2015; BAAQMD 2016):

- METHOD TEMP SUB_TT was turned on; therefore, temperature substitution from the NWS site was performed.

This final step was repeated separately for each of the 5 years. The surface characteristics portions of the input files were created by using the AERSURFACE output corresponding to the moisture characteristics of each month and year. The output message and report files were checked for error messages. The error messages were examined and the errors were corrected when possible. Warning messages were also reviewed. In some cases, changes in inputs were made based on warnings (e.g., discrepancies in elevations provided in site list files and in the actual data). In other cases, they were left unchanged (e.g., variations in elevations throughout the data files). Other warnings regarding missing data and substituted data were noted, but no changes were made to the data

5.1.2.2 San Francisco International Airport

The National Weather Service collected representative meteorological data available from an instrumented tower located in San Francisco International Airport for the period 2011–2015. Use of this data required AERMET processing for use in the AERMOD model. Meteorological data used in the creation of the San Francisco International Airport AERMET data for input to AERMOD are shown in Table 11.

Table 11 Meteorological Data for AERMET Processing at the San Francisco International Airport

Site ID	Site Name	Latitude (deg N)	Longitude (deg W)	Elevation (m)	Source of Data
23234/KSFO	San Francisco Int'l Airport	37.362	-112.365	2.4	ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
23234/KSFO	San Francisco Int'l Airport	37.362	-112.365	2.4	1-min ASOS data: ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/
23230/OAK	Metropolitan Oakland Int'l Airport	37.75	-122.220	6	http://esrl.noaa.gov/raobs/
047769	San Francisco Int'l Airport	37.362	-112.365	6	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7769

Sources: BAAQMD 2017; NOAA 2017a, 2017b; WRCC 2017
BAAQMD = Bay Area Air Quality Management District
deg N = degrees north
deg W = degrees west
Int'l = International
m = meters

The surface data for the San Francisco International Airport site were obtained from the National Weather Service as 1-minute data processed using AERMINUTE for wind data and the remaining surface meteorological data were obtained from the 1-hour NWS integrated hourly surface data files for the period 2011–2015. These represent the surface meteorological conditions portion of AERMET. Upon the suggestion of the BAAQMD (Cordova 2015; BAAQMD 2016), data from San Francisco International Airport were used for cloud cover and for the precipitation and to determine surface moisture conditions to be used in AERSURFACE. Data from the Oakland upper-air site at Metropolitan Oakland International Airport were used to represent conditions aloft.

AERSURFACE Processing

The NLCD92 (Vogelmann et al. 2001) was downloaded and used with AERSURFACE (version 13016) to provide the surface parameters needed for the third stage of AERMET. The coordinates of the San Francisco International Airport meteorological site were used to determine surface characteristics in AERSURFACE. AERSURFACE was run with specifications that the area was not arid and that the site was at an airport. Per the BAAQMD's recommendation (Cordova 2015; BAAQMD 2016), twelve 30-degree sectors were used for San Francisco International Airport to account for variations in land cover near the measurement site. The study radius for surface roughness was set at 1 kilometer. The monthly seasonal profile used is shown in Table 12.

Table 12 Monthly Seasonal Profile at the San Francisco Sewage Treatment Plant Site

Months	Season
November, December, January	Late autumn after frost and harvest or winter with no snow
February, March	Transitional spring with partial green coverage or short annuals
April, May, June, July	Midsummer with lush vegetation
August, September, October	Autumn with unharvested cropland

AERSURFACE was run separately specifying dry, average, and wet surface moisture, and the results were later used to create composite surface characteristics for the third stage of AERMET.

Determination of Dry, Average, and Wet Months

Based on recommendations from the BAAQMD (Cordova 2015; BAAQMD 2016) and information provided in the AERSURFACE users' guide, each month in the modeling period was classified as either dry, average, or wet, and this information was later used in Stage 3 of AERMET. The rainfall data for the San Francisco International Airport for the 30-year period ending 2016 were gathered, and 30-year monthly averages were computed for each month. The monthly statistics for a given month were not used in the average if more than 5 days of data were missing in a given month. The next step was to compute the ratio of the monthly precipitation total for a given month during the modeling period and the corresponding 30-year monthly average. If the ratio was less than 0.5, the month was designated as dry. If the ratio was greater than or equal to 0.5 but less than 2, the month was designated as average. If the ratio was greater than or equal to 2, the month was designated as wet. Table 13 shows the moisture classification of the region.

