Appendix A
under RULE 1180 FENCELINE AIR MONITORING PLAN

Quality Assurance Project Plan for
Ultramar Wilmington Refinery

South Coast AQMD
Rule 1180 Refinery Fenceline Monitoring

Prepared for:

Ultramar Wilmington Refinery
2402 East Anaheim Street
Wilmington, CA 90744

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Revision History

Revision	Date	Prepared by	Approved by	Comment
0	11-Nov-2020	Naomi Perel Nagy, Atmosfir	Thomas Cheng, Ultramar	
1	26-Mar-2020	Naomi Perel Nagy, Atmosfir	Thomas Cheng, Ulrtamar	After comments from South Coast AQMD
2	13-Oct-2020	Mason Hebert, Ultramar	Mason Hebert, Ultramar	Abiding by provided checklist
3	20-May-2021	Naomi Perel Nagy, Atmosfir	Mason Hebert, Ultramar	Abiding by provided recommendations
4	11-Jan-2023	Naomi Perel Nagy, Atmosfir	Jon Elliott, Ultramar	Abiding by provided South Coast AQMD Disapproval Letter from 12/15/23
5	11-June-2024	Naomi Perel Nagy, Atmosfir	Sophie McCabe, Ultramar	Abiding by provided South Coast AQMD requests
6	5-Aug-2024	Naomi Perel Nagy, Atmosfir	Sophie McCabe, Ultramar	Changes following amended Rule 1180 from January 5, 2024 And full overview

A PROJECT BACKGROUND AND MANAGEMENT ELEMENTS

A.1 Title and Approval Sheet

Quality Assurance Project Plan
for
Ultramar Wilmington Refinery
South Coast AQMD Rule 1180 Refinery Fenceline Monitoring

Approvals

Signatures & Date	Responsible Party
8/5/2024	Ultramar Inc. Rule 1180 Program Administrator
8/5/2024	Atmosfir Optics Project Manager
8/5/2024	Atmosfir Optics Quality Assurance Manager
	South Coast AQMD Rule 1180 Program Manager
	South Coast AQMD Quality Assurance Manager

A.2 Table Of Contents

Refer to page i.

A.3 Distribution List

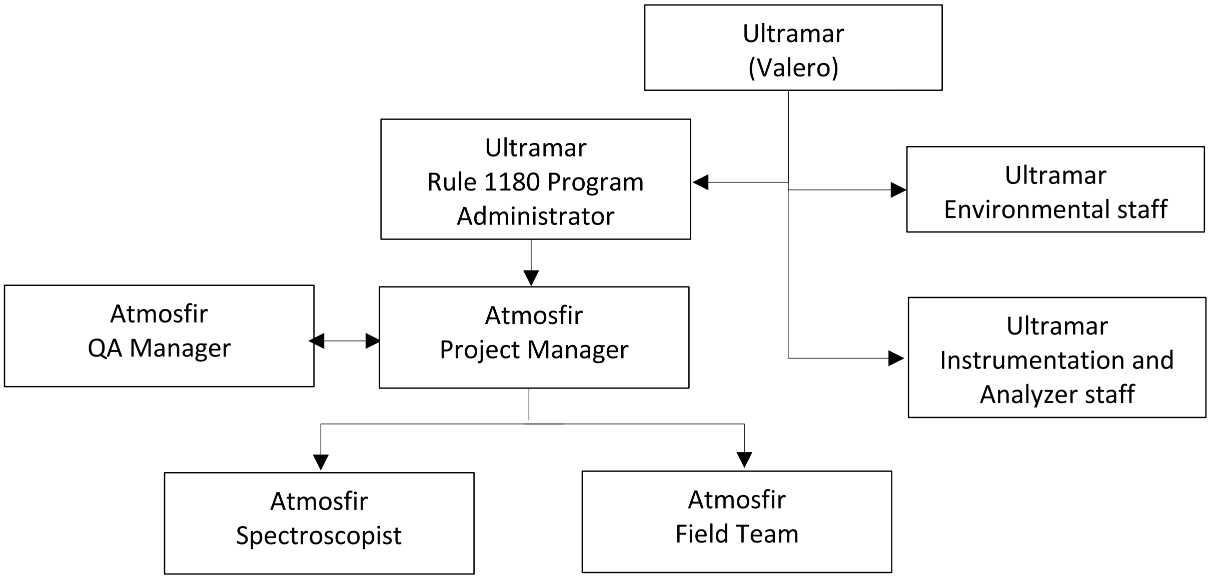
The distribution list includes all individuals or groups that should receive a copy of the Quality Assurance Project Plan (QAPP). The distribution list will be updated accordingly to reflect roles and responsibilities based on the approval sheet in section A.1. A hard copy as well as an electronic format is available at the facility. Revisions to the distribution list will be assessed annually and reflect on the revision history section in the fenceline air monitoring plan on page iii.

Organization	Role/Title	Contact
Ultramar Inc. Environmental Department	Program Administrator	valerowilmingtonfenceline@valero.com
Atmosfir Optics, LTD	Project Manager	guy@atmosfir.net
Atmosfir Optics, LTD	Quality Assurance Manager	naomi@atmosfir.net
South Coast AQMD	Program Manager	opikelnaya@aqmd.gov
South Coast AQMD	Quality Assurance Manager	kdurkee@aqmd.gov

A.4 Project/Task Organization

The organization of the project team is as shown in Figure A-1.

Figure A-1 Organization Chart



Names and contacts for key personnel are listed below:

Role	Name	Contact information
Ultramar Rule 1180 Program Administrator	Sophie McCabe	Sophie.mccabe@valero.com
Ultramar Environmental Manager	Natalie Irwin	natalie.irwin@valero.com
Ultramar Instrumentation and Analyzer Manager	Joe Roberts	joe.roberts@valero.com
Atmosfir QA Manager	Naomi Perel Nagy	naomi@atmosfir.net
Atmosfir project Manager	Guy Kessler	guy@atmosfir.net
Atmosfir Spectroscopist	Yael Etzion	yael@atmosfir.net

Ultramar has overall responsibility for maintaining and updating the QAPP. The QAPP will be continuously updated/modified as the Rule 1180 program develops. Other aspects of the monitoring project are managed by support staff and Atmosfir, under the supervision of Ultramar.

A.5 Problem Definition and Background

On December 1, 2017, the South Coast Air Quality Management District (South Coast AQMD) adopted Rule 1180 Refinery Fenceline and Community Air Monitoring. The purpose of Rule 1180 is to require petroleum refineries to establish a real-time fenceline air monitoring system that provides air quality information to the public and local air district about levels of various criteria air pollutants, volatile organic compounds, and other compounds at or near the property boundaries of petroleum refineries. Rule 1180 was amended and issued on January 5, 2024.

The main goals and objectives of this Quality Assurance Project Plan (QAPP) are the assessment of the quality of data collected by evaluating precision, reliability, accuracy, and timeliness based on South Coast AQMD Rule 1180. Another goal of the QAPP is the control and improvement of the quality of the fenceline monitoring system by implementing quality control policies and defining necessary corrective actions.

This shall be accomplished by the implementation of the procedures and practices found in this QAPP. Quality Assurance (QA) is an integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed, and expected. Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer. The QC system includes the operational techniques and activities that are used to fulfill requirements in South Coast Rule 1180.

Quality Control is largely implemented through adherence to activities defined within a QAPP. Each monitoring program has unique requirements, statutory guidelines, rules, and policies that must be followed. A QAPP incorporates the unique qualities that are specific to each monitoring program.

Ultramar and its contractors are committed to the principles and practices of its QA Program. The QA Program developed for this program focuses on preventing quality problems and ensuring data of the highest quality practicable.

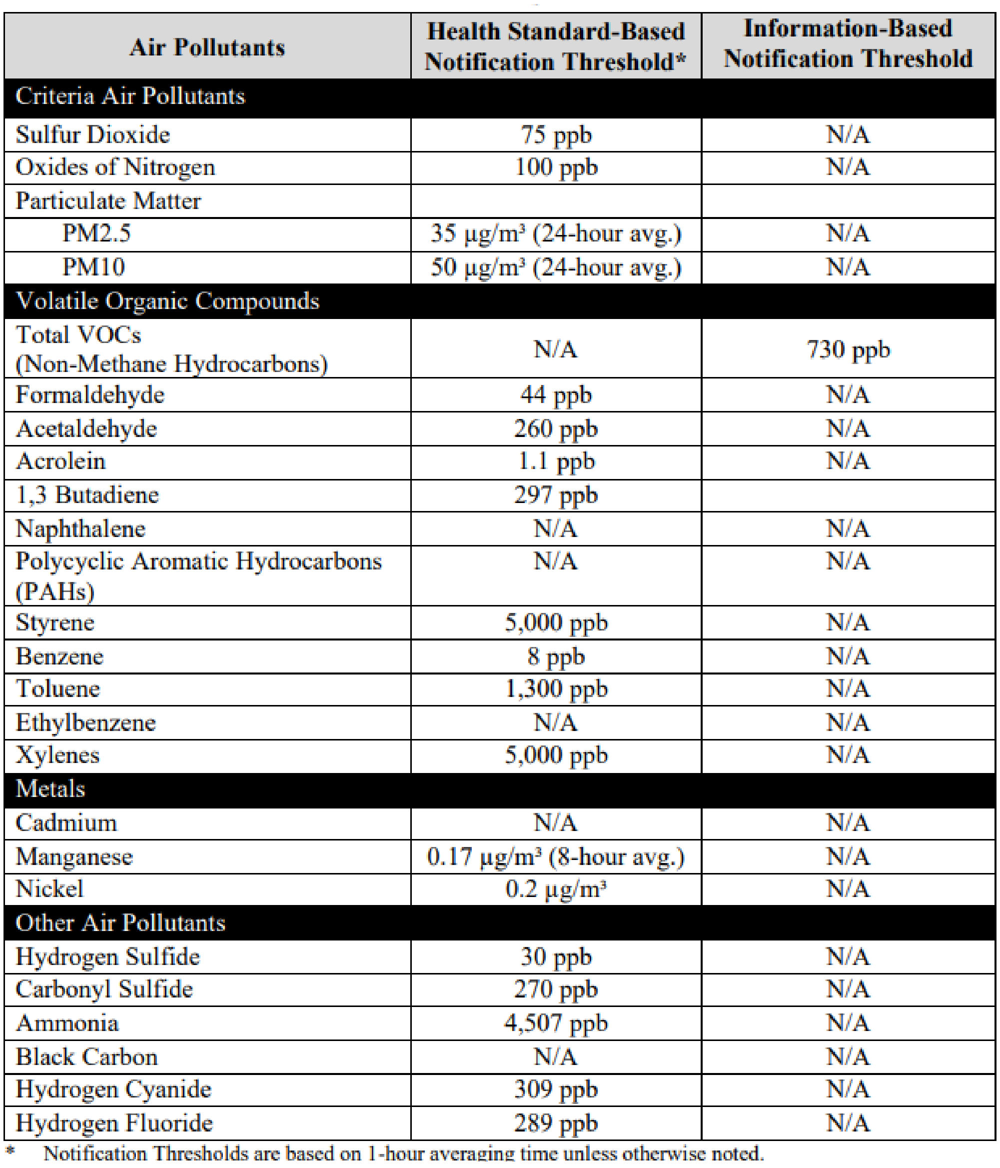
A.6 Project/Task Description

Ultramar's Fenceline Air Monitoring Plan specifies the project goals to be fulfilled. In summary, the project involves establishing a network of monitoring stations to continuously monitor air quality at the fenceline surrounding the Ultramar refinery in Wilmington, California. The monitoring stations will continuously monitor a variety of pollutants using a combination of open path and point-extractive monitoring technologies, as required by South Coast AQMD Rule 1180.

Wind speed and direction monitoring will be included in order to address upwind versus downwind pollutant concentrations. The collected data will be used to better understand emissions and potential impacts at the fenceline and surrounding community. Preliminary monitoring data will be posted to a publicly accessible website in near-real time to enhance public awareness of current air quality conditions in the vicinity, and will notify public information subscribers when concentrations exceed pre-defined health thresholds. Further analysis of the results and monitoring system performance evaluation will be posted quarterly. South Coast AQMD will retain oversight of Rule 1180 activity.

The pollutants that should be monitored at the facility according to Rule 1180 are summarized below in Table A-1, along with the defined air quality standard. Besides PAHs, all pollutants will be monitored at Valero Wilmington FLM; PAHs are pending feasible technology approved by South Coast AQMD.

Table A-1 Monitored Pollutants and Notification Thresholds



Air Pollutants	Health Standard-Based Notification Threshold*	Information-Based Notification Threshold
Criteria Air Pollutants		
Sulfur Dioxide	75 ppb	N/A
Oxides of Nitrogen	100 ppb	N/A
Particulate Matter		
PM2.5	35 µg/m^3 (24-hour avg.)	N/A
PM10	50 µg/m^3 (24-hour avg.)	N/A
Volatile Organic Compounds		
Total VOCs (Non-Methane Hydrocarbons)	N/A	730 ppb
Formaldehyde	44 ppb	N/A
Acetaldehyde	260 ppb	N/A
Acrolein	1.1 ppb	N/A
1,3 Butadiene	297 ppb	
Naphthalene	N/A	N/A
Polycyclic Aromatic Hydrocarbons (PAHs)	N/A	N/A
Styrene	5,000 ppb	N/A
Benzene	8 ppb	N/A
Toluene	1,300 ppb	N/A
Ethylbenzene	N/A	N/A
Xylenes	5,000 ppb	N/A
Metals		
Cadmium	N/A	N/A
Manganese	0.17 µg/m^3 (8-hour avg.)	N/A
Nickel	0.2 µg/m^3	N/A
Other Air Pollutants		
Hydrogen Sulfide	30 ppb	N/A
Carbonyl Sulfide	270 ppb	N/A
Ammonia	4,507 ppb	N/A
Black Carbon	N/A	N/A
Hydrogen Cyanide	309 ppb	N/A
Hydrogen Fluoride	289 ppb	N/A

* Notification Thresholds are based on 1-hour averaging time unless otherwise noted.

The Instrument installed in Valero FLM is listed in Table A-2.

Table A-2 Summary table for the instrument installed in Valero FLM

Instrument	Make	Model	Temp range	Power supply	Weight
OP-FTIR	Bruker Optik	FTIR OPS	0 - 40 °C	24 VDC	43 Kg
P/T unit	MOOG	MPT-90	-15 - 55 °C	24 - 28 VDC	31.7 Kg
UV-DOAS	OPSIS	UVDOAS AR500	5 - 30 °C	115 VAC	30 Kg
Aethalometer	Magee scientific	AE33	10 - 40 °C	100 to 250 VAC	20 Kg
UV Fluorescence	Teledyne	T101	5 - 40 °C	100 - 120 VAC	20.5 Kg
BAM	Met One	1020*	-40 - 55°C	100 - 230 VAC	24.5 kg
XRF	SCI	625i	15 -25°C	120 VAC	59 kg
Wind sensors	R.M. Young	05305	-50 - 50 °C	15 VDC	1 Kg

* Pending the infrastructure a different but similar Met One BAM model may be installed.

