

The logo for CTEH, consisting of the letters 'CTEH' in a bold, white, sans-serif font with a registered trademark symbol (®) to the upper right, all contained within a dark blue rectangular box. The background of the entire page features a vertical, wavy, light blue pattern on the left side.

CTEH®

THE SCIENCE OF READYSM

VALERO ENERGY

BENICIA REFINERY PARTICULATE

RELEASE

Benicia, CA

March 16, 2019

Project #111342

1.0 Introduction

On March 13, 2019 Valero Energy requested that CTEH® conduct air monitoring in the surrounding community after a release of particulate matter from the Benicia Refinery in Benicia California. CTEH® arrived on-site on March 13, 2019 and began air monitoring operations. Activities were comprised of real-time air monitoring and analytical air sampling.

This report summarizes air monitoring data collected from March 15, 2019 06:30 PDT to March 16, 2019 06:30 PDT.

2.0 Air Monitoring and Sampling Methods

CTEH® developed and implemented an air sampling and analysis work plan (SAP) to document and quantify the release of fugitive emissions from the flue gas scrubber. All instrumentation was calibrated at least once per day or per manufacturer's recommendations. Target analytes were measured as benzene, carbon monoxide (CO), nitrogen dioxide (NO₂), 2.5-micron particulate matter (PM_{2.5}), 10-micron particulate matter (PM₁₀), sulfur dioxide (SO₂), toluene, and xylene using handheld instruments such as RAE Systems MultiRAEs, TSI SidePak™ AM510/AM520 Aerosol Monitors, and Gastec GV-100 pumps with chemical-specific colorimetric detection tubes.

Hand-held air monitoring consisted of roaming air monitoring in the surrounding community. All hand-held air monitoring was conducted in the breathing zone.

Analytical air samples were deployed in the breathing zone at six locations through the community. Each station consisted of SKC active sampling pump equipped with mixed cellulose ester (MCE) filter media suitable for collection of metals.

All samples will be sent to an accredited laboratory for analysis in accordance with NIOSH Method 7303. **Figure 11 in Attachment A** depicts these analytical air sampling locations.

3.0 Air Monitoring Results

Figures 1 – 10 in Attachment A depicts the site location and hand-held monitoring locations for this reporting period.

Table 1 summarizes the results for community hand-held air monitoring readings.

Table 1: Community Hand-Held Real-Time Air Monitoring Results

Analyte	Instrument	# Readings	# Detections	Range
Benzene	Gastec #121L	7	0	< 0.05 ppm
Carbon Monoxide	MultiRAE	71	0	< 1 ppm
NO2	MultiRAE	74	0	< 0.1 ppm
PM10	AM510/AM520	72	72	0.004 - 0.04 mg/m3
PM2.5	AM510/AM520	54	54	0.003 - 0.033 mg/m3
SO2	MultiRAE	56	0	< 0.1 ppm
Toluene	Gastec #122L	6	0	< 0.5 ppm
Xylene	Gastec #123L	6	0	< 1 ppm

¹Maximum detections preceded by the "<" symbol are considered non-detections below the limit of detection (LoD) value to the right.

Additionally, at the request of public health officials, particulate matter (PM_{2.5} and PM₁₀) data have been grouped by region around the refinery, and averaged over a 24-hour period for comparison to AQI category equivalents. Wind-rose maps are provided for the corresponding time periods (Appendix B). It is notable that the USEPA has eliminated spatial averaging provisions as part of the annual National Ambient Air Quality Standards (NAAQS) to avoid potential disproportionate impacts on at-risk populations. Additionally, due to the uneven temporal distribution of particulate matter monitoring data at these locations, averages may be biased and are not directly comparable to the NAAQS. Thus, comparisons to AQI category equivalents are provided for illustration purposes only.