Table 13 Precipitation at the San Francisco International Airport Site

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2011	0.94	4.79	5.7	0.33	0.47	1.49	0	0	0.01	1.18	1.55	0.13
2012	2.16	0.66	4.76	2.79	0	0.09	0	0	0	0.7	4.06	6.24
2013	0.2	0.67	0.49	0.47	0.01	0.05	0	0	0.23	0	0.91	0.35
2014	0.01	3.76	1.93	1.61	0	0	0	0	0.42	0.31	1.99	10.66
2015	0.00	2.01	0.06	1.28	0.02	0.26	0	0	0.02	0	1.42	3.37
30-year mean (1987–2016)	3.59	3.70	2.55	1.27	0.47	0.16	0.00	0.04	0.11	0.88	1.98	4.24

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ratio to 30-Year Mean												
2011	0.26	1.29	2.23	0.26	1.01	9.27	0.00	0.00	0.09	1.34	0.78	0.03
2012	0.60	0.18	1.86	2.20	0.00	0.56	0.00	0.00	0.00	0.80	2.05	1.47
2013	0.06	0.18	0.19	0.37	0.02	0.31	0.00	0.00	2.04	0.00	0.46	0.08
2014	0.00	1.02	0.76	1.27	0.00	0.00	0.00	0.00	3.73	0.35	1.01	2.51
2015	0.00	0.54	0.02	1.01	0.04	1.62	0.00	0.00	0.18	0.00	0.72	0.79
Moisture Classification												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2011	dry	avg	wet	dry	avg	wet	dry	dry	dry	avg	avg	dry
2012	avg	dry	avg	wet	dry	avg	dry	dry	dry	avg	wet	avg
2013	dry	dry	dry	dry	dry	dry	dry	dry	wet	dry	dry	dry
2014	dry	avg	avg	avg	dry	dry	dry	dry	wet	dry	avg	wet
2015	dry	avg	dry	avg	dry	avg	dry	dry	dry	dry	avg	avg

Source: WRCC 2017
avg = average
in = inches

AERMET

Version 16126 of AERMET was used to process the meteorological data. The first step used data from the Oakland upper-air soundings with the MODIFY option turned on. San Francisco International Airport data were used for the SURFACE portion of the processing, and San Francisco International Airport on-site data were used for the ONSITE portion for cloud cover and temperature. AERMINUTE Version 15272 was run using the 1-minute San Francisco International Airport observational data to create the hourly average wind data The missing flags were set per BAAQMD recommendations (Cordova 2015; BAAQMD 2016) and are shown in Tables 14 and 15.

Table 14 AERMET Single-Value and Date/Time Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
OSDY	Day		-9	1	<=	31
OSMP	Month		-9	1	<=	12
OSYR	Year		-9	0	<=	99
OSHR	Hour		-9	0	<=	24
PAMT	Precipitation	cm	999	0	<=	100
INSO	Insolation	watts/square meter	9999	0	<	1250

Sources: Cordova 2015; BAAQMD 2016; USEPA 2016

Table 15 AERMET Multi-Value Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
TT01	Temperature	degrees Centigrade	99	-30	<	46
WS01	Wind speed	meters / second	999	0	<	50
WD01	Wind direction	degrees from north	999	0	<=	360
RH01	Relative humidity	percent	999	0	<=	100
DP01	Dew-point temperature	degrees Centigrade	99	-65	<	35
SA01	Standard deviation horizontal wind	degrees	999	0	<	104

Source: Cordova 2015; BAAQD 2016; USEPA 2016

The second step was a simple merging of the quality assurance files produced from step one. The third step was to set the following options per BAAQMD suggestion (Cordova 2015; BAAQMD 2016):

- METHOD TEMP SUB_TT was turned on, therefore, temperature substitution from the NWS site was performed.
- METHOD WIND_DIR RANDOM, was included to randomize the NWS wind directions.