A.6.1 Meteorological Monitoring Station

A meteorological station on the facility property measures both wind direction and wind speed. The meteorological station will provide high time resolution at least matching the time resolution of the air quality monitors and will be located at Cabinet 2 (see Figure A-2). A meteorological station installed on another cabinet will serve as backup systems if the station in Cabinet 2 is down. Refer to Section 3.5 Routine Maintenance and Failure Management in the fenceline air monitoring plan for more details.

A.6.2 Fenceline Monitoring Systems

A.6.2.1 Sampling Technologies

The technologies for the monitored pollutants are detailed in Table A-3 and meet South Coast AQMD Rule 1180 requirements. The detection limits (minimum and maximum) are based on data from the current Valero installation, when possible, and specifications provided by instrument manufacturers. The secondary technology, shown in parentheses, is explained in the notes of the Table.

Table A-3 Monitoring Technologies and Detection Limits

Pollutant	Monitoring Technique [1]	Actual Detection Limit [ppb] [2]	Maximum Detection Limit [ppb] [3]	Notification Threshold [ppb] [4]
Sulfur Dioxide	UV-DOAS (OP-FTIR)	0.70 (0.90)	1,900 (>1,000ppm)	75
Nitrogen Dioxide	OP-FTIR	0.80	52,000	100
Total VOCs (as Total Alkanes)5	OP-FTIR	0.45	114,000	730
Formaldehyde	OP-FTIR	0.20	80,000	44
Acetaldehyde	OP-FTIR	0.25	114,000	260
Acrolein	OP-FTIR	0.30	44,000	1.1
1,3-Butadiene	OP-FTIR	0.15	4,000	297
Naphthalene6	OP-FTIR	0.25	340 / 7,300	NA
Styrene	OP-FTIR	0.20	57,000	5000
Benzene	UV-DOAS (OP-FTIR)	1.90 (0.80)	626 (333,000)	8
Toluene	OP-FTIR[7] (UV-DOAS)	0.80 (1.30)	15,000 (531)	1300
Ethyl Benzene	OP-FTIR[7] (UV-DOAS)	0.65 (10.50)	28,000 (461)	N/A
m-Xylene	OP-FTIR[7] (UV-DOAS)	0.40 (2.05)	25,000 (461)	5000
o-Xylene	OP-FTIR[7] (UV-DOAS)	0.65 (7.00)	10,000 (461)	5000
p-Xylene	OP-FTIR[7] (UV-DOAS)	0.40 (0.50)	16,000 (461)	5000
Carbonyl Sulfide	OP-FTIR	0.05	7,000	270
Ammonia	OP-FTIR	0.05	66,000	4507
Hydrogen Cyanide	OP-FTIR	0.95	>1,000,000	309
Hydrogen Fluoride	OP-FTIR	0.10	16,000	289
Hydrogen Sulfide	UV Fluorescence	0.4	10,000	30
	Monitoring Technique	**Detection Limit [$\mu g/m^3$]**	**Maximum Detection Limit [$\mu g/m^3$]**	**Notification Threshold [$\mu g/m^3$] [4]**
Black Carbon	Aethalometer	0.0005	10	NA
Cd	PM-EDXRF[8]	0.012	60	NA
Mn	PM-EDXRF[8]	0.00071	60	0.17 (8 hr. av.)
Ni	PM-EDXRF[8]	0.0047	60	0.2
PM2.5	BAM	<4.8	1000	35 (24 hr. av.)
PM10	BAM	<7	1000	50 (24 hr. av.)

Notes.

[1] The primary open path technology was chosen based on the ability to measure well below the notification threshold (threshold at least three times the lower actual DL) and above the threshold (threshold below the Maximum DL) and that no cross interference will trigger a false positive. The FTIR used at Valero Wilmington is well within these criteria for all gaseous compounds in Rule 1180. H_2S is the exception, whose detection limit is way above the notification threshold. UV-DOAS is used upon SCAQMD request and only in cases where these criteria can be met.

[2] The 1-hour actual detection limits for FTIR and UV-DOAS are based on the actual measurements by the installed units at Valero Wilmington (from the latest 2 quarterly reported Detection Limits on path C2P2, path length 336m). Since the open path detection limits are dynamic and depend on the open path itself, the specific location, and local interferences, these actual detection limits best reflect the system's ability and not the estimated detections based on lab experiments. In parentheses are the detection limits of the secondary technology.

[3] For OP FTIR and OP UV-DOAS, the range is path-dependent since the measurements are in ppb*m. The numbers stated in the tables for the maximum range are for a path of 250m for the OP FTIR, and a path of 500m for the OP UV-DOAS.

[4] Thresholds based on Rule 1180 Table 1– Air Pollutants and Notification Thresholds to be addressed by FAMPs.

[5] Because there is no open-path technology capable of measuring all NMHC, the OP FTIR technology will monitor at least C4-C8 alkanes as an indicator of NMHC concentrations.

[6] For Naphthalene, OP FTIR measurements provide sensitive and specific detection and quantification and are already vastly applied by Atmosfir D-fenceline™ with Bruker's OPS in refineries' fencelines (another spectral method can be used for a higher range of 7,300 ppb). There is almost null experience with UV-DOAS for Naphthalene OP-quantitative monitoring. The band in the UV range is expected to be smooth, leading to a non-specific response in the presence of interfering compounds, like ETB. DOAS use for naphthalene quantitative monitoring is pending the assessment of the linear range for quantification and the sensitivity to atmospheric interferences. The current UV-DOAS system optical system requires re-configuration to measure Naphthalene in addition to BTEX and SO_2.

[7] The primary technology was chosen for these compounds to be FTIR for these reasons: based on field data, all BTEX measurements using Bruker's OPS FTIR stand in compliance with the requirements of the Rule when their Detection Limits are well below the Threshold and their Max Detection Limits are above the Threshold; In the UV range, Ethylbenzene and o-Xylene bands are wide and relatively low, therefore not sensitive and selective enough; For all TEX compounds (Toluene, Ethylbenzene, and Xylenes) the maximum detection level of the TEX compounds is below the Threshold; and cross-interference in their range will trigger false positives of other compounds.

[8] The detection limits of the metals with XRF depend on the sampling time, longer sampling times obtain smaller detection limits. The sampling time final selection will be a compromise between tape frequency exchange, sensitivity, and the delay due to analysis time. The stated DL in the table is based on a 30-minute sample but depends on the final selected sampling time.

Rule 1180 requires measurement of Total non-methane VOC for fenceline monitoring. Currently, there is no open path method to measure the entire Total VOC fraction, and point monitoring is not an acceptable alternative in Rule 1180. The Atmosfir D-fenceline™ system applies the method for total alkanes measurement as defined and explained in the approved EPA-600/R-09-136 study.[1] The spectral analysis is designed to quantify a bimodal mixture of total alkanes starting at C4, using a predefined surrogate pair of a low-order alkane and a high-order alkane. The total alkanes analysis in the D-fencline™ system includes calculation for the molecular weight of the alkanes mixture (equivalent molecular weight). This feature enables the user to characterize the content of the mixture (heavy versus light alkanes). To date, this is the most appropriate methodology to determine the Total VOC faction and has been approved by South Coast in the Rule 1180 Guidelines.

A.6.2.2 Sampling Locations

Monitoring equipment locations are shown in Figure A-2. Cabinets 1 to 4 and the path locations have been approved by AQMD. The two new locations of C3a and C5 are pending approval. Details on the locations are under the FAMP.

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[1] THOMA, E. D., M. MODRAK, AND D. J. Williams. Investigation of fugitive emissions from petrochemical transport barges using optical remote sensing. U.S. Environmental Protection Agency, Washington, DC, 2009. EPA Document ID EPA-600/R-09-136.

Figure A-2 Monitoring Equipment Locations

A.6.3 Sampling Frequency

Air quality and Meteorological data are sampled and recorded at least every five minutes when feasible. For further details on the sampling frequencies and intervals of the following rolling averages, see Section B.2.

A.7 Data Quality Objectives and Data Quality Measurements

This QAPP details the methodologies used to establish continuous fenceline measurements around the refinery. Fenceline monitoring will be conducted to satisfy the requirements of Rule 1180. The procedures and Data Quality Objectives (DQOs) defined in this QAPP were developed to meet the goals and objectives of this monitoring project as outlined in Rule 1180. Namely to provide the public and local air district with real-time levels of the air pollutants on the refinery fenceline.

The QAPP will be revised from time to time, to reflect improvements and adjustments in response to lessons learned and gained experience over the long-term operation of the fence-line, and in response to changes in regulations and goals of the monitoring project. As a minimum, the QAPP will be reviewed annually.

The monitoring program will adhere to the guidance found in the following documents:

- EPA’s Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Meteorological Measurements, EPA March 2008;
- EPA’s Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, EPA-454/B-08-003, May 2013.

This is intended to ensure the appropriate quality and usability of the measured data and the documented technical information.

Data Quality Indicators (DQIs) and their acceptance criteria, the Measurement Quality Objectives (MQOs), are designed to evaluate and control various phases of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the data quality objectives. For typical measurement data, DQIs can be defined in terms of the following data quality indicators:

- Precision is a measure of agreement among repeated measurements of the same property under identical or substantially similar conditions. This is the random component of error. Precision is estimated by various statistical techniques, typically using some derivation of the standard deviation.
- Bias is the systematic or persistent distortion of a measurement process that causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value as a percentage of the true value.
- Accuracy is a measure of the overall agreement of a measurement to a known value and includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.
- Representativeness refers to the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or a condition.
- Comparability expresses the degree of confidence that one data set can be compared to another and can be combined for the decision(s) to be made.
- Completeness describes the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.
- Sensitivity is the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability.

For this monitoring program the Data Quality Indicators (DQIs) and the Measurement Quality Objectives (MQOs) were selected to ensure that the fenceline measurement system meets the Data Quality Objectives of the project, as defined by Rule 1180 and District guidance. Mainly to keep real-time, continuous fenceline measurements at levels adequate to the required health thresholds.

The project DQIs and MQOs are presented in Table A-4 for key criteria such as **precision**, **accuracy**, and **completeness,** and the DQIs equations are detailed in Table A-5. These enable the project team to measure progress and success in attaining the quality goals for the monitoring effort.

Other quality indicators are sensitivity, representativeness, and comparability:
The **sensitivity** for this project is described by the detection limits (DL). The detection limits for each technology are detailed Table A-3. The technologies selected to have sensitivity are well below the health threshold, and this should be monitored throughout the project. The extractive point monitoring technologies for Black Carbon, H_2S, $PM_{2.5}$ & PM_{10}, and Metals have a fixed instrument detection limit. The open path spectrometry technologies (OP FTIR and OP UV-DOAS) have a dynamic method detection limit[2] (MDL) that varies across time and open path locations, depending on the content of cross-interfering pollutants and atmospheric compounds in the open path during measurement, and depending on the present target compound concentration. Each measurement will have its actual MDL derived from the measurement standard error, and it is part of the automatic QCs screening (see section B.5 for more details). Estimating typical MDL values is based on actual MDLs (above background level for FTIR) from real site measurements calculated from the 25 percentiles (zero concentration). These estimations better represent and account for the real open path conditions than laboratory offline measurements. The MDLs detailed in Table A-3 for these technologies are the estimated typical MDL based on zero concentration cases from the actual measurements in Valero Wilmington FLM. The typical MDL can change for each fenceline monitoring location and each path length depends on the above factors for the specific site. Typical site MDL values in this project will be evaluated, presented, and discussed in the quarterly report to validate the ability to meet project goals and to ensure detection limits well below the health threshold.

Representativeness of the data has been addressed in the fenceline monitoring plan review and approval process. The spatial representativeness of the data is covered by the fenceline sampling locations, which have been selected with a variety of goals and constraints in mind. The final locations (see Figure A-2) provide the best possible spatial representativeness of the facility considering the limitations that constrain the fenceline monitoring locations selection and the prevailing winds (these are listed in the FAMP).
Temporal representativeness is covered by the sampling frequencies (see section B.2) and by the minimum acceptable data recovery percentage that stands at 75% of an hour to be considered to represent a full hour (see section D.2.5).

Comparability of the data will be addressed in the validation process by examining and comparing the QC of the instruments and their MDLs on different paths. Comparing their trends for the same compound and in regard to the meteorological data, see section D.2.4. This will ensure that the data from the different locations for the same compound is comparable for decision making.

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[2] Method Detection Limit (MDL) is defined by the EPA as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

The checks for these quality indicators and other quality control tests are described in Section B.5 per technology; some of the tests are automatically performed per measurement or daily, while others are manual tests, periodically performed. Periodic tests that fail the MQOs will immediately trigger an investigation of the reason for the failure and, when required, a corrective action. An investigation may lead to retrospective invalidation of measurement results between the last successful test and the next maintenance that leads to regaining MQO. Part of the automatic quality objectives described in Section B.5 automatically invalidate and exclude ambient measurements. The QC Criteria and what should be done in case of failing the quality threshold (hereby, limit) is summed Table B-1 under section B.5.

