

Action: Air emission monitoring from refineries**Background and Objectives**

There are five major petroleum refineries located within the Wilmington, Carson, West Long Beach (WCWLB) community. These facilities are subject to rules and regulations adopted by the South Coast AQMD and other regulatory agencies. One of these rules ([Rule 1180 – Refinery Fenceline and Community Air Monitoring](#)) was adopted by the South Coast AQMD Governing Board in December 2018 and mandates the implementation of a near-real-time fenceline air monitoring system for each major refinery in the South Coast Air Basin (Basin). It also requires community air monitoring in nearby communities. Fenceline and community air monitoring for Rule 1180 officially commenced at the end of March 2020. Links to dedicated websites displaying fenceline air monitoring data for all refineries in the Basin can be found in Attachment A and on the [South Coast AQMD Rule 1180 data portal](#).

The AB 617 community steering committee (CSC) determined that additional air measurements should be conducted near and around refineries to address potential leaks and assess the feasibility of further reductions of fugitive volatile organic compounds (VOC) emissions. To this end, the South Coast AQMD has been conducting periodic mobile surveys near and around all five refineries in WCWLB since June 2019. These mobile measurements are focused on quantifying emissions of VOCs and other air toxic pollutants from refining process equipment, storage tanks, other refinery related activities, and on measuring ambient levels of these pollutants in nearby communities.

In an effort to establish techniques that are less time consuming, labor intensive, and potentially more comprehensive than the traditional Leak Detection and Repair (LDAR) program, South Coast AQMD will continue to work with the refineries to utilize more advanced and effective leak detection systems (Smart LDAR). These will help to identify, quantify, and locate leaks in real-time, which will lead to faster repair.

The combination of these various technologies, methods and activities, including the periodic mobile surveys and the refinery LDAR program records, will help establish an emissions baseline for fugitive VOCs from all refineries in this community. Based on this information, South Coast AQMD will work with refineries to develop a fugitive emission reduction plan to achieve VOC emission reduction goals of 25% and 50% by 5 and 10 years afterwards.

Methods

Rule 1180 fenceline and community air measurements are conducted in near-real-time using fixed installations of advanced measurement technologies, such Optical Remote Sensing (ORS) techniques (Attachment A) to measure a wide range of pollutants and air toxics. In addition, point monitors are used to measure hydrogen sulfide (H₂S) and black carbon (BC) at the Rule 1180 community monitoring stations and at strategic points along the refinery fencelines.

Community air monitoring stations also include other advanced air monitoring systems to enhance detection limits (i.e., sub-ppb) for benzene, acrolein and other important air toxic pollutants.

A mobile laboratory equipped with specialized ORS instruments is used for measuring ground level concentrations of a wide range of gaseous pollutants and to quantify VOC emissions. Periodic mobile surveys are conducted to identify and characterize potential leaks from storage tanks, other equipment, and refinery operations, as well as to perform follow up surveys after leaks have been mitigated. A gas imaging camera is used to confirm or help identify the location of the leak.

If data collected from periodic mobile air measurements, fenceline monitoring and community monitoring suggests persistent elevated VOC levels, the South Coast AQMD will conduct on-site inspection of the facility equipment for compliance with South Coast AQMD rules. South Coast AQMD will continue to explore opportunities to incorporate new advanced tools to modernize and improve LDAR program for storage tanks at refineries.