This final step was repeated separately for each of the 5 years. The surface characteristics portions of the input files were created by using the AERSURFACE output corresponding to the moisture characteristics of each month and year. The output message and report files were checked for error messages. The error messages were examined and the errors were corrected when possible. Warning messages were also reviewed. In some cases, changes in inputs were made based on warnings (e.g., discrepancies in elevations provided in site list files and in the actual data). In other cases, they were left unchanged (e.g., variations in elevations throughout the data files). Other warnings regarding missing data and substituted data were noted, but no changes were made to the data.

5.1.2.3 San Mateo Sewage Treatment Plant

The BAAQMD had representative meteorological data available from an instrumented tower located in San Mateo Sewage Treatment Plant for the period 2011–2015. Use of this data required AERMET processing for use in the AERMOD model. Meteorological data used in the creation of the San Mateo Sewage Treatment Plant AERMET data for input to AERMOD are shown in Table 16.

Table 16 Meteorological Data for AERMET Processing at the San Mateo Sewage Treatment Plant

Site ID	Site Name	Latitude (deg N)	Longitude (deg W)	Elevation (m)	Source of Data
6801	San Mateo Sewage Treatment Plant	37.570	-122.295	9.0	BAAQMD
23234/KSFO	San Francisco Int'l Airport	37.362	-112.365	2.4	ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
23230/OAK	Metropolitan Oakland Int'l Airport	37.75	-122.220	6	http://esrl.noaa.gov/raobs/
047769	San Francisco Int'l Airport	37.362	-112.365	6	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7769

Sources: BAAQMD 2017; NOAA 2017a, 2017b; WRCC 2017
BAAQMD = Bay Area Air Quality Management District
deg N = degrees north
deg W = degrees west
Int'l = International
m = meters

The surface data for the San Mateo Sewage Treatment Plant site were obtained from the Bay Area Air Quality Management in the ONSITE format for the period 2011–2015. These represent the surface meteorological conditions portion of AERMET. Upon the suggestion of the BAAQMD (Cordova 2015; BAAQMD 2016), data from San Francisco International Airport were used for cloud cover and for the precipitation and to determine surface moisture conditions to be used in AERSURFACE. Data from the Oakland upper-air site at Metropolitan Oakland International Airport were used to represent conditions aloft.

AERSURFACE Processing

The NLCD92 (Vogelmann et al. 2001) was downloaded and used with AERSURFACE (version 13016) to provide the surface parameters for the third stage of AERMET. The coordinates of the San Mateo Sewage Treatment Plant meteorological site were used to determine surface characteristics in AERSURFACE. AERSURFACE was run with specifications that the area was not arid and that the site was not at an airport. Per the BAAQMD's recommendation (Cordova 2015; BAAQMD 2016), twelve 30-degree sectors were used for San Francisco International Airport to account for variations in land cover near the measurement site. The study radius for surface roughness was set at 1 kilometer. The monthly seasonal profile used is shown in Table 17.

Table 17 Monthly Seasonal Profile at the San Mateo Sewage Treatment Plant Site

Months	Season
November, December, January	Late autumn after frost and harvest or winter with no snow
February, March	Transitional spring with partial green coverage or short annuals
April, May, June, July	Midsummer with lush vegetation
August, September, October	Autumn with unharvested cropland

AERSURFACE was run separately specifying dry, average, and wet surface moisture, and the results were later used to create composite surface characteristics for the third stage of AERMET.

Determination of Dry, Average, and Wet Months

Based on recommendations from BAAQMD (Cordova 2015; BAAQMD 2016) and information provided in the AERSURFACE users' guide, each month in the modeling period was classified as either dry, average, or wet, and this information was later used in Stage 3 of AERMET. The rainfall data for the San Mateo Sewage Treatment Plant site for the 30-year period ending 2016 were gathered, and 30-year monthly averages were computed for each month. The monthly statistics for a given month were not used in the average if more than 5 days of data were missing in a given month. The next step was to compute the ratio of the monthly precipitation total for a given month during the modeling period and the corresponding 30-year monthly average. If the ratio was less than 0.5, the month was designated as dry. If the ratio was greater than or equal to 0.5 but less than 2, the month was designated as average. If the ratio was greater than or equal to 2, the month was designated as wet. Table 18 shows the moisture classification of the region.