Table A-4 Data Quality Indicators (DQIs) and Data Quality Measurements (MQOs)

Instrument	Section	DQI^	Frequency	MQO	Reference	Completeness
Fourier Transform Infrared Spectroscopy (FTIR)	B.5.3	Accuracy: Gas cell verification	Quarterly	±20%	Manufacturer Recommendation & South Coast AQMD Request	90%
		Precision: Gas cell verification	Quarterly	±20%		
		N_2O accuracy – periodic check	Monthly	±20%	EPA Compendium Method TO-16 & GD-52 - EPA Handbook: Optical Remote Sensing for Measurement and Monitoring of Emissions Flux & Manufacturer Recommendation	
		N_2O precision – periodic check	Monthly	±10%		
Ultraviolet Differential Optical Absorption Spectroscopy (UV-DOAS)	B.5.4	Accuracy: Gas cell verification	Quarterly	±25%	EPA QA Handbook (EPA-454/B-17-001)	90%
		Precision: Gas cell verification	Quarterly	±25%	EPA QA Handbook (EPA-454/B-17-001)	
Black Carbon Aethalometer	B.7.2.1	Bias: Flow Rate	Semi-annually (every 6 months)	±10%	ARB SOP #407 & Manufacturer Recommendations	90%
		Bias: Neutral Density (ND) Optical Filter test	Annual	±10% Test Value	Manufacturer Recommendations	
Hydrogen Sulfide (H_2S) Ultraviolet (UV) Fluorescence	B.5.2	Accuracy: Gas cylinder span	Quarterly	±15%	Proposed based on EPA QA Handbook (EPA-454/B-17-001), Appendix I criteria for SO_2, allowing for additional uncertainty due to differences between H_2S and SO_2 analyzers	90%
		Precision: Gas cylinder span	Quarterly	±15%		
$PM_{2.5}$ & PM_{10} BAM	B.5.5	Accuracy: mass density reference membrane	Per measurement	±5%	Manufacturer internal reference	90%
		Bias: Flow Rate	Monthly	±4%	40 CFR Part 50, App .L, 40 CFR Part 58, Appendix A	

Instrument	Section	DQI^	Frequency	MQO	Reference	Completeness
Metals (Cd, Ni, Mn) XRF	B.5.6	Accuracy: Calibration Check	Quarterly	±10%	EPA IO 3.3 Manufacturer Recommendations	90%
		Bias: Flow Rate	Quarterly	Average ≤ 1%		
Wind Speed	B.5.5	Calibration/ Accuracy	Annually or after major maintenance	≤5 m/s: ±0.25 m/s >5 m/s: ±5% not to exceed 2.5 m/s	EPA SLAMS Program MQO	90%
		Starting Threshold	Annually or after major maintenance	0.5 m/s	EPA SLAMS Program MQO Manufacturer's specifications	
Wind Direction		Calibration/ Accuracy	Annually or after major maintenance	±5 degrees; includes orientation error	EPA SLAMS Program MQO	90%

Table A-5 Data Quality Indicators (DQIs) Equations list

Instrument	DQI	Equation
Fourier Transform Infrared Spectroscopy (FTIR)	Accuracy: Gas cell verification	$Accuracy\ \% = 100 \times \frac{C_{ref} \cdot f - \bar{c}_m}{C_{ref}}$ C_{ref}- gas cylinder concentration $\bar{c}_m$- Average of measured concentrations per defined open path f- The ratio between the cell path length and the defined open path length
	Precision: gas cell verification	$Precision\ \% = 100 \times \frac{\sqrt{\frac{\sum(C_{mi} - \bar{c}_m)^2}{n}}}{\bar{c}_m}$ C_{mi}- Measured concertation of the ith measurement n - number of measurements (min. 5 once the concentration stabilizes)
	N_2O accuracy – periodic check	$Accuracy\ \% = 100 \times \frac{N_2OC_{atm} - N_2OC_m}{N_2OC_{atm}}$ N_2OC_{atm}- N_2O atmospheric background level N_2OC_m- Daily average of measured N_2O concentrations
	N_2O precision – periodic check	$Precision\ \% = 100 \times \frac{\sqrt{\frac{\sum(N_2OC_{mi} - \overline{N_2OC}_m)^2}{n-1}}}{\overline{N_2OC}_m}$ $\overline{N_2OC}_m$=Monthly average of N_2O concentrations N_2OC_{mi} - The ith measured N_2O concertation for that month n - number of measurements
Ultraviolet Differential Optical Absorption Spectroscopy (UV-DOAS)	Accuracy: Gas cell verification	$Accuracy\ \% = 100 \times \frac{C_{ref} f - \bar{c}_m}{C_{ref}}$ C_{ref}- gas cylinder concentration $\bar{c}_m$- Average of measured concentrations per defined open path f- The ratio between the cell path length and the defined open path length
	Precision: Gas cell verification	$Precision\ \% = 100 \times \frac{\sqrt{\frac{\sum(C_{mi} - \bar{c}_m)^2}{n}}}{\bar{c}_m}$ C_{mi}- Measured concertation of the ith measurement n - number of measurements (min. 5 once the concentration stabilizes)

Instrument	DQI	Equation
Black Carbon Aethalometer	Bias: Flow Rate	$Bias\,\% = 100 \times \frac{Flow\ rate_{\ ext} - Flow\ Rate_m}{Flow\ Rate_{ext}}$ $Flow\ rate_{\ ext}$ - External calibrated flowmeter reading (mLPM) $Flow\ Rate_m$ - Aethalometer- flow rate reading (mLPM)
	Bias: Neutral Density (ND) Optical Filter test	Bias of response to ND filters = linear fit slope $Slope\ = \frac{\sum(x_i - \bar{X})(y_i - \overline{Y})}{\sum(x_i - \bar{X})^2}$ X - Measured attenuation values Y - Calibrated attenuation values
Hydrogen Sulfide (H_2S) Ultraviolet (UV) Fluorescence	Accuracy: Gas cylinder span	$Accuracy\,\% = 100 \times \frac{C_{ref} - C_m}{C_{ref}}$ C_{ref}- Cylinder H_2S concertation C_m- Measured H_2S concertation
	Precision: Gas cylinder span	$Precision\,\% = 100 \times \frac{H_2S\ STB}{C_m}$ $H_2S\ STB$ - standard deviation of H_2S Concentration readings. Data points are recorded every ten seconds. The calculation uses the last 25 data points. The instrument output parameter is named “Stability” C_m- Measured H_2S concertation
$PM_{2.5}$ & PM_{10} BAM	Accuracy: mass density reference membrane	$Accuracy\,\% = 100 \times \frac{\mathrm{ABS} - m_{ref}}{ABS}$ ABS– the factory given mass density (mg/cm^2) of the reference membrane foil $m_{\ ref}$ – measured mass density of the reference
	Bias: Flow Rate	$Bias\,\% = 100 \times \frac{Flow\ rate_{\ ext} - Flow\ Rate_m}{Flow\ Rate_{ext}}$ $Flow\ rate_{\ ext}$ - External calibrated flowmeter reading (LPM) $Flow\ Rate_m$ - BAM flow rate reading (LPM)
Metals (Cd, Ni, Mn) XRF	Accuracy: Calibration Check	$Accuracy\,\% = 100 \times \frac{M_{std} - M_{rep}}{M_{std}}$ M_{std}- Standard Mass (ng) M_{rep} - Reported Mass (ng)
	Bias: Flow Rate	$Avg\,\% = Average\ (100 \times \frac{Flow\ rate_{\ ext\ i} - Flow\ Rate_{m\ i}}{Flow\ Rate_{ext\ i}})$ $Avg\,\%$ – Averaged percentage difference $Flow\ Rate_{ext\ i}$ – External calibrated flowmeter ith reading (LPM) $Flow\ Rate_{m\ i}$ – Flow rate i reading (LPM) i^{th} flow rate (out of three rates)

Instrument	DQI	Equation
Wind Speed	Calibration/ Accuracy	$Accuracy\ [m/s] = (RPM_r - RPM_m) \times 0.00512$ $$Accuracy\ \% = 100 \times \frac{RPM_r - RPM_m}{RPM_r}$$ RPM_r- Calibrated rotor speed in round per minute (rpm) RPM_m - Measured wind speed in round per minute (rpm) Anemometer factor - 1 m/s = 0.00512 X rpm
	Starting Threshold	Starting torque of 1 gr-cm equivalent value to 0.5 m/s Starting Threshold
Wind Direction	Calibration/ Accuracy	$Accuracy\ [deg.] = WD_s - WD_m$ WDs- Set wind direction WD_m – Measured wind direction
All sensors	Completeness	$$Completeness\ \% = 100 \times \frac{AMD}{PMD} = 100 \times \frac{PMD - NA + wNA}{PMD}$$ AMD-actual measured data PMD-potential measured data NA-not available data wNA-not available data due to weather* * The completeness calculation for the UV-DOAS and FTIR sensors can exclude invalid readings at times of bad weather which reduces visibility and increases the noise for the open path spectroscopy. Valero’s reported result is without this facilitation.

A.8 Special Training/Certifications

All qualified personnel will become familiar with the fenceline monitoring system and its proper use. Ongoing training is provided to all responsible parties involved with the fenceline monitoring system as needed. The roles and responsibilities are listed in Table A-6 and will be adjusted as needed for each party.

Table A-6 Training and Responsibilities

Organization	Role	Responsibilities	Training*
Ultramar	Program Administrator	Rule 1180 compliance; Quarterly audit reporting and analysis; QAPP; Public website management	Rule 1180 compliance Quality assurance procedures Client UI
Ultramar	Environmental Staff	South Coast AQMD communication ; Response and notification from; Fenceline monitoring (FLM) system	Rule 1180 compliance Client UI
Ultramar	Facility Operations	Response and notification from FLM system	Rule 1180 compliance
Ultramar	Maintenance – Instrumentation & Electrical	Instrumentation, electrical, & data communication network	Rule 1180 compliance Quality assurance procedures Instrument hands-on training Client UI
Atmosfir	Project manager	Quarterly audit reporting and analysis; Public website development and maintenance; Open-path equipment calibration, maintenance, & repair; Point sensor equipment calibration, maintenance, & repair; QAPP	Rule 1180 compliance Quality assurance procedures Instrument hands-on training
Atmosfir	QA Manager	Quarterly audit reporting and analysis; Ambient air quality data analysis; Public website development and maintenance; QAPP	Rule 1180 compliance Quality assurance procedures
Atmosfir	Spectroscopist	Ambient air quality data analysis; Spectral validation	Rule 1180 compliance Quality assurance procedures
Atmosfir	Field technician	Open-path equipment calibration, maintenance, & repair; Point sensor equipment calibration, maintenance, & repair	Rule 1180 compliance Quality assurance procedures Instrument hands-on training

* The training listed above contains at least the following:
Client UI training – basic spectral validation, basic examination of results and alerts, and reports.
Rule 1180 compliance training – knowledge of Rule 1180 and AQMD guidelines.
Quality assurance procedures training – SOP, documentation, validation.
Instrument hands-on training - field training for all instruments in the FLM, documentation.

No special certification of field personnel is required for this project other than refinery-specific safety training and Refinery Safety Overview (RSO) training necessary for site access. Field personnel conducting all the field activities are experienced staff whose members either received hands-on field training or gained former experience in similar monitoring activities and equipment.

The open path measurements analysis will be conducted automatically by dedicated software for ambient air quality data management and analysis, and manually inspected by professional highly experienced personnel, including spectral analysis.

Facility personnel will get full training by Atmosfir on the use of the Client User Interface of the dedicated software, including results examination, first level of maintenance, and first level review of the spectral validation feature (see section D.2.3).

A.9 Documents and Records

The refinery will document all activities related to data collection, analysis, validation, and reporting. Table A-7 contains a list of the records maintained by the air monitoring program. These records can be electronic, bound in notebooks, and/or forms that are used for specific applications.

Table A-7 Documentation and Reports

Documentation Type	Frequency	Archive	Retention Period
Monitoring Data	Online Upload	Google cloud server	5 years
Raw Spectral Data	Online upload	Google cloud server	5 years
QAPP	Reviewed annually or modification/upgrade to FLM system as needed	Ultramar and Atmosfir archives	5 years
Copies of Field Logbooks	After each site visit	Ultramar and Atmosfir archives	5 years
Equipment Calibration Records	Per calibration	Ultramar and Atmosfir archives	5 years
QA/QC checks and audit assessments	Per check	Ultramar and Atmosfir archives	5 years
Training	Per training	Ultramar and Atmosfir archives	5 years
Quarterly Reports	Quarterly	Ultramar/Atmosfir archives, website	5 years

The quarterly reports will be submitted to South Coast AQMD and uploaded to the website in electronic format no later than sixty (60) days after the end of each quarter.

This QAPP is a key component of the quality system developed for a project. It is intended to ensure that the data used in decision-making processes have known, defensible, and documented quality. This QAPP and associated standard operating procedures are reviewed annually and updated when significant changes are made to the monitoring equipment or sampling and analysis procedures. The Refinery is responsible for distributing the approved QAPP to the distribution list in Section A.3, both initially and when revisions are approved.

Other documentation relevant to the FLM are the approved FAMP, Specific Cause Analysis reports, and Independent Audit reports that with the QAPP will also be published on the Public website.

Data flow and data backups are as follows:

- Sensors in the site generate the raw data.
- The fenceline instruments are connected to a front-end PC in each cabinet. The computer gets the raw data from the instruments, and the raw data is saved in local files and sent to the cloud system for storage and analysis. The local files are a local backup for cases of temporary network failures. Once the raw data reaches the cloud, it is stored in a database.
- The backend runs algorithms to identify pollutant concentrations and perform real-time data analysis, automatic QC, reports, etc. The results are also stored in the database.
- The cloud system resides in GCP (Google Cloud Provider), with automatic backups of the analysis results and the raw data, in order to assure redundancy and disaster recovery.
- The database (raw data and analysis results) has daily backups of the last 60 days, and each copy holds the entire data set.
- The cloud storage bucket (raw data) is automatically backed up every day.
- The data is retained on the server for 5 years.
- The system includes web users' interfaces (UI) for Client UI and Admin UI. Client users and Admin users can each use the system with separate interfaces. Both interfaces are secured and allow controlled access according to user permissions. The UIs query the backend system and get results to display for the users on the web interface. The Admin UI includes system management capabilities.
- The public website uses an independent database that synchronizes on-line in real-time with the system database.
- The public website database also resides on GCP and will retain data for 5 years.
- The system backend is protected with a WAF (Web Application Firewall) and a second layer of protection (VPN - Virtual Private Network) between the backend and the database. The cloud storage, which stores the raw data, is a private protected storage.

The public website will contain the current near real-time meteorological and air quality chart trends, data values, timestamps, and quality assurance flags (see details in section B.9.2). Historical data will also be available for review and download from the public website with specific time periods request. All near-real time data records will be clearly identified as preliminary data. A validated dataset will be posted to the public website with the quarterly reports. Once the approved data set is published with the quarterly report this will be the only data set available to the public. The users will be able to download this final data set for each quarter for at least 5 years.

B DATA GENERATION AND ACQUISITION (TECHNICAL APPROACH)

This section describes the project design and implementation of the monitoring program, including sampling methods, sample collection, data handling and analysis, quality control requirements, equipment testing, inspection, calibration, and maintenance, and managing and validating the data.

B.1 Sampling Process Design

The fenceline air monitoring system is designed to measure routine emissions from the refinery and detect leaks, as well as unplanned releases from refinery equipment and other sources of refinery-related emissions. The fenceline air monitoring system will inform the refinery and the public about air pollution exposure at the fenceline and in nearby communities.

The monitoring methods and equipment implemented provide quality air pollutant measurements and meteorological data that meet the requirements of Rule 1180. A local PC collects the raw data from the instruments and stores it locally in files until it is sent to the cloud system for storage and analysis. All the files are saved in the database. The public database synchronizes with the system online and then the public website sends queries to the cloud database to view the data (See Section A.9 for full description).

The monitoring equipment will continuously monitor pollutant concentrations in near real-time at all the fenceline monitoring locations. This minimizes the potential that an air quality event may go undetected when it occurs between periodic sampling events.

B.2 Sampling / Monitoring Methods

Sampling and monitoring for this project will use a combination of extractive point monitoring and open path monitoring. In both cases, pollutant concentrations are monitored continuously using equipment located at each fenceline.

The open path technologies analyze the air sample at its place, on the path, and no sample of the air is drawn to the sensor itself. The point sensors extract the air sample to the sensor itself through tubing which extends from the outside of the cabinet to the point sensor. The tubing materials meet the manufacturers' recommendations. H_2S sampling requires polytetrafluoroethylene tubing and related polymers such as PTFE and PFA, which are considered acceptable by the EPA as intake sampling material for reactive gaseous pollutants. These polymers do not react with hydrogen sulfide, so no hydrogen sulfide is lost in the inlet tubing. The air sample for BC analysis is conveyed through a sharp-cut cyclone $PM_{2.5}$ inlet into the black carbon analyzer (aethalometer), and carbon conductive tubing, designed to prevent particle loss to electrostatic and impaction mechanisms during sample transport. The air sample for PM mass and metals analysis is conveyed through a size-selective inlet, as follows: to measure PM_{10} mass fraction, the PM_{10} Size-Selective Inlet is installed directly onto the inlet tube; to measure $PM_{2.5}$ mass fraction and metal-element mass fractions, a $PM_{2.5}$ size selective cyclone is installed after the PM_{10} head.