Results

Rule 1180 Implementation

- Pursuant with Rule 1180, all major refineries in this community are now conducting continuous measurements of a comprehensive list of pollutants at their respective fenceline and displaying their data on dedicated websites. Links to fenceline air monitoring websites for each refinery can be found in the Attachment A
- South Coast AQMD established six permanent and one temporary refinery-related community air monitoring stations in WCWLB (Figure 1 and Attachment A) and the data is available in real-time on the [South Coast AQMD Rule 1180 data portal](#) (the data portal also contains links to all refinery fenceline air monitoring sites)

Mobile Monitoring

- A total of 17 measurement days have been conducted between June 2019 and February 2020. These measurements include 54 emission measurements from refineries and about 34 hours of mobile monitoring in nearby communities
- Data is being analyzed in an ongoing effort to support leak detection investigations and to better understand the potential impact of refinery emissions on the WCWLB community

Next steps

- Continue to evaluate Rule 1180 refinery fenceline and community air monitoring results
- Continue periodic mobile measurements at refinery fencelines and neighboring communities

- Establish a refinery emissions baseline for VOCs using the data from the periodic mobile measurements and refinery LDAR program records
- Explore Smart LDAR technologies and programs and support enforcement actions where appropriate



Figure 1. Map showing mobile monitoring routes taken by the South Coast AQMD mobile platform (yellow lines) in the WCWLB community between June 2019 and February 2020. The shaded areas show the five major petroleum refineries, and red circles refer to the locations of the Rule 1180 Community Air Monitoring Stations

Attachment A

Rule 1180 fenceline and community air measurements are conducted in near-real-time using fixed installations of Optical Remote Sensing (ORS) monitors to measure a wide range of pollutants and air toxics. These ORS monitors include Open Path Fourier Transform Infrared (OP FTIR) spectroscopy and Long Path Ultraviolet Differential Optical Absorption Spectroscopy (LP-DOAS) monitors. ORS instruments are used to measure the concentrations of certain compounds in the air based on the natural ability of gases to interact and absorb radiation (e.g. visible light). Each gas absorbs light in one or more wavelengths of the light spectrum. The set of absorbed wavelengths is a specific property of each gas and allows to identify its presence in the air. These monitors send continuous beams of light across an open path to measure the concentrations of compounds along this pathway. As the light passes through the air, different compounds absorb different portions of the light in a unique manner. The analyzer uses the “missing” light to calculate how much of a particular compound is present along the light path. OP FTIR and LP-DOAS monitors use infrared (IR) and ultraviolet (UV) light beams, respectively, to measure the concentrations of certain compounds across an open path. This information helps to identify, quantify and locate leaks in real-time, allowing for faster repair of equipment. The following table is providing direct links to the fenceline monitoring website of each refinery:

Refinery	Fenceline monitoring website
Marathon - Wilmington & Carson	https://marathonlosangelesrefineryfencelinemonitoring.com/monitors.html
Philips 66 – Carson	https://p66la.argos-sci.info/airmon/sites/view/2/
Philips 66 – Wilmington	https://p66la.argos-sci.info/airmon/sites/view/1/
Valero - Wilmington	https://wilmingtonrefinerymonitoring.org/measurements

The FTIR and DOAS optical cell systems installed as point monitors in the community monitoring stations that are part of the Rule 1180 network are based on the same technology as the open path fenceline systems. While air passes through an optical cell it undergoes multiple reflections between mirrors, and the air sample is analyzed for multiple pollutants simultaneously. In addition to ORS instruments, point monitors are used to measure hydrogen sulfide (H₂S) and black carbon (BC) at the Rule 1180 community monitoring stations. These stations are also equipped with automated gas chromatography (GC) systems to enhance the detection limits (i.e., sub-ppb) for benzene, acrolein and other important air toxic pollutants. Gas chromatography is a type of chemical analysis typically used for a variety of VOCs. Through this technique the gaseous pollutants in an air sample are passed through an analytical column where they are selectively adsorbed and separated into individual species/components. Each component emerges from the end of the column and moves past an electronic detector, which identifies it as a peak on a chart. The final chart has a series of peaks that correspond to all the chemical species in the sample. Air monitoring data collected at the community monitoring stations will help assess the potential impact of refinery emissions in nearby communities.