Table 18 Precipitation at the San Mateo Sewage Treatment Plant Site

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2011	0.94	4.79	5.7	0.33	0.47	1.49	0	0	0.01	1.18	1.55	0.13
2012	2.16	0.66	4.76	2.79	0	0.09	0	0	0	0.7	4.06	6.24
2013	0.2	0.67	0.49	0.47	0.01	0.05	0	0	0.23	0	0.91	0.35
2014	0.01	3.76	1.93	1.61	0	0	0	0	0.42	0.31	1.99	10.66
2015	0.00	2.01	0.06	1.28	0.02	0.26	0	0	0.02	0	1.42	3.37
30-year mean (1987–2016)	3.59	3.70	2.55	1.27	0.47	0.16	0.00	0.04	0.11	0.88	1.98	4.24
Ratio to 30-Year Mean												
2011	0.26	1.29	2.23	0.26	1.01	9.27	0.00	0.00	0.09	1.34	0.78	0.03
2012	0.60	0.18	1.86	2.20	0.00	0.56	0.00	0.00	0.00	0.80	2.05	1.47
2013	0.06	0.18	0.19	0.37	0.02	0.31	0.00	0.00	2.04	0.00	0.46	0.08
2014	0.00	1.02	0.76	1.27	0.00	0.00	0.00	0.00	3.73	0.35	1.01	2.51
2015	0.00	0.54	0.02	1.01	0.04	1.62	0.00	0.00	0.18	0.00	0.72	0.79
Moisture Classification												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2011	dry	avg	wet	dry	avg	wet	dry	dry	dry	avg	avg	dry
2012	avg	dry	avg	wet	dry	avg	dry	dry	dry	avg	wet	avg
2013	dry	dry	dry	dry	dry	dry	dry	dry	wet	dry	dry	dry
2014	dry	avg	avg	avg	dry	dry	dry	dry	wet	dry	avg	wet
2015	dry	avg	dry	avg	dry	avg	dry	dry	dry	dry	avg	avg

Source: WRCC 2017
avg = average
in = inches

AERMET

Version 16126 of AERMET was used to process the meteorological data. The first step used data from the Oakland upper-air soundings with the MODIFY option turned on. San Mateo Sewage Treatment Plant data were used for the SURFACE portion of the processing and in the ONSITE portion of the processing but with the San Francisco International Airport used for cloud cover and it's precipitation data used to determine surface moisture conditions to be used in AERSURFACE and the data from the Oakland upper-air site at Metropolitan Oakland International Airport were used to represent conditions aloft. The missing flags were set per BAAQMD recommendations (Cordova 2015; BAAQMD 2016) and are shown in Tables 19 and 20.

Table 19 AERMET Single-Value and Date/Time Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
OSDY	Day		-9	1	<=	31
OSMP	Month		-9	1	<=	12
OSYR	Year		-9	0	<=	99
OSHR	Hour		-9	0	<=	24
PAMT	Precipitation	cm	999	0	<=	100
INSO	Insolation	watts/square meter	9999	0	<	1250

Sources: Cordova 2015; BAAQMD 2016; USEPA 2016
cm = centimeters

Table 20 AERMET Multi-value Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
TT01	Temperature	degrees Centigrade	99	-30	<	46
WS01	Wind speed	meters / second	999	0	<	50
WD01	Wind direction	degrees from north	999	0	<=	360
RH01	Relative humidity	percent	999	0	<=	100
DP01	Dew-point temperature	degrees Centigrade	99	-65	<	35
SA01	Standard deviation, horizontal wind	degrees	999	0	<	104

Source: Cordova 2015; BAAQD 2016; USEPA 2016

The second step was a simple merging of the quality assurance files produced from step one. The third step was to set the following option per BAAQMD suggestion (Cordova 2015; BAAQMD 2016):

- METHOD TEMP SUB_TT was turned on, therefore, temperature substitution from the NWS site was performed.

This final step was repeated separately for each of the 5 years. The surface characteristics portions of the input files were created by using the AERSURFACE output corresponding to the moisture characteristics of each month and year. The output message and report files were checked for error messages. The error messages were examined and the errors were corrected when possible. Warning messages were also reviewed. In some cases, changes in inputs were made based on warnings (e.g., discrepancies in elevations provided in site list files and in the actual data). In other cases, they were left unchanged (e.g., variations in elevations throughout the data files). Other warnings regarding missing data and substituted data were noted, but no changes were made to the data.