The extractive probes siting (for the point measurements) and site configuration for the monitoring are, to the extent practical, based upon 40 CFR Part 58 Appendix E as well as manufacturer recommendations.

Data integrity is maintained by the data flow and backups as described in Section A.9.

The best available technologies were chosen per pollutant to satisfy South Coast AQMD Rule 1180 requirements after considering their limitations. These technologies are listed in Table A-3 above, and specified in the section B.4 below.

To fulfill Rule 1180 requirements, data will be reported on the public website in 5-minute concentrations, 1-hour rolling average concentrations, 8-hour rolling averages, and 24-hour rolling averages. The 5-min concentrations will be reported in a 5-min update time and the longer rolling averages will have a 10-min update time. The 10-min interval was chosen based on the FTIR 1-hr spectral average (explained in the next section). $PM_{2.5}$, PM_{10}, and Metals sensors will be reported only as 1-hour averages, 8-hour rolling averages, and 24-hour rolling averages with a one-hour update time. PM mass fractions will be measured by beta attenuation monitoring (BAM), which is superior to other technologies in the scope of Rule 1180 since it is by far more robust and insensitive to the particulate type than other continuous PM monitoring technologies (see more details on this method below); however, it requires hourly sampling to obtain satisfactory detection limits. XRF for metals also requires a long sampling period since it has a limited filter tape extent that makes minute-scale sampling impractical due to the tape replacement frequency (every few days). The XRF analysis is conducted after the sampling is completed and in parallel to the next sampling cycle which causes an inevitable lag in the reporting time. Note that XRF for metals and BAM for PM are the Best Available Technologies for continuous near-real-time measurements, as the Rule requires, considering that the thresholds are 1hr and above.

For the OP FTIR 1-hour data, the Atmosfir D-fencline^{TM} system averages the single beams, and not the concentrations, in that period. This process reduces the potential over-estimation from reporting MDLs for those readings that fall below the detection limit, and it reports one reading of the actual measurement for the entire sampling duration in question. Using a 10-minute update time is superior compared to a 5-minute update time as it enables reaching the extremely low detection limits required to meet Rule 1180 goals and intent.

In case of a reading that falls below the corresponding detection limit, the detection limit value will be used instead of the reading value in calculating averages. That implies that all average calculations are presented as an upper limit for the actual concentration, except for the Aethalometer (BC) readings where the 1-min raw concentration is taken “as is” for the time average to remove random noise, and the open-path technologies where the detection limit is dynamic and system limitation cannot replace the reading with the dynamic detection for the average calculation. For the open path measurement, the detection limit is replaced with zero.

An average concentration below the quantification limit will be marked as "BQL" (Below Quantification Limit) for the public website. The quantification limits for the Open Path technologies are the actual quantification limits calculated in real-time for each measurement (see QC section B.5) and on top of that, in the public site, the reporting limit will be set at a fixed value, which will be evaluated periodically as part of the validation process (see section B.9.2).

Wind data will be averaged and presented according to the same sampling durations as the concentrations of the pollutants: 5 minutes and 1 hour. Wind data will not be calculated for the larger averages, 8-hr and 24-hr, since the large averages do not contribute any additional information.

Raw data will continue to be stored after averaging to allow for subsequent detailed evaluation.

B.3 Sample Handling and Custody

Continuous monitors analyze and report results in near real-time without additional sample handling or conventional custody forms. Other forms are the Maintenance and Calibration forms and Site Logs for all instrumentation. These records will document any potential problems, maintenance, operation, and other relevant activities.

All records are kept and backup in a way that no record, either the raw data or calculated data or any form will be lost (see section A.9).

Any change to preliminary data as part of the validation process (see section D) will be marked and recorded with the reason for the change, who approved it, and on what level the change was done (Database / external spreadsheet); the data will also be saved before the change. The final data record and the reason for the change will be posted in the quarterly report.

B.4 Analytical Methods

Six different monitoring technologies will be used as part of the fenceline monitoring system, in addition to monitoring meteorological conditions. The equipment will be operated and maintained in accordance with Standard Operating Procedure (SOP) documents. The SOPs for the FLM are enclosed in the appendix, as a separate file. SOPs are living documents that are updated as needed. The analytical methods are briefly summarized below.

B.4.1 Aethalometer

The Aethalometer is selected for black carbon measurement as a mature technology specialized for this single purpose. The unit continuously samples ambient particulate matter at 5 liters per minute on a Teflon-coated glass fiber filter tape. The collected particles are analyzed based on light transmission through the filter; the light is attenuated by the accumulating particles on the filter. The Aethalometer divides the sampled air into separate streams that flow through the filter. Another separate stream of filtered air is also passed through a designated location on the filter. Measuring the attenuation of light through three cross sections on the filter is used to compensate for blank filter, particulate overload effects and non-linearities. Rate of change in the light absorbance between samples is used to calculate the mass concentration of latest sample. The Aethalometer measures absorbance at seven wavelengths channels simultaneously. The data obtained from measurement at 880 nm (channel 6) corresponds to black carbon concentration. The filter tape advances automatically when a loading threshold is achieved so that sampling can begin on new filter spots and maintain sensitivity.

B.4.2 Ultraviolet (UV) Fluorescence Hydrogen Sulfide (H_2S) Monitor

The hydrogen sulfide analyzer continuously samples air flow at 0.6 liter per minute, converts H_2S to SO_2 and analyzes concentration by measuring sulfur dioxide (SO_2) fluorescence in response to UV light. First, the sample flows through a particulate matter filter to avoid optics contamination, a hydrocarbon scrubber to remove other species such as naphthalene and meta-xylene that interfere with the ultraviolet measurement, and a chemical scrubber to remove any sulfur dioxide residues in the sample. Then the filtered sample flows through a molybdenum converter heated to 315 ºC to catalytically oxidize hydrogen sulfide in the sample to sulfur dioxide. The sample proceeds to an optical chamber where it is radiated by a monochromatic ultraviolet light (214 nm) that selectively excites SO_2 molecules. While returning to ground state each molecule emits a photon at 330 nm, going through a photomultiplier to provide a measurable signal by a UV detector. The Model T101 prevents ozone absorbance and bias by applying a very short light path between the area where the excited SO_2 fluorescence occurs and the detector. That way the amount of O_3 reasonably expected has negligible effect.

B.4.3 Open Path Fourier Transform Infrared Spectroscopy (FTIR)

The FTIR includes an infrared (IR) source, interferometer, and detector. The interferometer takes the IR radiation and splits it in two. One part is reflected to a fixed mirror, and the other proceeds to a moving mirror. The two beams of IR are then recombined and interfere in a destructive or constructive mode, depending on the path distance between them. The change in path distance produces a modulated IR radiation called an interferogram. The moving mirror and radiation sampling are controlled by pulses of a dedicated laser. Applying Fourier transform to the modulated intensity results in an IR spectrum (radiation vs its frequency). The use of IR modulation instead of grating enables to preserve most of the signal intensity and still obtains thousands of frequencies. In open-path measurements, the IR beam is aligned to travel through an open path, typically 100-500m in length, hits a reflecting mirror and travels back to the detector. The IR radiation is thus partially absorbed by chemical species in the open path, linear to the present compound's concentration and the path length. The measured absorbance is the sum of all the present compounds' contributions. The high frequency resolution enables to differentiate between unique spectral absorbance signatures of multiple species and retrieves the concentration of dozens of compounds from each measurement. The multiple concentration retrieval is based on a CLS algorithm using standard reference spectra (absorbance coefficients per compound measured in standard laboratory conditions).

B.4.4 Open Path Ultraviolet (UV) - Differential Optical Absorption Spectroscopy (DOAS)

The UV-DOAS instrument applies Xenon lamp to emit UV light through an open path to a receiver at the end of the path (typically, 400-600 m long). An auto-alignment system keeps the UV beam focused on the receiver. From the receiver the light is directed by fiber optic cable through a grating wheel to fall on a detector to collect a spectrum. The UV light is partially absorbed by several organic compounds, ozone, nitrogen dioxide and sulfur dioxide. The analyzer software controls the grating wheel to scan a set of spectral regions where the monitored compounds have specific absorbance patterns in UV light. Each spectrum is automatically normalized to the instrument line shape (a fixed spectrum, measured and saved per specific UV-DOAS unit at the manufacturer). The analyzer algorithm mathematically fits a background spectrum to the normalized spectrum and uses it to calculate the differential absorbance spectrum. Then, a best-fit analysis, using the reference spectrum of each compound to retrieve their respective concentrations, based on Beer-Lambert Law. The reference spectra are measured at the manufacturer's laboratory for calibrated concentrations.

B.4.5 BAM (Beta-ray Attenuation) Particulate Monitoring

The Beta Attenuation Monitor (BAM) measures the mass concentration of ambient particulate (aerosol) based on beta-ray attenuation. The monitor draws air flows through a PM size-selective inlet and across a glass-fiber filter tape. The beta-ray that is emitted from a 14C isotope traverses first across clean filter tape and then transverses the PM-collected spot on the filter. The beta ray that goes through the filter tape, I_0 and I respectively, reaches a scintillation detector that measures the radiation flux counts. The beta attenuation, $\ln\frac{I_0}{I}$, equals the aerosol mass, M (mg), multiplied by the aerosol absorption cross-section coefficient, μ (cm2/mg), and divided by the PM spot area, S (cm^2). The absorption cross-section μ is fixed and determined by factory calibration per BAM unit. It mostly depends on the mass of the absorbing species and is not affected by its chemical composition. Therefore, an accurate mass concentration is obtained for all commonly found species in ambient particulate matter such as soot, iron oxide, silica, or salt without pre-knowledge about the chemical composition of the sampled PM. PM mass concentration (mg/m3) is derived using the flow rate and the setup sampling time. The stated detection levels require 1-hour cycle measurement, including 42 minutes of sampling, and two 8-minute intervals of beta radiation detection before and after the sampling. The filter tape movements occur in the spare two minutes. This configuration meets the EPA and EU-designated PM2.5 configuration. When running the BAM as a US-EPA-designed equivalent method for PM10, the detector count time may be set to 4, 6, 8, or 10 minutes as long as the total measurement cycle is 1 hour.

The Met One BAM models are US-EPA designated for PM_{10}, and $PM_{2.5}$ measurements when using the specific size selection configurations. This implies that two separate BAM sensors should be utilized for these two fractions. Concentrations are reported as actual flow conditions.

B.4.6 XRF (X-ray fluorescence)

The monitor draws ambient air through a PM size-selective inlet and across a filter tape. The resulting PM deposit is then automatically advanced and analyzed by the nondestructive X-ray fluorescence (XRF) system for the multiple selected metals (up to 67 elements). The sampling and the analysis are conducted simultaneously and continuously, except for the time required to advance the tape (~20 seconds) and the time for daily automated quality assurance (QA) checks (30 minutes). The metal mass (ng per deposited spot) is determined by energy dispersive-X-ray fluorescence (ED-XRF) spectroscopy. The sample tape passes through the block of the source detector. The source is an X-ray tube, activated by a high-voltage power supply, that emits X-rays and irradiates the deposit. In response, the external electrons in the metal atoms are temporarily excited. During the return to a lower energy level, the electrons emit energy as fluoresced photons. The photons reach a solid-state detector, are sorted by energy levels (channels), and counted. The energy level of the fluorescing X-ray is element-characteristic.

The counts per channel are normalized to tube current and live time to generate net count rates. The spectrum is a plot of intensity versus energy. The intensity of the characteristic radiation is directly proportional to the mass of each element in the sample. The measured spectrum is analyzed to quantify the contributing elements to the spectral peak intensities. A process of spectral deconvolution, based on least squares, fits multiple reference spectra stored in the instrument library to the measured spectrum. The quantitative calibration parameters uploaded to the instrument are used to convert element intensity to element mass (ng). Element-mass concentration (mg/m^3) is derived using the flow rate and the setup sampling time.

B.4.7 Meteorological Equipment

The wind speed sensor chosen is a high-resolution wind sensor designed specifically for air quality applications. The unit is equipped with precision-grade stainless steel ball bearings. The wind speed measurements are made with a four-blade helicoid propeller, which produces a signal directly proportional to wind speed. The starting threshold is 0.5 meters per second (m/s). The wind speed on the public website will be reported in miles per hour.

The wind direction sensor consists of a counter-balanced, lightweight vane and precision low torque, highly reliable potentiometer that yields a voltage output proportional to the wind direction. Once properly oriented on the cross-arm, the wind direction sensor can be removed without requiring reorientation. The vane starting threshold is 0.5 m/s at 10-degree deflection and has an accuracy of ±2 degrees.

B.5 Quality Control

This section describes the routine quality control (QC) procedures used for the fenceline monitoring program. All procedures have been specifically designed to provide the appropriate quality control and ensure that defensible data of a known quality recovery is maximized.

The air quality monitoring program will follow the quality control guidelines stated in the following documents:

- 40 CFR Part 58 Ambient Air Quality Surveillance
- EPA’s Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I: Principles,
- EPA’s Quality Assurance Handbook for Air Pollution Measurement Systems Volume II: Ambient Air Specific Methods, December 2008,
- EPA's Compendium Method TO-16 Long-Path Open-Path Fourier Transform Infrared Monitoring of Atmospheric Gases, January 1999, EPA/625/R-96/010b
- Equipment Manuals.

The meteorological monitoring program will follow the quality control guidelines stated in the following documents:

- Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, March 2008; and
- Meteorological Monitoring Guidance for Regulatory Modeling Applications, 2000.
- Equipment Manuals.

The specific QC checks for each instrument are discussed below. For a summary of the QC criteria and limits, see Table B-1. The frequencies of these checks are detailed along with the maintenance procedures in section B.6. For a list of the QC checks that are part of the DQIs, see Table A-4 above.

B.5.1 Black Carbon Aethalometer Quality Control

- Automatic QC Flagging
  The system and aethalometer instrument software continuously monitor and flag status parameters for subsequent review:
  - Monitor Sample Inlet Flow – is conducted automatically online.
  - Internal Flow monitoring – Internal mass flow meter checks the flow in the calibration range in all flow sections.

- Leak Check
  Leakage is the difference between the flow entering the inlet port and the flow passing through the system downstream of the filter. The difference is due to tangential leakage through the edges of the filter tape. The acceptable leakage limit is <10%.

- Clean Air Test
  The Clean Air test is conducted using the built-in filter to determine the stability and performance of the Aethalometer under airflow conditions. Acceptable limit: mass concentration lower than 550 ng/m^3.

- Stability Check
  The Stability Test determines the performance of the light source and detector, without air flow through the system. Acceptable limit: mass concentration lower than 450 ng/m^3.

- Flow Check (flow verification, flow calibration)
  The flow is initially checked by the Flow Verification software routine that allows the operator to check if the internal flow sensors are responding accurately using an external flow meter. The test is satisfactory if the difference of flow readings is less than +/-10%. If the test fails then the flow should be recalibrated using the manual calibration routine; see Section B.7.2.1.