A specialized mobile platform that can measure a wide range of air pollutants using FTIR, UV-DOAS, Solar Occultation Flux (SOF), and IR gas imaging cameras is used for measuring ground level concentrations of benzene, toluene, ethylbenzene, xylenes, and total VOCs. SOF is an ORS technique that uses direct sunlight to determine vertically integrated concentrations of selected trace gases. This method is used to quantify VOC emissions from refineries and other industrial sources. A technical description of the SOF method can be found in the [South Coast AQMD 2015 ORS technology demonstration study report](#). Periodic mobile surveys are conducted to measure VOC emissions from refineries, identify and characterize potential leaks from storage tanks, other equipment and refinery operations, and to perform follow up surveys after leaks have been mitigated.

WILMINGTON, CARSON, WEST LONG BEACH REFINERY FENCELINE AIR MONITORING

South Coast AQMD staff updates on the technology used for implementing Rule 1180 and the available websites that report real-time air quality data around refineries in WCWL community.

Rule 1180 - Fence line monitoring

Rule 1180 requires petroleum refineries to install and operate continuous fence line air monitoring systems to measure a broad list of air pollutants and toxic compounds in real-time and immediately report the results to the public. This report explains the principle of Optical Remote Sensing (ORS) for fence line air monitoring.

Refineries Fence line systems

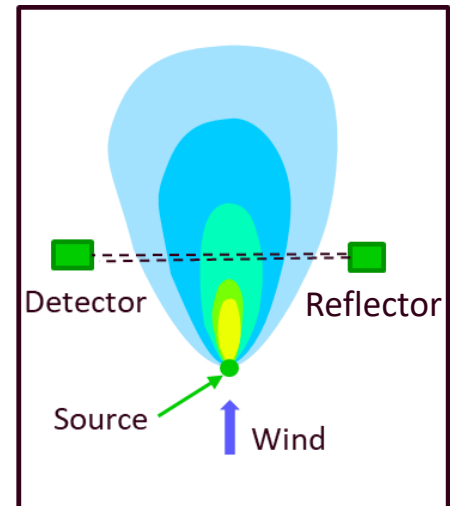
- Each refinery installed multiple monitoring systems that are based on ORS techniques, around their property boundaries
- These fence line systems measure multiple organic compounds and important air toxics in near-real-time (e.g. Benzene, hydrogen sulfide, ammonia, and many more)
- Each refinery has a website that reports fence line air quality data in near-real-time
Marathon (Carson and Wilmington): <https://marathonlosangelesrefineryfencelinemonitoring.com/>
Phillips 66 Carson and Wilmington): <https://p66la.argos-sci.info/>
Valero: <https://wilmingtonrefinerymonitoring.org/>
- Refineries provide notifications to the community if emissions exceed pre-determined health-based thresholds. Instructions on how to sign-up for notifications are provided on each refinery fence line air monitoring website.

Principle of Optical Remote Sensing

Naturally, every gas in the air can absorb a set of light wavelengths. This set is unique and serves as a fingerprint that allows to explicitly identify it. ORS systems work by projecting a beam of light to the open air and receiving it at a detector. If a gas is present in the path, part of the beam light is absorbed. By comparing known reference standards of light absorption by gases with the results from field measurements, the system can identify the gas and quantify the average gas concentration in the path between the source projector and the detector.



Map of the fence line air monitoring at Phillips 66 Carson refinery, where air quality is continuously monitored along the light paths around the refinery



A schematic of the ORS system, the projector and reflector can detect pollutant plumes that cross the light beam



WILMINGTON, CARSON, WEST LONG BEACH REFINERY COMMUNITY AIR MONITORING

Rule 1180 - Community Air Monitoring

- South Coast AQMD monitors the levels of refinery-related air pollutants in the WCWL community as part of the Rule 1180
- Seven air quality monitoring stations in WCWL community (yellow circles in the map) continuously measure a wide range of air pollutants
- Real-time air quality data at the community air monitoring stations can be found on Rule 1180 Community Air Monitoring [Website](#)
- In addition to the stationary air quality monitoring, South Coast AQMD operates a ORS mobile laboratory as part of the [AB 617 program](#) in WCWL community
- The ORS mobile laboratory is used to measure a wide range of air pollutants at the fenceline of refineries and in the nearby neighborhoods to assess community impact and establish a volatile organic compounds (VOC) baseline