5.1.2.4 San Carlos

The BAAQMD had representative meteorological data available from an instrumented tower located in San Carlos for the periods 2010–2012 and 2014–2015. Use of this data required AERMET processing for use in the AERMOD model. Meteorological data used in the creation of the San Carlos AERMET data for input to AERMOD are shown in Table 21.

Table 21 Meteorological Data for AERMET Processing at the San Carlos Site

Site ID	Site Name	Latitude (deg N)	Longitude (deg W)	Elevation (m)	Source of Data
6901	San Carlos	37.517	-122.252	1.0	BAAQMD
23234/KSFO	San Francisco Int'l Airport	37.362	-112.365	2.4	ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
23230/OAK	Metropolitan Oakland Int'l Airport	37.75	-122.220	6	http://esrl.noaa.gov/raobs/
047769	San Francisco Int'l Airport	37.362	-112.365	6	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7769

Sources: BAAQMD 2017; NOAA 2017a, 2017b; WRCC 2017
BAAQMD = Bay Area Air Quality Management District
deg N = degrees north
deg W = degrees west
Int'l = International
m = meters

The surface data for the San Carlos site were obtained from BAAQMD in the ONSITE format required by AERMET for the periods 2010–2012 and 2014–2015. The data were used to represent the surface meteorological condition portion of AERMET. Data completion collected from 2013 was not sufficient for processing into a complete meteorological dataset. Upon the suggestion of the BAAQMD (Cordova 2015; BAAQMD 2016), data from San Francisco International Airport were used for cloud cover when processing the ONSITE data and for the precipitation data from used to determine surface moisture conditions to be used in AERSURFACE, and the data from the Oakland upper-air site at Metropolitan Oakland International Airport were used to represent conditions aloft.

AERSURFACE Processing

The NLCD92 (Vogelmann et al. 2001) was downloaded and used with AERSURFACE (version 13016) to provide the surface parameters needed for the third stage of AERMET. The coordinates of the San Carlos BAAQMD meteorological site were used to determine surface characteristics in AERSURFACE. AERSURFACE was run with specifications that the area was not arid and that the site was not at an airport. Per the BAAQMD's recommendation (Cordova 2015; BAAQMD 2016), twelve 30-degree sectors were used for San Carlos processing to account for variations in land cover near the measurement site. The study radius for surface roughness was set at 1 kilometer. The monthly seasonal profile used is shown in Table 22.

Table 22 Monthly Seasonal Profile at the San Carlos Treatment Plant Site

Months	Season
November, December, January	Late autumn after frost and harvest or winter with no snow
February, March	Transitional spring with partial green coverage or short annuals
April, May, June, July	Midsummer with lush vegetation
August, September, October	Autumn with unharvested cropland

AERSURFACE was run separately specifying dry, average, and wet surface moisture, and the results were later used to create composite surface characteristics for the third stage of AERMET.

Determination of Dry, Average, and Wet Months

Based on recommendations from the BAAQMD (Cordova 2015; BAAQMD 2016) and information provided in the AERSURFACE users' guide, each month in the modeling period was classified as either dry, average, or wet, and this information was later used in Stage 3 of AERMET. The rainfall data for the San Francisco International Airport for the 30-year period ending 2016 were gathered, and 30-year monthly averages were computed for each month. The monthly statistics for a given month were not used in the average if more than 5 days of data were missing in a given month. The next step was to compute the ratio of the monthly precipitation total for a given month during the modeling period and the corresponding 30-year monthly average. If the ratio was less than 0.5, the month was designated as dry. If the ratio was greater than or equal to 0.5 but less than 2, the month was designated as average. If the ratio was greater than or equal to 2, the month was designated as wet. Table 23 shows the moisture classification of the region.