- ND Filter Test
  See section B.7.2.1

B.5.2 H_2S UV Fluorescence Analyzer Quality Control

- Automatic QC Screening and flags
  The System and UV Fluorescence instrument software automatically screens status parameters to validate its measurements for accuracy or flag them for subsequent review:
    - UV Fluorescence instrument software identified invalid data.
    - Check the range of operational parameters (temperature, pressure, flow, etc.), and if out of range, will flag for further review.

- Zero and Span Test
  Verification check in the lower range. The H_2S span concertation of this check is in the lower range of about 30 ppb, closer to the health threshold. This check is intended to verify concentration in a shorter interval (biweekly) than the checks with the higher span, but it does not alter the analyzer's calibration curve. The acceptable limits are detailed in Table B-1.

- Calibration check and Zero/Span Calibration
  A calibration check is performed quarterly with an H2S gas cylinder. The concentration of the flowing gas should be 400ppb-500ppb to check the full analyzer span. This concentration was set to cover the expected extreme concentration in the area. The acceptable limits are detailed in Table B-1, see section B.7.2.2 for details on the calibration process when not in limit.

B.5.3 Open Path FTIR Quality Control

Open path monitoring requires the use of specialized quality control check procedures.

- Automatic QC Screening
  Atmosfir's software runs automatic QC screening in real-time at two data levels- the raw single beams and the absorbance signals. This screening evaluates the following:

  - Intensity: The open path system parameter of the entire IR beam. A minimum threshold and a change of signal threshold are defined to reject bad single beam(s), such as might occur if the beam were blocked momentarily by-passing traffic or equipment. The parameter is tunable per mirror.
  - Nitrous Oxide (N_2O) background concentration: This N_2O is monitored due to its global prevalence at uniform concentrations. A maximum delta is allowed between sequential measurements (as a default ±15% from the atmospheric background level). The maximum allowed delta is a tunable parameter per mirror.
  - Spectral validation: The detected signal is validated by calculating correlation between the measured signature and the reference signature. The spectral validation correlation threshold filters detections that won't pass the spectral validation. This ensures that unrecognized pollutants are not falsely pattern-matched and labeled as pollutants being monitored for this project.
  - Concentration error calculation: Real-time QC tests per every absorbance spectrum, and every compound analysis. The error, which is the fitting residual of the CLS, is calculated for the spectral analysis range and sets the actual method detection limit (MDL) as three times the measurement error (according to EPA Method TO-16 Long-Path Open-Path Fourier Transform Infrared Monitoring of Atmospheric Gases, Section 5.13). Calculating the Method Quantification Limit (MQL) as a function of the MDL (compound specific factor) as a minimum threshold to confirm a detection. Any concentration that falls below this level will be flagged as BQL (Below Quantification Limit).
  - Signal to Noise Ratio (SNR)– The ratio between the measurement concentration and the measurement error is calculated per measurement. The SNR must meet a minimum threshold as defined per compound and site.
  - Interference check- each measurement is checked for the presence of the interfering compounds to include in the CLS analysis.

- Gas Cell Verification
  A gas cell verification with a known gas concentration to effectively test instrument response using a gas cell of practical size, the gas cell must use a very high concentration of the pollutant gas. The gas to be used for this test can be ammonia or Isobutylene, while ammonia is least harmful from the target compounds of 1180, isobutylene is even less harmful and more stable and hence is better for this test. Both compounds' signatures for analysis are in the same spectral range. See Table A-4 for the MQOs limits. If the test fails to meet the MQO, an investigation will begin to understand the reason and a corrective action will be executed accordingly.

- Stray Radiation
  Stray radiation is a source of uncertainty that should be controlled and minimized. In a monostatic FTIR configuration the radiation is modulated before passing the open path, and therefore any internal stray radiation is a constant for the instrument that results from scattering within the instrument, bypassing the intended beam path and the actual monitoring path. It does not change with the monitoring path or the meteorology. The internal stray radiation can be determined by measurement without a reflector and poses a problem for measurements only at low intensities. The stray light is automatically compensated.

Under regular maintenance, values range from 0.05 to 0.15V (pending on the specific open path and the base signal).

- Periodic Atmospheric N_2O
  A check for N_2O concentration compared to the atmospheric background levels can be used as a QC check for the system as this substance is present in relatively constant amounts in ambient air. Two parameters will be periodically checked in addition to the real-time automatic QC check for N_2O (see above section), the N_2O precision and the N_2O accuracy. The N_2O precision will be calculated for each month from the standard deviation of the N_2O measurements for the month. The N_2O accuracy will be calculated for one day for each month against current N_2O background levels[3] (this check is not applicable for long paths >500m where saturation of the absorbance may occur). For the N_2O DQO accuracy and precision see Table A-4These checks will be performed for each path. If any of these checks fail, the relevant system needs to be checked, and corrective action needs to be performed as needed.

B.5.4 Open Path UV-DOAS Quality Control

Open path monitoring requires the use of specialized quality control check procedures.

- Automatic QC Screening and flagging
  The System and UV-DOAS instrument software automatically screen status parameters in order to validate its measurements for accuracy or flag them for subsequent review.
    - Intensity: The intensity of the signal on the receiver is derived from the required signal gain to reach the setup signal level to trigger a measurement. The gain is defined as a percentage of the allowed gain. A minimum of 30% is required to obtain a valid measurement.
    - Concentration error calculation - The standard deviation of the actual measurement data is checked for every measurement on every compound. The Method Quantification Level (MQL) is two times the standard deviation. Measurements below the MQL are flagged as BQL.
    - Signal to Noise Ratio (SNR): The ratio between the concentrations to the calculated measurement error. The instrument’s internal SNR threshold is at least 10. Below that level, the level of noise is considered too large relative to the measured concentration, and the value is rejected. This parameter is tunable for each compound.

- Gas Cell Verification
  A gas cell verification with a known gas concentration will be conducted with one gas from the required pollutant gases measured by the UV-DOAS for the project. Benzene has been chosen from the UV-DOAS compounds for this test since it has been classified as a common toxic substance of concern to the US EPA and health professionals. This serves as a precision and accuracy test; see Table A-4 for the MQOs. If the test fails to meet the MQO, an investigation will begin to understand the reason and a corrective action plan will be executed accordingly.

- Multipoint Span/Offset Calibration
  Calibration requirements are discussed in Section B.7.2.

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[3] From the NOAA/ESRL halocarbons in situ program, https://www.n2olevels.org/

- Reference Check
  The reference spectrum is the raw lamp spectrum and needs to be updated to compensate for changes in the analyzer spectrometer and electronics, to minimize the measurement noise. The reference check is the measurements of the reference spectrum in the wavelength ranges that are used for the target compound analysis. In practice, each target compound is measured under background conditions using the recorded reference spectrum. In case the results of the concentrations and the deviation are high, a specialist will determine if a reference calibration is needed.

- Light Attenuation Test
  Estimate analyzer sensitivity to change in light intensity for every path to ensure the maximum light amount of light is entering the analyzer. A built-in automated function that, in case of light amount deficiency below a given percentage, automatically readjusts the emitter lamp as well as the receiver fiber cable's position to ensure sufficient operation.
  In case of reduced light intensity over time, a specialist will assess the trends and evaluate if maintenance is needed, such as cleaning mirrors, alignment, or a new reference.

- Wavelength Precision
  Wavelength precision is achieved by the accurate setting of the grating. It is applied by using a calibration Mercury lamp and measuring the spectral window for gas analysis. Its range is typically 40nm. Therefore, the requirement is to obtain an accuracy of the Mercury peak bands within +/- 10 channels. If the threshold is exceeded by less than 50 channels a shift correction is applied and re-checked. If the shift is larger, it should be checked by the manufacturer.

- System check
  Before starting any measurements, a system check (analyzer built-in procedure) is applied. The grating wheel is rotated to the channel position where maximum intensity is obtained on the detector. That peak intensity should be reached at channel 500 +/- 50 out of 1000 channels. The system check procedure is repeated at least twice to validate the stability of the results. If the system check fails, a correction to the measured shift will apply.

B.5.5 BAM Particulate Monitoring Quality Control

- Automatic QC Screening and flagging
  An automated hourly quality control check includes a built-in reference membrane with a known mass density to determine that the calibration is maintained and fits a span concentration of 800 µg/cm3. If the difference is not within +-5%, a warning flag is sent.

- Leak check
  A leak check is performed using a dedicated leak check valve. The valve is connected instead of the PM_{10} head while the $PM_{2.5}$ cyclone is left and part of the check. If the flow rate is 1.5 LPM or less, the leak check is satisfactory; otherwise, the last sample spot on the tape roll is inspected, and the nozzle/vane interface is cleaned. If it fails a second time, the instrument should be checked.

- Flow check
  The flow rate must be maintained at 16.70 L/min for the instrument to work effectively. Flow verification is conducted with an external NIST traceable calibrated flowmeter. A 4% difference is acceptable for flow bias acceptance criteria, but at 2% a flow calibration should be performed to keep an efficient flow over time.

- Flow calibration
  See section B.7.2.5

- Zero filter Background Test
  The initial zero-test is used to determine the instrument noise (σ) and to confirm that the lower limit of detection (LLD), which is 2σ, is within specifications and that the background (BKGD) is maintained stable. A zero-filter assembly is used for 24-72 hours, and the average background concentration is calculated. The BKGD value is the negative of this average and should not change by more than 2 µg/m^3 from the most recent field (not factory) zero-filter test. The LLD is the standard deviation of the sample and should meet the factory-specified value. If any of these values are not in the specification, repeat the zero-filter test, and if the problem persists, the instrument should be checked.

- Beta detector count rate and dark count test
  Count tests are performed with a clean section of filter tape between the source and detector, as in normal operation. The Dark Count Test is performed with a steel shim that is placed between the beta source and detector. The shim blocks all beta particles, and only counts created by noise or cosmic rays will appear. The total four-minute dark count value should be less than 10 counts. If the total is more than 50 counts the instrument should be checked.

B.5.6 XRF Quality Control

- Automatic QC Screening and flagging
  A daily 15-minute energy calibration followed by a 15-minute QA upscale procedure is performed to maintain stable and accurate performance. The automated Energy Calibration tests that the spectral peak for the element is at the correct energy levels. A warning flag is sent if the QA test is not within 10% margins of the factory set point.
  Once a month, an examination of the QA Upscale values is conducted to identify systemic deviation trends from the factory set point over time.

- Leak check
  A leak check is performed while removing all PM inlets and installing the leak tester over the PM inlet tube. If the leak rate is less than 150 mmHg/min, Xact 625i has passed the Leak Check. If the instrument fails the leak check, an examination of the sample tubing and vanes is performed, and the process is repeated. If the instrument continues to fail, it should be checked.

- Flow Check
  Using a NIST-certified reference flow meter, the flow is checked at three points: 15.0, 16.7, and 18.4 l/m. The percentage difference for each of these points is calculated and averaged. The total Average

percentage difference should not exceed 1% when the temperature and pressure are within 10% of the reference values. If this criterion fails, a Flow Calibration is needed.

- Calibration Check
  Each of the elements (Ni, Cd, and Mn) undergoes a quarterly calibration test with SCI element standards. The percentage difference between the corresponding mass (ng) value should be within ±10%. If it fails, the instrument must be checked and recalibrated.

- Flow calibration
  See section B.7.2.6

- Blank test
  With a clean tape installed the elemental masses are determined for Blank measurements. The QA Blank values are monitored for systematic deviations.

B.5.7 Wind Sensor Quality Control

- Starting torques check
  The wind speed threshold test is a torque measurement using a torque disk. The torque disk has a center hole to attach the disk to the propeller; and threaded holes that radiate out from the center. The holes that radiate out from the center are utilized to attach screws of varying weights. The weight (g) is multiplied by its distance (cm) from the center of the disk force torque (g cm). In the sensor model used, a torque of 1 g cm is equivalent to a horizontal wind speed of 0.5 m/s. The minimum measured torque that forces disk movement should be below or equal to 1 g cm. If the starting torque is higher, the sensor should be checked. This check should be performed before the wind speed calibration check.

- Wind direction calibration check
  Calibration requirements are discussed in Section B.7.1.1.

- Wind speed calibration check
  This check should be performed only after the starting torque check. Calibration requirements are discussed in Section B.7.1.2.

Table B-1 QC criteria

QC criteria	Automatic/ Manual	Limit	What to do in case of a failure
Black Carbon Aethalometer			
Sample Inlet Flow	Automatic real-time	Flow is lower/higher than 0.5 LPM	Flag the sample for further review
Internal Flow	Automatic real-time	The ratio between the splitter streams flow outside 0.2 – 0.75 range	Flag the sample for further review
Leak Check	Manual	Leakage <10%.	Check tubing and instrument
Clean Air Test	Manual	Mass concentration < 550 ng/m^3	Check optical chamber
Stability Check	Manual	Mass concentration < 450 ng/m^3	Check optical chamber
Flow Check	Manual	Bias < +/-10%.	flow should be re-calibration
ND Filter Test	Manual	Slope < 10% of unity	Check instrument
H_2S UV Fluorescence Analyzer			
Check range of operational parameter	Automatic real-time	*UV lamp warning 1000-4095mV; Box temperature exceeds range 5-48C; Flow rate 525-675cc/min; Pressure 10- 35inHg; Cell Temperature 45-55C; Converter Temperature 310-320C; High Voltage Supply Output 400-900	Flag the sample for further review
Invalid data	Automatic real-time	Instrument indication	Invalid
Zero and Span Test (~30ppb range)	manual	*15% accuracy and precision	Calibration correction
Zero/Span Calibration (400-500 ppb)	manual	* 15% accuracy and precision	Calibration correction
		Calibration: 0.7-1.3 for slope, -20 to 150 for offsets	Check instrument
* Limits that can change as the project evolves			

QC criteria	Automatic/ Manual	Limit	What to do in case of a failure
Open Path FTIR			
Intensity	Automatic real-time	*50% of maximum signal for a path	Invalid sample
ΔN_2O	Automatic real-time	*15% as default	Invalid sample
Spectral validation correlation	Automatic real-time	*Per compound, per site	Flag as BQL
Error Check (fitting residuals)	Automatic real-time	* MDL=3error, MQL=Function of MDL per compound, per site	Flag as BQL
Signal-to-Noise Ratio	Automatic real-time	*Per compound, per site	Flag as BQL
Ongoing interferences check	Automatic real-time	*Per compound, per site	Accounted in the CLS
Gas Cell Verification	Manual	*20% accuracy and precision	Check instrument
Stray Radiation	Manual	*Amplitude on the detector ≤0.15 V	Check instrument
Periodic Atmospheric N_2O	Manual	20% accuracy, 10% precision	Check the system
Open Path UV-DOAS			
Intensity	Automatic real-time	< 30%	Invalid
Error Check (fitting residuals)	Automatic real-time	Two times the standard deviation of the actual measurement data	Flag as BQL
Signal to Noise Ratio (SNR)	Automatic real-time	*at least 10; per compound, per site	Flag as BQL
Gas Cell Verification	Manual	25% accuracy and precision	Check the instrument
Multipoint Span/Offset Calibration	Manual	Span factors up to 1.25	Check the instrument
Reference Check	Manual	*Per compound (specialist determination)	Apply reference calibration
Light Attenuation Test	Automated	Adjusted per path Specialist determination over time	Maintenance
Wavelength Precision	Manual	+/- 10 channels	Wavelength shift correction
System check	Manual	System Parameters ranges	Wavelength Shift correction / Check the instrument
* Limits that can change as the project evolves			

QC criteria	**Automatic/ Manual**	**Limit**	**What to do in case of a failure**
PM BAM Beta-ray Attenuation			
Calibration check	Automated real-time	+/- 5%	Failed sample
Leak check	Manual	>1.5 LPM	Check and clean, second fail check the instrument
Flow check	Manual	4% for acceptance criteria and 2% for calibration	Calibrate flow
Zero filter Background Test	Manual	LLD < factory specified value and BKGD change < 2 µg/m3 (compared to former field test)	Check instrument
Dark Count Test	Manual	< 50 counts	Check instrument
Metals XRF			
Daily Energy Calibration	Automated	10% of the factory set point Consistent deviation trend from the factory set point	Warning Calibration check
Leak check	Manual	leak rate < 150 mmHg/min	examine sample tubing and vanes and repeat the process
Flow Check	Manual	Average % difference ≤1%	Flow Calibration
Calibration Check	Manual	±10% mass (ng) bias	Check instrument
Wind sensor			
Check starting torques	Manual	0.5 m/s	Check the instrument
Check wind Speed calibration	Manual	For speed ≤5 m/s: ±0.25 m/s For speed >5 m/s: ±5% and < 2.5 m/s	Recalibrate
Check wind direction calibration	Manual	±5 degrees	Recalibrate

B.6 Instrument/Equipment Testing, Inspection and Maintenance

Various types of ambient air monitoring instruments are used in support of air monitoring activities for this project. To ensure data collected by the fenceline monitoring instrumentation is valid, of a known quality and defensible, it is critical to properly test, inspect, and maintain the fenceline equipment.