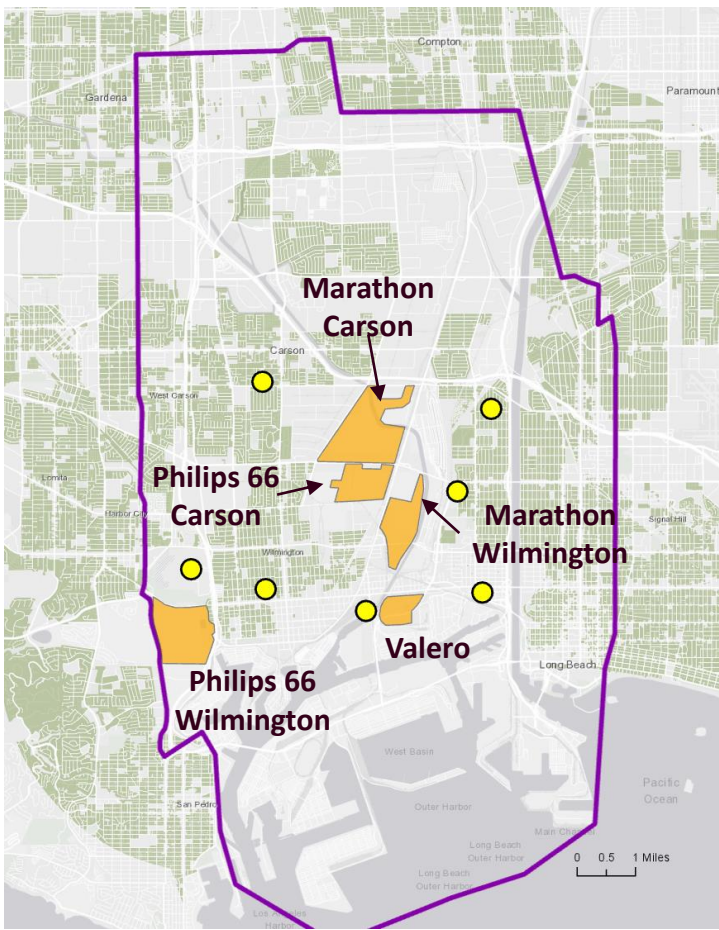
Monitored Air Pollutants

The community monitoring stations measure a comprehensive set of air pollutants:

- ✓ Black Carbon (BC)
- ✓ Hydrogen Sulfide (H₂S)
- ✓ Hydrogen Fluoride (HF) (*measured near Valero refinery*)
- ✓ Several volatile organic compounds such as Benzene, Toluene, Ethylbenzene, Xylenes (BTEX), Acrolein, Styrene and 1,3-Butadiene
- ✓ Other important air pollutants and air toxics such as hydrogen cyanide, carbonyl sulfide, ammonia, sulfur dioxide and nitrogen oxides

The ORS mobile laboratory is equipped with multiple advanced monitors that are capable of measuring a wide range of gaseous pollutants including air toxics:

- ✓ Nitrogen Dioxide (NO₂), Sulfur Dioxide (SO₂)
- ✓ Formaldehyde (HCHO)
- ✓ Total alkanes
- ✓ Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)



	Community boundary
	Refineries
	Residential areas
	Rule 1180 monitoring stations



For more information, please visit [Rule 1180 Community Air Monitoring webpage: https://xapprod.aqmd.gov/Rule1180CommunityAirMonitoring/](https://xapprod.aqmd.gov/Rule1180CommunityAirMonitoring/)