Table 23 Precipitation at the San Francisco International Airport Site

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	5.97	2.7	2.78	2.75	0.69	0	0	0	0.01	0.84	2.41	6
2011	0.94	4.79	5.7	0.33	0.47	1.49	0	0	0.01	1.18	1.55	0.13
2012	2.16	0.66	4.76	2.79	0	0.09	0	0	0	0.7	4.06	6.24
2014	0.01	3.76	1.93	1.61	0	0	0	0	0.42	0.31	1.99	10.66
2015	0	2.01	0.06	1.28	0.02	0.26	0	0	0.02	0	1.42	3.37
30-year mean (1987–2016)	3.59	3.70	2.55	1.27	0.47	0.16	0.00	0.04	0.11	0.88	1.98	4.24
Ratio to 30-Year Mean												
2010	1.66	0.73	1.09	2.17	1.48	0.00	0.00	0.00	0.09	0.96	1.22	1.42
2011	0.26	1.29	2.23	0.26	1.01	9.27	0.00	0.00	0.09	1.34	0.78	0.03
2012	0.60	0.18	1.86	2.20	0.00	0.56	0.00	0.00	0.00	0.80	2.05	1.47
2014	0.00	1.02	0.76	1.27	0.00	0.00	0.00	0.00	3.73	0.35	1.01	0.79
Moisture Classification												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	avg	avg	avg	wet	avg	dry	dry	dry	dry	avg	avg	avg
2011	dry	avg	wet	dry	avg	wet	dry	dry	dry	avg	avg	dry

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2012	avg	dry	avg	wet	dry	avg	dry	dry	dry	avg	wet	avg
2014	dry	avg	avg	avg	dry	dry	dry	dry	wet	dry	avg	wet
2015	dry	avg	dry	avg	dry	avg	dry	dry	dry	dry	avg	avg

Source: WRCC 2017
avg = average
in = inches

AERMET

Version 16126 of AERMET was used to process the meteorological data. The first step used data from the Oakland upper-air soundings with the MODIFY option turned on. San Francisco International Airport data were used for the SURFACE portion of the processing, and San Carlos on-site data were used for the ONSITE portion. The missing flags were set per BAAQMD recommendations (Cordova 2015; BAAQMD 2016) and are shown in Tables 24 and 25.

Table 24 AERMET Single-Value and Date/Time Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
OSDY	Day		-9	1	<=	31
OSMP	Month		-9	1	<=	12
OSYR	Year		-9	0	<=	99
OSHR	Hour		-9	0	<=	24
PAMT	Precipitation	cm	999	0	<=	100
INSO	Insolation	watts/square meter	9999	0	<	1250

Sources: Cordova 2015; BAAQMD 2016; USEPA 2016
cm = centimeters

Table 25 AERMET Multi-Value Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
TT01	Temperature	degrees Centigrade	99	-30	<	46
WS01	Wind speed	meters / second	999	0	<	50
WD01	Wind direction	degrees from north	999	0	<=	360
RH01	Relative humidity	percent	999	0	<=	100
DP01	Dew-point temperature	degrees Centigrade	99	-65	<	35
SA01	Standard deviation horizontal wind	degrees	999	0	<	104

Source: Cordova 2015; BAAQD 2016; USEPA 2016

The second step was a simple merging of the quality assurance files produced from step one. The third step was to set the following options per BAAQMD suggestion (Cordova 2015; BAAQMD 2016):

- METHOD TEMP SUB_TT was turned on, therefore, temperature substitution from the NWS site was performed.

This final step was repeated separately for each of the 5 years. The surface characteristics portions of the input files were created by using the AERSURFACE output corresponding to the moisture characteristics of each month and year. The output message and report files were checked for error messages. The error messages were examined and the errors were corrected when possible. Warning messages were also reviewed. In some cases, changes in inputs were made based on warnings (e.g., discrepancies in elevations provided in site list files and in the actual data). In other cases, they were left unchanged (e.g., variations in elevations throughout the data files). Other warnings regarding missing data and substituted data were noted, but no changes were made to the data.

5.1.2.5 Moffett Field

The National Weather Service had representative meteorological data available from an instrumented tower located at Moffett Field for the period 2011–2015. Use of this data required AERMET processing for use in the AERMOD model. Meteorological data used in the creation of the Moffett Field AERMET data for input to AERMOD are shown in Table 26.