Fenceline monitoring equipment used in this monitoring program is generally designed to operate without major maintenance or repair. However, routine service checks and preventative maintenance are critical areas of quality control that help to prevent extended periods of downtime, costly errors, and data loss. Table B-2 through Table B-8 present for each instrument the routine maintenance requirements and its schedule. Downtime for each maintenance period per unit is included in the tables; these are estimated times that are dependent on the actual operation on-site in each visit. Trained field technicians are responsible for testing, inspection, and maintenance.

Table B-2 Maintenance and QC Procedures - Aethalometer

Task	On-Line	Monthly	Semi-Annually	Annually	As Needed
Estimated Downtime:	**none**	**1hr**	**3hr**	**2hr**	
Check Sample Inlet Flow, Internal Flow monitoring	X				
Inspect Sample Line Tubing		X			
Inspect and clean insect screen		X			
Inspect and clean size-selective inlet			X		
Inspect Optical Chamber (Clean if Necessary)			X		X
Perform Leak Test			X		
Perform Clean Air Test			X		
Flow check (flow verification & flow calibration)			X		
Stability check			X		
ND filter test				X	
Lubricate Optical Chamber Sliders				X	
Change Bypass Cartridge Filter				X	
Install a New Filter Tape Roll					X

Table B-3 Maintenance and QC Procedures - UV Fluorescence H_2S Analyzer

Task	On-Line	Bi-weekly	Monthly	Quarterly	Semi-Annually	Annually	As Needed
Estimated Downtime:	**none**	**2hr**	**2hr**	**2hr**	**1hr**	**4hr**	
Operating working range	X						
Replace SO_2 Scrubber							X
Replace H_2S to SO_2 Converter Catalyst							X
Replace Particulate Filter			X				X
Verification test low conc.		X					
Zero/Span Calibration				X			
Verify Test Functions			X				
Replace Zero Air Scrubber				X			
Flow Check					X		
Replace Critical Flow Orifice and Sintered Filters						X	
Pneumatic Leak Check						X	
Replace Pump Diaphragm						X (2 years)	X

Table B-4 Maintenance and QC Procedures – Open Path FTIR

Task	On-Line	Monthly	Quarterly	Semi-Annually	Annually	As Needed
Estimated Downtime:	**none**	**1hr**	**2hr**	**none**	**none**	
Light intensity; N_2O background check; spectral validation correlation; concentration error	X					
Retroreflectors cleaning		X				X
Telescope mirror cleaning & alignment check			X			X
Silica gel dry check			X			X
Stray light check					X	
Gas cell verification – Ammonia/Isobutylene			X			
Laser replacement						X
Source replacement						X (12-24 months)
Cooler replacement						X (12-24 months)
Instrument Log examination (remote)				X		
Atmospheric N_2O periodic check (remote)			X (monthly basis)			

Table B-5 Maintenance and QC Procedures – Open Path UV-DOAS

Task	On-Line	Quarterly	Semi-Annually	Annually	As Needed
Estimated Downtime:	**none**	**2hr**	**2hr**	**8hr**	
Light level; error check; and SNR threshold	X				
UV DOAS – Lamp replacement			X		
Cleaning windows			X		X
Mirror replacement					X
Gas cell verification - Benzene		X			X
Span / Offset calibration				X	X
Reference check				X	X
Light attenuation test	X				
Wavelength precision				X	X
System check					X
Instrument Log examination (remote)			X		

Table B-6 Maintenance and QC Procedures – BAM

Task	On-Line	Monthly	2-Months	Quarterly	Semi-Annually	Annually	As Needed
Estimated Downtime:	**none**	**1hr**	**2hr**	**2hr**	**2hr**	**24-72hr**	
Calibration check	X						
Cleaning *		X					
Leak Check		X					
Flow check		X					
Download error log		X					
Check/adjust clock		X					
Replace filter tape			X				
Run Self-Test			X				
Download settings file				X			
Flow calibration				X			
Disassemble PM10 inlet and PM2.5 cyclone and clean				X			
Replace or clean pump muffler					X		
FILTER-T test & FILTER-RH test					X		
Zero filter Background Test						X	
Annual cleaning**						X	
Remove and check membrane span foil						X	X
Detector count rate and dark count test						X	
Replace lithium battery if necessary							X
Replace nozzle O-ring						X (2 years)	
Replace vacuum tubing if necessary						X (2 years)	X
Rebuild the vacuum pump if necessary						X (2 years)	

*Monthly cleaning: Nozzle and vane; capstan shaft and the wheels of the roller; PM10 inlet and PM2.5 cyclone
** Annual cleaning -internal debris filter; vertical inlet tube

Table B-7 Maintenance and QC Procedures – XRF

Task	On-Line	~Bi-weekly	Monthly	Quarterly	Annually	As Needed
Estimated Downtime:	**0.5hr**	**1hr**	**none**	**3hr**	**4hr**	
Daily Energy calibration and QA upscale	X					
Upscale examination (remote)			X			
Replace filter tape roll*		X				
Leak check				X		
Flow Check				X		
Calibration Check				X		
Blank Check					X	X
Flow calibration					X	
X-ray tube replacement					X (1-3 years)	X
Xact Recalibration					X (1-3 years)	X
Cleaning					X	

*Frequency depends on the final selection of sampling time

Table B-8 Maintenance and QC Procedures – Wind Sensor

Task	Monthly	Annually	As Needed
Estimated Downtime:	**none**	**3hr**	
Visual inspection for prop/tail damage, normal movement	X		
Check starting torques		X	X
Replace bearings		X	X
Check calibration		X	X

Prior to installation, all equipment will be visually inspected to ensure there is no physical damage. Installation will be performed according to the manufacturer’s instructions. Acceptance testing procedures will be documented appropriately. Sensors and analyzers that fail to meet specifications will be returned to the manufacturer. Preventative maintenance and quality assurance procedures will be conducted on a routine basis as described in this QAPP.

At least monthly or as needed, beyond the above checks and procedures, the field technician will visit the monitoring station to inspect the monitoring shelter, heating and cooling systems, meteorological tower and sensors, and other auxiliary equipment. The field technician will conduct any maintenance that is required according to the maintenance schedules. Off-site maintenance will be coordinated in a way that at any time, only one unit for the same instrument is under maintenance and replaced by the spare unit when feasible (see section 3.5 in the FAMP for maintenance management).

Some of the checks can be performed remotely, like checking time and date, verification of data streaming, etc. The system is designed to send operations alerts that are monitored by the field operator to ensure proper operation of the equipment and data acquisition system.

Entries, either on-site or remote, will be recorded in a logbook documenting all site activities conducted. These entries will include the date of the visit, reason for the visit, and the activities performed. Entries will be made any time there is a change or modification in the way a sample is obtained, or the station configuration altered. If the field technician encounters a problem which cannot be rectified, a corrective action plan will be used to resolve the issue.

Personnel operating the air quality monitoring and meteorological and systems are trained in the proper operation, calibration, and maintenance of the equipment to ensure continued collection of valid, defensible and representative data.

Measures that will be taken in the event of a system failure or during routine maintenance activities with long downtime are specified in the corrective action section C.1.3 below and in the FAMP under section 3.5 for Routine Maintenance and Failure Management.

B.7 Instrument/Equipment Calibration and Frequency

Detailed calibration procedures for each instrument are provided in the instrument's SOPs. Calibration records will be retained on file for at least five years.

B.7.1 Meteorological Equipment Calibration

Meteorological equipment calibrations will be performed annually with equipment that is in current calibration traceable to the National Institute of Standards and Technology (NIST) or A2LA standards. Instruments that do not meet calibration specifications or fail performance audits will be repaired and re-calibrated. Calibration procedures for the meteorological sensors are presented below, the limits are summarized in Table A-4.

B.7.1.1 Wind Direction

The cross-arm orientation will be checked using a professional compass. The wind vane will be aligned with the cross arm and set to true north. True north is distinguished from magnetic north by reading a magnetic compass and applying a correction factor for the magnetic declination. The declination will be determined from a declination calculation computer program. If the overall wind direction error (orientation plus linearity) exceeds ±5 degrees from true North, the sensor will be re-calibrated.

The wind direction linearity will be checked using a direction template. The sensor response will be checked at a minimum at 30-degree increments in both clockwise and counterclockwise rotations and compared with the data acquisition readings. If the indicated wind direction linearity plus orientation error exceeds ±5 degrees, the sensor will be repaired and re-calibrated.

B.7.1.2 Wind Speed

Horizontal wind speed response checks will be performed using a synchronous motor. Sensor readings taken from the data acquisition will be compared to calibration values obtained from transfer functions provided in the sensor manufacturer’s specifications. If for wind speed ≤5 m/s the error exceeds ±0.2 m/s and for wind speed >5 m/s the error exceeds ±5% or ±2.5 m/s, then the instrument will be recalibrated.

B.7.2 Air Quality Equipment Calibration

Calibration will be performed as scheduled and if one or more of tests show the sampling equipment are outside defined criteria or exhibit abnormal characteristics. Air quality monitoring equipment will be calibrated as summarized in this section.

B.7.2.1 Aethalometer Calibration

The aethalometer’s internal flow meter is calibrated against a NIST-traceable primary standard and adjusted as needed to ensure that the instrument is sampling black carbon at the correct flow rate. It is intended that the flow be checked semi-annually or if the online internal flow monitoring alert is triggered, but the sensor calibration only be adjusted on an as-needed basis when the measured flow deviates more than 10% from the primary standard.

The verification for the response of the optical detectors to varying intensities of light from the optical sources is performed with the Neutral Density (ND) Optical Filter test routine. The ND Test uses 4 optical elements, each fitted with inserts of Neutral Density glass which have stable and standards-traceable optical absorbance. The routine compares the measured attenuation values for each glass element at each wavelength, versus the calibrations at the time of manufacture. The data is analyzed as a linear fit: if the slope differs more than 10% from unity, the test fails.

B.7.2.2 UV Fluorescence Hydrogen Sulfide Analyzer Calibration

Calibration verification is conducted quarterly by flowing known H_2S concentrations within the instrument measurement range while setting the H_2S analyzer in calibration mode. A minimum of two calibration points is used, consisting of a zero and analyzer span concentration. Calibration check in low concentrations is conducted bi-weekly.

The device software controls the valves of the air sampling and calibration gas flows, therefore physical adjustment is not required. When calibration adjustment is required (such as failure in the verification test), in calibration mode, the operator supplies desired multipoint concentrations to the instrument. The software assigns the detector response to each concentration level and fits a linear regression curve to the data. The new calibration parameters are saved in the device software.

B.7.2.3 FTIR Calibration

A reference library is used as part of the FTIR measurement principle to get the concentration for each compound from the spectrum. The reference library consists of calibrated spectra with high spectral resolution using the same spectrometer type used in the system, following high-quality standards (such as NIST and PNNL). According to the methods, the use of this calibration library eliminates the need for calibration performance as part of routine maintenance activity.

B.7.2.4 UV-DOAS Calibration

UV-DOAS concentrations are based on the factory-calibrated spectral coefficients. Annual multipoint calibration retrieves the correction factors, offset, and span, for the factory calibration. Span factors goal criterion is up to 1.25. Higher span values indicate unit failure and require the instrument check and corrective actions as needed.

B.7.2.5 BAM calibration

Each new BAM 1020 has been calibrated against a reference beta gauge whose calibration is traceable to a gravimetric standard. The unit calibration parameters (K and μsw) that are found in each calibration certificate were determined by the factory for specific standard membrane against collocated BAM measurements. The calibration is tested in every measurement cycle for this standard membrane and should stand in 5% agreements. The BAM calibration and response are practically insensitive to the PM chemical composition.

The BAM internal flow meter is calibrated against a NIST-traceable primary standard to ensure that the instrument is sampling at the correct flow rate 16.70 LMP. On an annual basis or if the flow check indicates, the flow is calibrated with three-point flow 15.00, 16.70, 18.40 LMP.

B.7.2.6 XRF calibration

Each Xact 625i is precisely calibrated for the user requested elements of interest. Element Standards are pure element standards and are free from any interfering elements. These standards contain a known amount of each element on a Nucleopore substrate that is mounted on CES-provided standard holder(s). After replacing a tube, the XRF spectra are examined, and the calibration files are adjusted and uploaded to the instrument according to the updated spectra.

The XRF internal flow meter is calibrated against a NIST-traceable primary standard to ensure that the instrument is sampling at the correct flow rate 16.70 LMP. On an annual basis or if the flow check indicates, the flow is calibrated with three-point flow 15.00, 16.70, 18.40 LMP.

B.8 Inspection/Acceptance for Supplies and Consumables

Procurement of items and services is performed through an approved vendor such as the instrument manufacturer or reputable suppliers, sole source non-competitive bid process, or a competitive bid/contract process as necessary.

The field technician is responsible for ensuring the availability and quality of the critical consumables and supplies identified in Table B-9. Spare parts and consumables, as recommended by the manufacturer, will be available for a full year of maintenance. Any expired or used consumable (e.g. gas cylinder, Lamp) will be marked to avoid improper use. Any COA (Certification Of Analysis) for any item such as analyzers, calibration gas, and others, will be checked upon receipt and retained in the documentation materials of Valero Wilmington FLM. Materials will be stored in the dedicated storage onsite.

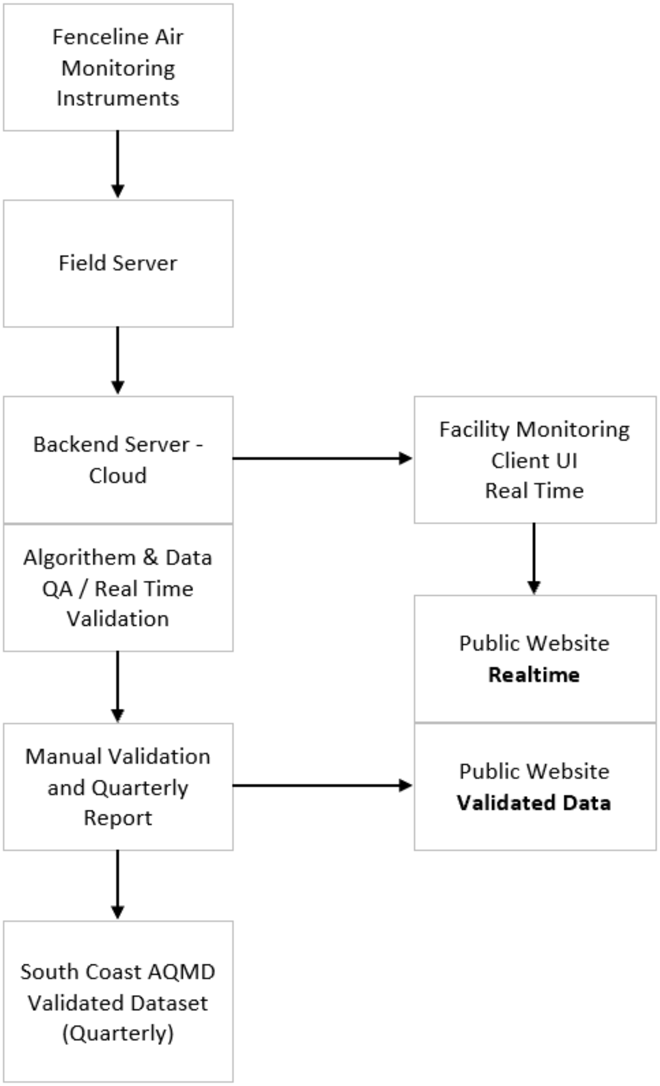
Table B-9 Critical instrument consumables, materials, and spare parts

Item	Supplier
Aethalometer Filter Tape	Magee Scientific
Aethalometer Zero Filter	Magee Scientific
H_2S Analyzer Expendables Kit	Teledyne API
OP FTIR Laser	Bruker
OP FTIR MCT	Bruker
OP FTIR IR source	Bruker
UV-DOAS lamp	Opsis
H_2S - Certified Standard-SPEC (CGA 330)	Airgas
Benzene – Primary Standard (CGA 350)	Airgas
Isobutylene/Ammonia - EPA Protocol Standard (CGA 705) EPA G2	Airgas
BAM filter tape roll	Met One
XRF filter tape roll	SCI
XRF X-ray tube	SCI

B.9 Data Management

Appropriate data management is critical in assuring the quality, defensibility, and usability of the monitoring results. Procedures have been implemented to ensure robust data acquisition, validation, reduction, reporting, and storage of electronic data (see Appendix for Valero's SOPs for Data Management and Validation). See section A.9 for a full description of the data flow and backups and the sections ahead for description of the reporting and validation of the data. The overall flow of data management is illustrated in Figure B-1.

Figure B-1 Data Management Flow Chart



B.9.1 Data Validation

Data validation ensures that data processing operations have been carried out acceptably and that the quality of field operations have been performed appropriately and in accordance with written procedures. Once data validation has identified a problem, the data can be corrected, flagged as appropriate or invalidated and corrective action is taken when necessary. In the event of a failed audit or out-of-range calibration or other QC test failure, the results will be reviewed and checked for acceptability. Data validation procedures are described in detail in Section D. All validated data will be available to the South Coast AQMD and the public as part of the quarterly report.

All spreadsheets, documents and software used in Valero FLM are managed by the QA manager in a controlled way:

- they are uniquely identified;
- any new version is approved before use and the changes are documented;
- distribution is controlled; and
- the old version is archived and marked to prevent unintended use.

All systems software undergoes a thorough QC examination by the QA manager for data acquisition, integrity, and reduction; and before and after any upgrade the IT and the QA manager test the version for, at least:

- Sanity test
- Regression test
- Stability test

The systems are secured and backup according to section A.9 above.

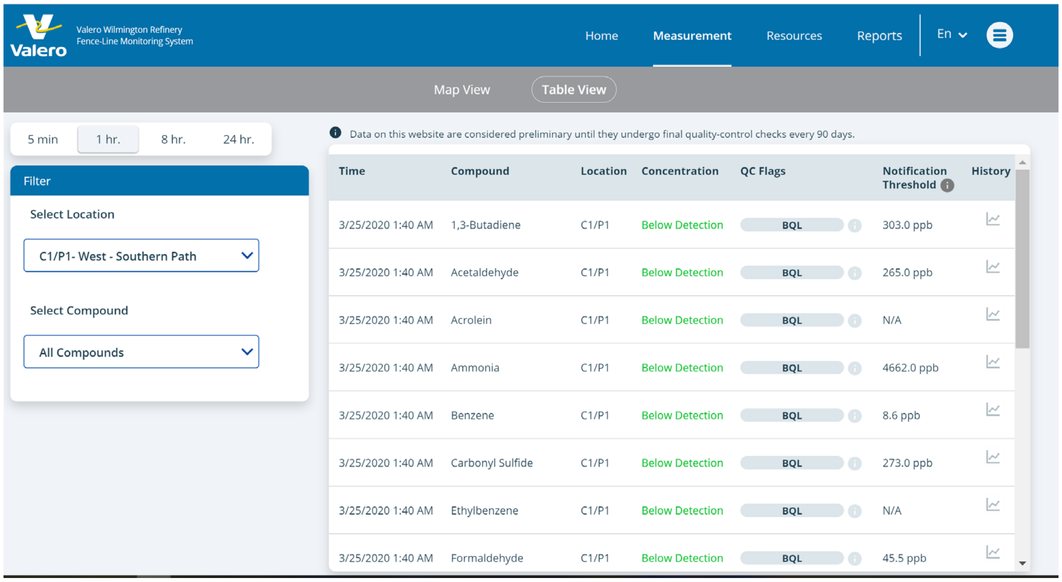
B.9.2 Reporting and notification to the public

The preliminary data can be viewed in two user' interfaces, a facility monitoring user interface (client UI) and a public website. Both contain real-time data after the automatic QC checks but feature different capabilities intended for each specific user.

- Public website:

  The Public website includes pollutant concentration for each path or point, and the QC flags if there is any, in near real-time for 5min, 1hr, 8hr, and 24hr in the form of tables (see Figure B-2). For each, a 48-hour graph illustration is also available with the hourly wind data indication as an arrow (see Figure B-3). The location of each of the paths or points on the facility fenceline and the facility location itself can be viewed on a map that includes the hourly data (see Figure B-4).

Figure B-2 Public Site – Table view



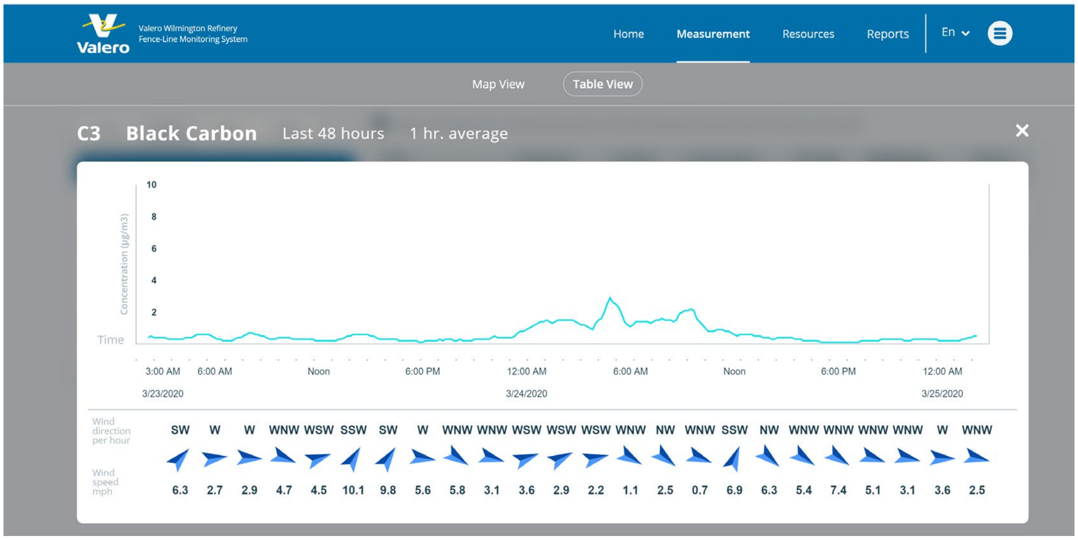
Select Location: C1/P1- West - Southern Path

Select Compound: All Compounds

Data on this website are considered preliminary until they undergo final quality-control checks every 90 days.

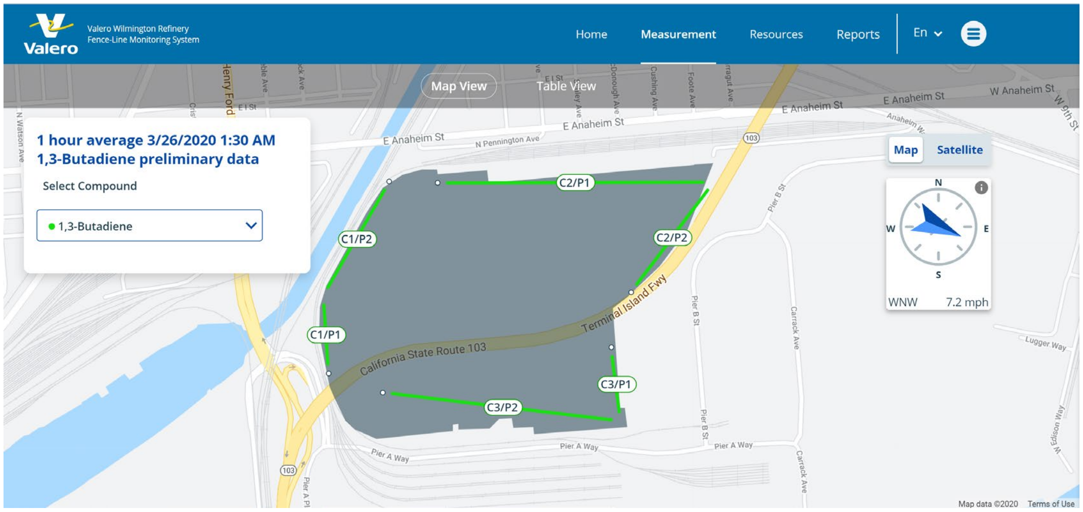
Time	Compound	Location	Concentration	QC Flags	Notification Threshold	History
3/25/2020 1:40 AM	1,3-Butadiene	C1/P1	Below Detection	BQL	303.0 ppb	
3/25/2020 1:40 AM	Acetaldehyde	C1/P1	Below Detection	BQL	265.0 ppb	
3/25/2020 1:40 AM	Acrolein	C1/P1	Below Detection	BQL	N/A	
3/25/2020 1:40 AM	Ammonia	C1/P1	Below Detection	BQL	4662.0 ppb	
3/25/2020 1:40 AM	Benzene	C1/P1	Below Detection	BQL	8.6 ppb	
3/25/2020 1:40 AM	Carbonyl Sulfide	C1/P1	Below Detection	BQL	273.0 ppb	
3/25/2020 1:40 AM	Ethylbenzene	C1/P1	Below Detection	BQL	N/A	
3/25/2020 1:40 AM	Formaldehyde	C1/P1	Below Detection	BQL	45.5 ppb	

Figure B-3 Public Site – Graph view



C3 Black Carbon Last 48 hours 1 hr. average

Figure B-4 Public Site – Map view



1 hour average 3/26/2020 1:30 AM
1,3-Butadiene preliminary data

Select Compound: 1,3-Butadiene

Any exceeding from notification health threshold is clearly marked by color in the home page and on the real-time tables and map. Times for maintenance or calibration are clearly marked by the relevant flag on the tables and map.

In addition, the public website includes a description of the compounds being measured, the monitoring technologies, the QC flags, and frequently asked questions. These are gathered under the resource page (see in above pictures of the public website).

Any public user can register on the public website to download reports and to get notifications through the email notification system.

Only valid concentration values are reported on the public site, a valid measurement is a result that has passed all quality controls and checks as mentioned in B.5 above. Data that did not pass the quality control is flagged accordingly as invalid or BQL. The quantification limits for the Open Path technologies are the actual quantification limit calculated for each measurement (see QC section B.5). On the public website, the reporting quantification limit will be set at a fixed value (listed in Table B-10) based on the actual typical dynamic quantification limit (plus confidence interval) of the primary technology and will be evaluated quarterly (in the validation process).

Table B-10 Reported Quantification Limit

Pollutant	MQL[1]	Units
Sulfur Dioxide	1.5	ppb
Nitrogen Dioxide	2.0	ppb
Total VOCs (as Total Alkanes)	1.0	ppb
Formaldehyde	1.0	ppb
Acetaldehyde	0.5	ppb
Acrolein	0.5	ppb
1,3-Butadiene	0.3	ppb
Naphthalene	1.0	ppb
Styrene	1.0	ppb
Benzene	2.0	ppb
Toluene	2.0	ppb
Ethyl Benzene	2.0	ppb
m-Xylene	1.0	ppb
o-Xylene	2.0	ppb
p-Xylene	1.0	ppb
Carbonyl Sulfide	0.1	ppb
Ammonia	0.1	ppb
Hydrogen Cyanide	3.0	ppb
Hydrogen Fluoride	1.0	ppb
Hydrogen Sulfide	0.4	ppb
Black Carbon	0.0005	µg/m^3
Cd	0.012	µg/m^3
Mn	0.00071	µg/m^3
Ni	0.0047	µg/m^3
$PM_{2.5}$	4.8[2]	µg/m^3
PM_{10}	7[2]	µg/m^3

Notes.

[1] The reported quantification limit is based on the actual dynamic quantification limit in Valero Wilmington FLM for the Primary technology specified in Table A-3

[2] May change with specific unit

- Download reports:
  - Historical data of the preliminary data is available for download according to requested time duration and up to the last posted quarterly report. The data includes concentration and the QC flag together with the wind data averaged for the same time duration (except for 8hr and 24hr where the average wind for these long durations has no meaning).

  - Quarterly report in PDF format and final data (for each month in the quarter) in Excel format. The quarterly reports summarize the measurements, data completeness, quality assurance, quality control efforts, instrument issues, and relationship to notification thresholds, see more details in the FAMP section 4.3.2.
  - Other reports such as the independent audit report, specific source analysis report etc.

- Notification system:

  For any registered user that marked to get notifications, an email and/or text message will be sent on:

  - Exceeding notification threshold – an email alert will be sent on the exceeding of a compound from the published notification threshold (thresholds are listed in Table A-1).
  - A follow-up notification if the concentration is raised above a multiplication of the threshold (2,4,8,16, and 256 times the thresholds).
  - All clear notification – A resolve email will be sent indicating that the concentration is below the notification threshold for the same compound in the same location. This email will be sent when the 30-minute rolling average is below the notification threshold.
  - A notification if the concentration that exceeds was a false positive and why.