Table 26 Meteorological Data for AERMET Processing at the Moffett Field

Site ID	Site Name	Latitude (deg N)	Longitude (deg W)	Elevation (m)	Source of Data
23244/KNUQ	Moffett Field	37.417	- 122.049	12.0	ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
23244/KNUQ	Moffett Field	37.417	- 122.049	12.0	1-min ASOS data: ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/
23230/OAK	Metropolitan Oakland Int'l Airport	37.75	-122.220	6.0	http://esrl.noaa.gov/raobs/
047821	San Jose Climate Station	37.333	-121.900	19.5	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7821

Sources: BAAQMD 2017; NOAA 2017a, 2017b; WRCC 2017
BAAQMD = Bay Area Air Quality Management District
deg N = degrees north
deg W = degrees west
Int'l = International
m = meters

The surface data for the Moffett Field site were obtained from BAAQMD in the ONSITE format required by AERMET for the period 2011–2015. These data were used to represent the surface meteorological condition portion of AERMET. Upon the suggestion of the BAAQMD (Cordova 2015; BAAQMD 2016), data from San Jose Climate Station were used for cloud cover when processing the ONSITE data and for the precipitation data from used to determine surface moisture conditions to be used in AERSURFACE, and the data from the Oakland upper-air site at Metropolitan Oakland International Airport were used to represent conditions aloft.

AERSURFACE Processing

TheNLCD92 (Vogelmann et al. 2001) was downloaded and used with AERSURFACE (version 13016) to provide the surface parameters for the third stage of AERMET. The coordinates of the

Moffett Field meteorological site were used to determine surface characteristics in AERSURFACE. AERSURFACE was run with specifications that the area was not arid and that the site was at an airport. Per the BAAQMD's recommendation (Cordova 2015; BAAQMD 2016), twelve 30-degree sectors were used for San Carlos processing to account for variations in land cover near the measurement site. The study radius for surface roughness was set at 1 kilometer. The monthly seasonal profile used is provided in Table 27.

Table 27 Monthly Seasonal Profile at the Moffett Field Treatment Plant Site

Months	Season
November, December, January	Late autumn after frost and harvest or winter with no snow
February, March	Transitional spring with partial green coverage or short annuals
April, May, June, July	Midsummer with lush vegetation
August, September, October	Autumn with unharvested cropland

AERSURFACE was run separately specifying dry, average, and wet surface moisture, and the results were later used to create composite surface characteristics for the third stage of AERMET.

Determination of Dry, Average, and Wet Months

Based on recommendations from BAAQMD (Cordova 2015; BAAQMD 2016) and information provided in the AERSURFACE users' guide, each month in the modeling period was classified as either dry, average, or wet, and this information was later used in Stage 3 of AERMET. The rainfall data for the San Jose Climate Station for the 30-year period ending 2016 were gathered, and 30-year monthly averages were computed for each month. The monthly statistics for a given month were not used in the average if more than 5 days of data were missing in a given month. The next step was to compute the ratio of the monthly precipitation total for a given month during the modeling period and the corresponding 30-year monthly average. If the ratio was less than 0.5, the month was designated as dry. If the ratio was greater than or equal to 0.5 but less than 2, the month was designated as average. If the ratio was greater than or equal to 2, the month was designated as wet. Table 28 shows the moisture classification of the region.

Table 28 Precipitation at the San Jose Climate Site

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2011	0.96	3.15	4.32	0.2	0.4	1.51	0	0	0	0.77	0.7	0.08
2012	0.9	0.67	1.98	1.88	0	0.15	0	0	0.01	0.35	2.58	4.24
2013	0.69	0.37	0.87	0.26	0.01	0.04	0	0	0.66	0	0.77	0.13
2014	0.12	2.65	1.35	0.64	0	0.01	0	0	0.36	0.62	1.57	7.74
2015	0.01	1.74	0.19	0.88	0.5	0.1	0	0.02	0.01	0.05	2.42	2.23
30-year mean (1987–2016)	3.59	3.70	2.55	1.27	0.47	0.16	0.00	0.04	0.11	0.88	1.98	4.24

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ratio to 30-Year Mean												
2011	0.37	1.11	1.96	0.18	0.75	10.04	0.00	0.00	0.00	1.08	0.52	0.03
2012	0.34	0.24	0.90	1.70	0.00	1.00	0.00	0.00	0.09	0.49	1.93	1.54
2013	0.26	0.13	0.40	0.24	0.02	0.27	0.00	0.00	5.82	0.00	0.58	0.05
2014	0.05	0.93	0.61	0.58	0.00	0.07	0.00	0.00	3.17	0.87	1.17	2.82
2015	0.00	0.61	0.09	0.80	0.94	0.67	0.00	0.92	0.09	0.07	1.81	0.81
Moisture Classification												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2011	dry	avg	avg	dry	avg	wet	dry	dry	dry	avg	avg	dry
2012	dry	dry	avg	avg	dry	avg	dry	dry	dry	dry	avg	avg
2013	dry	dry	dry	dry	dry	dry	dry	dry	wet	dry	avg	dry
2014	dry	avg	avg	avg	dry	dry	dry	dry	wet	avg	avg	wet
2015	dry	avg	dry	avg	avg	avg	dry	avg	dry	dry	avg	avg

Source: WRCC 2017
avg = average
in = inches

AERMET

Version 16126 of AERMET was used to process the meteorological data. The first step used data from the Oakland upper-air soundings with the MODIFY option turned on. San Jose Airport data were used for the SURFACE portion of the processing, and Moffett Field on-site data were used for the ONSITE portion with 1-minute wind data processed using AERMINUTE version 15272. The missing flags were set per BAAQMD recommendations (Cordova 2015; BAAQMD 2016) and are shown in Tables 29 and 30.

Table 29 AERMET Single-Value and Date/Time Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
OSDY	Day		-9	1	<=	31
OSMP	Month		-9	1	<=	12
OSYR	Year		-9	0	<=	99
OSHR	Hour		-9	0	<=	24
PAMT	Precipitation	cm	999	0	<=	100
INSO	Insolation	watts/square meter	9999	0	<	1250

Sources: Cordova 2015; BAAQMD 2016; USEPA 2016
cm = centimeters

Table 30 AERMET Multi-Value Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
TT01	Temperature	degrees Centigrade	99	-30	<	46
WS01	Wind speed	meters / second	999	0	<	50
WD01	Wind direction	degrees from north	999	0	<=	360
RH01	Relative humidity	percent	999	0	<=	100
DP01	Dew-point temperature	degrees Centigrade	99	-65	<	35
SA01	Standard deviation, horizontal wind	degrees	999	0	<	104

Sources: Cordova 2015; BAAQD 2016; USEPA 2016

The second step was a simple merging of the quality assurance files produced from step one. The third step was to set the following options per BAAQMD suggestion (Cordova 2015; BAAQMD 2016):

- METHOD TEMP SUB_TT was turned on, therefore, temperature substitution from the NWS site was performed.
- METHOD IND_DIR RANDOM, was included to randomize any NWS wind directions used in the analysis.
- METHOD CCVR SUB_CC, was included, hence cloud cover substitution from the NWS site was performed.

This final step was repeated separately for each of the 5 years. The surface characteristics portions of the input files were created by using the AERSURFACE output corresponding to the moisture characteristics of each month and year. The output message and report files were checked for error messages. The error messages were examined and the errors were corrected when possible. Warning messages were also reviewed. In some cases, changes in inputs were made based on warnings (e.g., discrepancies in elevations provided in site list files and in the actual data). In other cases, they were left unchanged (e.g., variations in elevations throughout the data files). Other warnings regarding missing data and substituted data were noted, but no changes were made to the data.

- **Terrain—**Terrain information for modeling used terrain data available from the National Elevation Dataset at 1/3 arc-second database.
- **Receptors—**Receptors were modeled using a network of discrete receptors. Details on the spacing, height, and layout are provided in Sections 5.5, Sensitive Receptors, and 6.3.3.2, Receptor Locations, of the Air Quality and Greenhouse Gases Technical Report.
- **Source parameters—**Details on the source type configurations, release height, and spatial dimensions are provided in Section 6.4.8 (Tables 6-5 and 6-6) of the Air Quality and Greenhouse Gases Technical Report. Construction is modeled as occurring 5 days per week with 8-hour days (250 days per year). AERMOD's HRDOW7 option was used to have emissions occur from 8:00 a.m. to 4:00 p.m., Monday through Friday.

5.2 Output Options

The dispersion model outputs hourly concentrations and these can be expressed in terms of different averaging periods, such as hourly, daily, and annual, in the same form as the air quality standard. The averaging times used for the ambient air quality standards and concentration thresholds are different for each pollutant. To compare the model results to the applicable ambient air quality standards and thresholds, criteria pollutant concentrations were calculated relative to the form of the air quality standard for the CAAQS and the NAAQS.

AERMOD output files and Hotspots Analysis and Reporting Program (HARP) Risk Assessment Standalone Tool (RAST) summary output files for the simulations are available upon request.

6 REFERENCES

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