- Specific Cause Analysis:

  Specific cause analysis report will be sent to SCAQMD and published on the Public Site for any exceeding event, see details in FAMP section 4.3.1.

C ASSESSMENTS AND OVERSIGHT

Assessments or evaluations of the QA Project Plan is being implemented as approved (conformance/nonconformance), to increase confidence in the information obtained, and ultimately to determine whether the information may be used for its intended purpose.

C.1 Assessments and Response Actions

C.1.1 South Coast AQMD Notifications

Monitoring will be conducted under the oversight of the South Coast AQMD. To facilitate this, Ultramar will comply with notification requirements in Rule 1180 by:

- Calling 1-800-CUT-SMOG 48 hours prior to planned maintenance activities and provide the name of the refinery, the name of the monitor, and the planned date(s) of the event(s).
- Calling 1-800-CUT-SMOG within 2 hours of discovering that equipment failed to accurately provide real-time air monitoring information and provide the name of the refinery, name of the monitor, date of occurrence, and the reason for the lapse in collecting and/or reporting the real-time air monitoring information.
- Providing written notification to the South Coast AQMD for any equipment failure that results in failure to provide accurate, continuous, real-time air monitoring information for 24 hours or longer. Written notification is required within 24 hours of discovering the equipment failure and shall include the following:
  - An explanation of activities currently being pursued to remedy the equipment failure;
  - Estimated time needed to restore the fenceline air monitoring equipment to normal operating conditions that comply with the approved fenceline community air monitoring plan; and
  - Temporary air monitoring measures to be implemented until the fenceline air monitoring system is restored to normal operating conditions.
- Submitting an updated fenceline monitoring plan to the South Coast AQMD if an equipment failure results in a failure to accurately provide continuous, real-time air monitoring information for more than 30 days.
- Specific Cause Analysis report requirement after an exceeding of the notification threshold – see section 4.3.1 in the FAMP.

Routine maintenance and calibrations will not trigger notification to South Coast AQMD. Maintenance and calibration flags will be present on the public website in near real-time. Email notifications will be sent out during periods of routine maintenance and calibration via opt-in subscription.

C.1.2 Independent Audit

Performance audits on the fenceline monitoring equipment will be conducted by an independent auditor every three years following protocol that will be published by South Coast AQMD. The first audit will be conducted in 2025 by NPL to all refineries. The next internal audit will be finished by January 1, 2029, and every 3 years from then.

The independent audit will be performed by a qualified independent party according to the independent audit protocol to identify any deficiencies in the fenceline air monitoring system and quality assurance procedures. Audit reports will be signed by the qualified independent party, submitted to the South Coast AQMD, and also will be published on the Public website within 90 days after the audit has been performed.

The qualified independent party, which will be selected with relevant technical expertise (but that was not involved in the implementation of the FAMP, installation, operation, maintenance, and/or quality assurance procedures of Valero Wilmington FLM), will certify under the penalty of law, based on information and belief formed after reasonable inquiry, that the statements and information in audit report and in all attachments and other materials are true, accurate, and complete.

If the Independent Audit report identifies deficiencies in a Fenceline Air Monitoring System, the refinery will develop a Corrective Action Plan within three calendar months of the audit report, describing all actions that will be taken to address all deficiencies. Any deficiency included in the Independent Audit report that the owner or operator of the Facility is proposing to exempt from corrective action because any corrective action will negatively affect safety will be specified.

C.1.3 Corrective Actions

All deficiencies identified during routine data surveillance, performance audits and/or site surveillances will be documented and reported by the refinery. Corrective action to address instrument failure or other issues impacting data collection and quality will be documented in the monitoring station logbook. Follow-up action shall be taken to verify implementation and success of the corrective action. The correction action plan below specifies the steps taken once a problem has occurred. Both the refinery and Atmosfir have the authority to shut down the fenceline if a problem is discovered. Atmosfir continuously checks on system health, via the corrective action plan below, and will provide guidance on how to proceed when a problem occurs. When a problem is first noticed, the refinery will initiate an investigation to determine the root cause, and then Atmosfir is notified.

Corrective Action Plan:
Level A – Noticing the Problem, reporting and preventing deterioration
Once a problem has occurred or has been noticed by a technician, it is immediately reported to Atmosfir's project manager and logged in the technician logbook. Together with the project manager, it is discussed whether and how the problem can be prevented from deteriorating. See Table C-1 below and SOP's troubleshooting for common potential issues. If needed, additional assistance is provided by the manufacturers. Atmosfir's Project Manager reports to the facility.

Level B - Root Cause analysis and Corrective action
Atmosfir's project Manager reports to Atmosfir's Quality Manager. Together, they investigate the root cause of the problem and search for the proper corrective action that can prevent the same problem from occurring again or minimize its scope. The corrective action is implemented in Atmosfir's Management system and it is tested for effectiveness to insure it minimizes the occurrence of the problem.

Table C-1 Common Potential Issues

Problem	**Checks and Corrective action**
Instrument DQI not in DQO limits	Checking or calibrating the instrument Investigating if it reflects on previous data
Software bugs	Version upgrade after full regression and sanity test
No connection to Cabinet	Checking power Checking modem Hardware replacement if needed
Sensor not transmitting data	Checking communication and power to sensor Trouble shootings in SOPs Spare parts replacement if needed
Typical sensor issues	See trouble shootings in SOPs
Alignment	Checking alignment Adjustment if needed
Safety and on-site violations	Checklist for on-site visits Safety training

Level C – Notifying South Coast AQMD and assuring backups
Besides the corrective action plan to resolve the problem according to Rule 1180, the refinery will notify South Coast AQMD and address the means to ensure the minimum loss of data possible. This is specified in the FAMP under section 3.5 for Routine Maintenance and Failure Management.

C.1.4 QAPP Revisions

Revisions to this QAPP and its SOPs will be evaluated by Ultramar annually. If any change is made, it will be approved by Ultramar and submitted to South Coast AQMD for review and comment, and a revised edition will be distributed to all appropriate individuals on the distribution list via email.

C.2 Reports to Management

Quarterly reports are intended to keep management and South Coast AQMD informed on fenceline system assessments and findings.

D DATA VALIDATION AND USABILITY

D.1 Data Review, Validation, and Verification Requirements

The refinery is responsible for verifying acceptable operation of the fenceline monitoring equipment. The data will be reviewed by qualified staff to ensure that the data are complete, accurate, representative, and that data with identified issues are either flagged or invalidated as appropriate prior to generation of the final quarterly report.

The data validation criteria for this project are primarily driven by the DQIs and the outcome of QC checks. If data are generated under conditions that fail to meet a DQI or QC check criterion, the data may need to be invalidated or flagged back to the prior passing DQI or QC check evaluation. Atmosfir is responsible for all software, spreadsheet, and algorithm updates to ensure the security of data. All procedures follow the refinery's cybersecurity policies.

Calibration procedures for the continuous monitoring equipment are presented in Section B.7. For the fenceline equipment, precision, bias, accuracy and/or other QC tests will be determined using the protocols presented in Section B.5 and the equipment SOPs. Data will be considered valid when the system response indicates MQOs are being achieved.

D.2 Data Validation and Verification Methods

The refinery is responsible for verifying the acceptable operation of the air quality and meteorological equipment by reviewing the QC checks, calibration records, audit results, and field notes form the site technicians prior to formal acceptance of these data. Precision and bias calculations will also be reviewed as a part of data validation. Valero FLM SOP for Data Management and Validation specifies the procedures to assure the validity of the data. The following sections describe the data validation levels that are part of this procedure.

D.2.1 Level 0 Data Validation

Level 0 data is raw data obtained directly from the data acquisition systems in the field. These data have not received any adjustments for known biases or problems that may have been identified during preventive maintenance checks or audits.

D.2.2 Level 1 Data Validation

Level 1 data validation consists of automatic verification using the Atmosfir D-fencline^{TM} software and equipment software.

- Operational alerts are sent to Atmosfir and the refinery.
- Automatic QC screening: The system, either directly from instrument manufacturer software or from Atmosfir's software, automatically screens data that do not pass QC conditions. For details, see Section B.5.
- Automatic QC flagging: The system generates QC flags for the public and reviewers. This data allows reviewers to identify data requiring further review and verification. See Table D-1.

Table D-1 QC Flags

QC Flags	Meaning	Description
N/A	Data is Not Available	Can generated from no readings, invalid data, or average that has a small sample size (see section D.2.5)
Cal	The instrument is under Calibration	This flag appears in times of calibration. Values during calibration will not be shown on the public website, as it does not represent ambient concentration data.
Maint.	The instrument is under Maintenance	This flag appears in times of maintenance. Values during maintenance will not be shown on the public website, as it does not represent ambient concentration data.
BQL	Below Quantification Level	This flag appears when the value is below the quantification limit (see Table B-10).
To be reviewed	The data need further review	This flag appears next to a concentration value, it can be generated from data that has high rate of change, repeated value, concentration above the instrument range, or if an instrument status parameter indicates that the data should be reviewed (see Section B.5).

The history of each flagged data point is auditable. Flag conditions will be reviewed as the project progresses to see if change or additional action is needed. Flags can also be changed according to any new South Coast AQMD requirements.

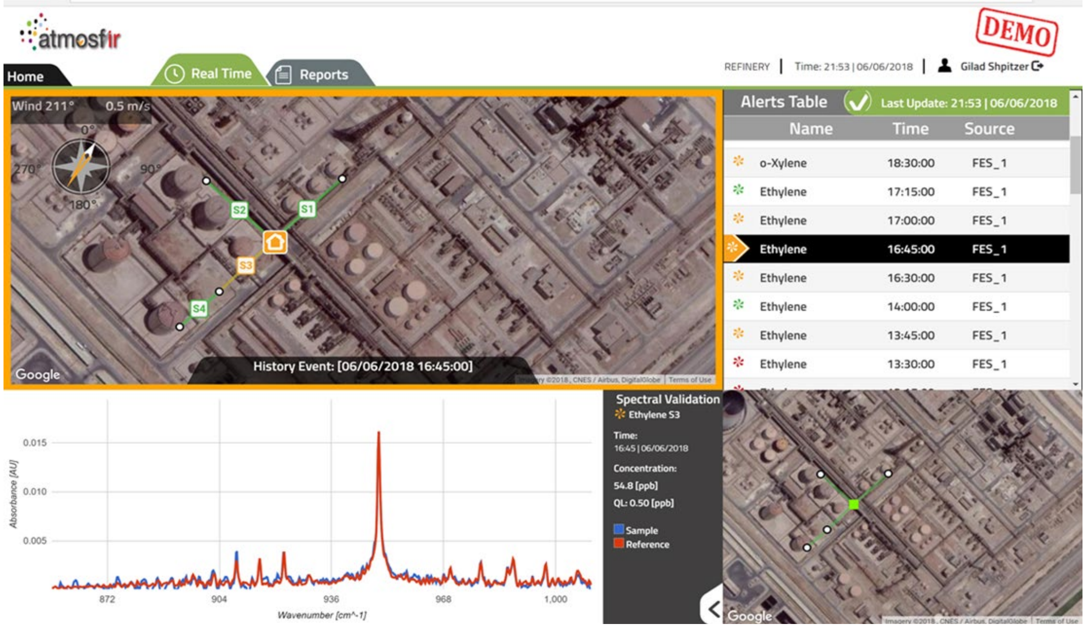
Data and flags will be published to the near real-time public website after these automatic QC checks but will be marked as preliminary.

D.2.3 Level 2 Data Validation

Level 2 data validation includes the first level of manual data validation. During daily review, project staff will check that systems are working acceptably and check for system alerts. Staff will check for concentration alerts (exceeding thresholds) and forward them as needed to the Atmosfir QC department for in-depth review. Staff will document in the site logbook outcome of the daily check. The reviewer of any concentration exceeding the notification threshold will document the outcome of the examination in a QC validation log.

The Atmosfir D-fencline™ system has a built-in spectral validation feature in the client UI (user interface) available to the project team. This feature enables any member of the team, that has access to the client UI and proper training, to easily look at a spectral validation figure. If this figure looks suspicious, (the reference spectrum and the field spectrum do not seem to match) it can be sent to an experienced spectroscopist for validation. The outcome from the spectroscopist validation will also be logged in the QC validation log.

Figure D-1 Client UI spectral validation feature (demo site)



Alerts Table ✓ Last Update: 21:53 | 06/06/2018

Name	Time	Source
o-Xylene	18:30:00	FES_1
Ethylene	17:15:00	FES_1
Ethylene	17:00:00	FES_1
Ethylene	16:45:00	FES_1
Ethylene	16:30:00	FES_1
Ethylene	14:00:00	FES_1
Ethylene	13:45:00	FES_1
Ethylene	13:30:00	FES_1

Spectral Validation
Ethylene S3
Time:
16:45 | 06/06/2018
Concentration:
54.8 [ppb]
QL: 0.50 [ppb]
🟦 Sample
🟥 Reference

D.2.4 Level 3 Data Validation

Quarterly, Atmosfir scientific specialist (or spectroscopist for FTIR and UV-DOAS), will review:

- Maintenance, calibration and other QC tests, logs, and systems alerts during the quarter.
- Reviewing any data exceeding calibration range.
- Ensuring the actual detection limits of the instruments are within specifications. For the dynamic DL of FTIR and UV-DOAS – review the 25% average (or the standard deviation at zero concentration) and any anomalies.
- Review concentration flags with "to be reviewed" and make a final decision on data validity.
- Review concentration for reasonableness by using time series graphs and in relevant to the wind data.
- Spectroscopist manual validation for all suspected FTIR and UV-DOAS concentrations above the threshold.
- Spectroscopist sampled review on the FTIR and UV-DOAS spectral methods for new interferences that can cause false positive/negative detections.
- Looking for trends with time and history reviews in all relevant checks that implement a change is needed.

Any change to the data will be reported in the QC validation log. The change data will be marked with the reason for the change, the name of the authorized person for the change, and the date. The new data set after these validations will be generated quarterly. The preliminary data set will be archived.

Published final data and any changes to the concentration will be published in the quarterly report.

The quarterly report serves as a final certification of the quality and usability of the data.

D.2.5 Minimum Acceptable Data Recovery Percentage

To be considered valid, each hour of air quality data must consist of at least 45 minutes (75%) of valid data. This criterion for valid data will be implemented also for the 8-hour and 24-hour averages.

D.3 Reconciliation with User Requirements

The purpose of reconciliation is a final step in which the validated data is evaluated to determine if it answers the original questions asked, such as the data quality objectives and project tasks. Data will be evaluated for reasonableness, and efforts made to determine its suitability for decision making. Limitations on the data should be considered and reported. If issues are noted during reconciliation, revisions to the fenceline monitoring plan or this QAPP will be performed as appropriate.

E APPENDICES

Appendix I - Standard Operating Procedures (SOP) for Valero FLM

Attached as a separate file – ‘Appendix I to QAPP - Valero Wilmington FLM SOP’