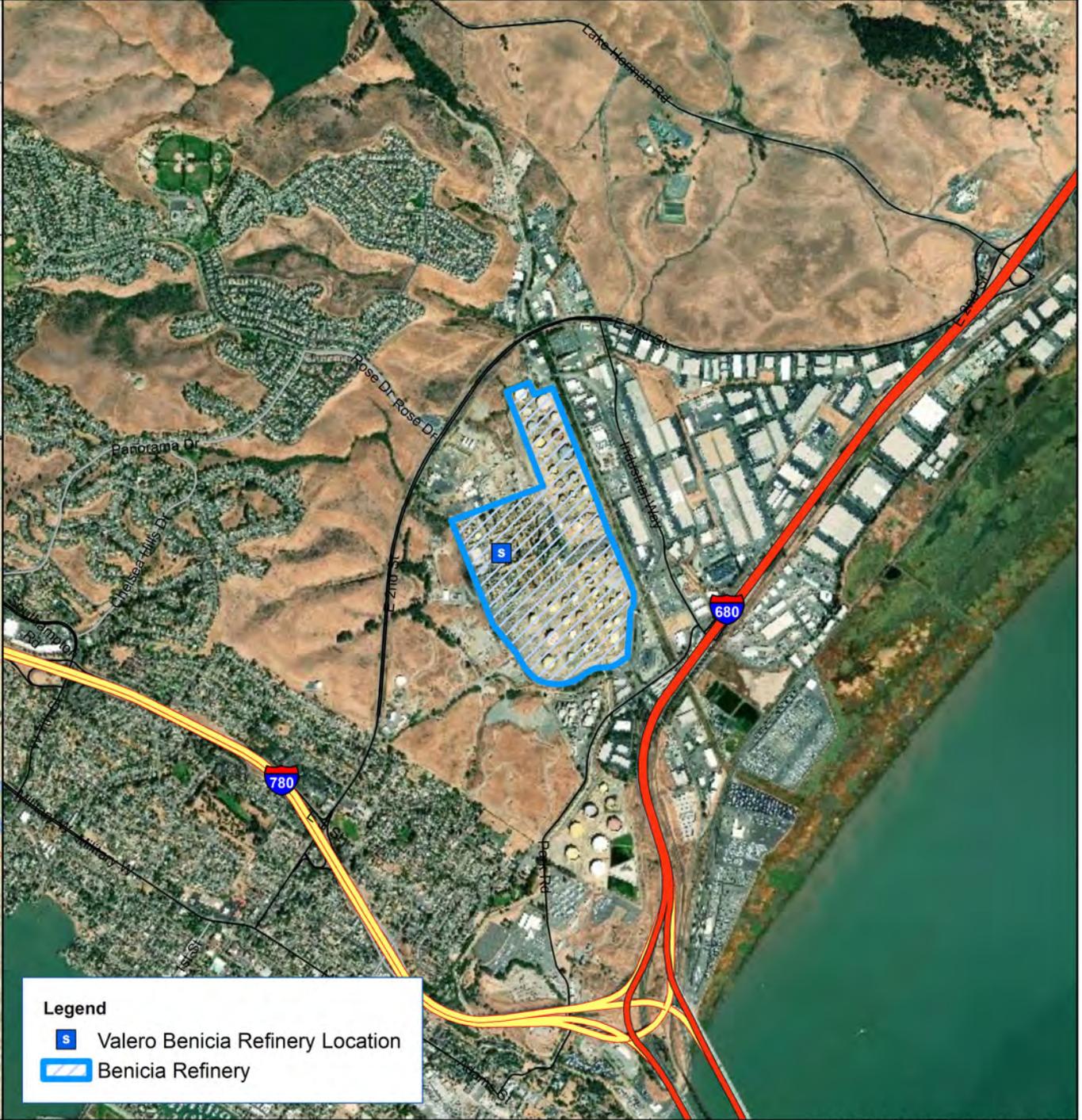
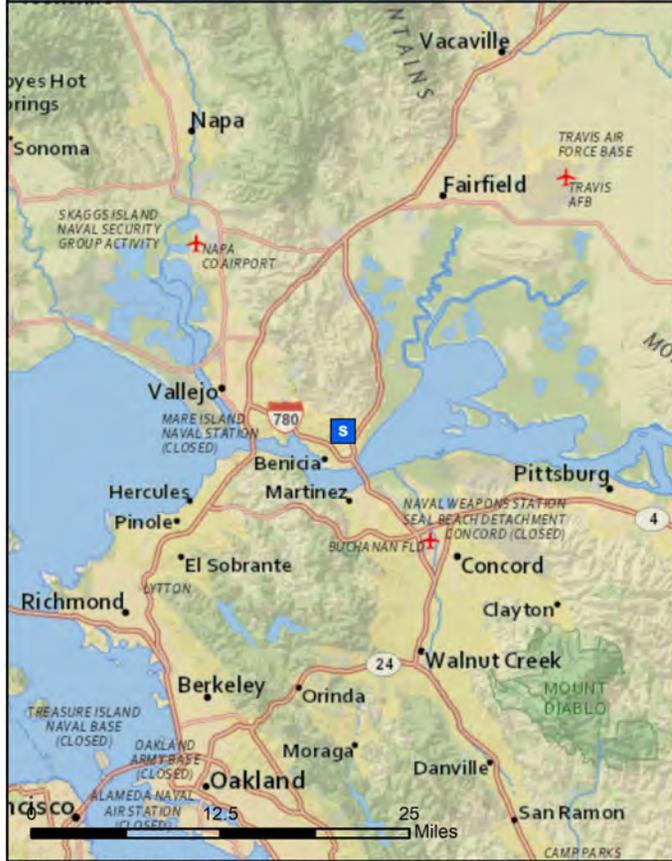
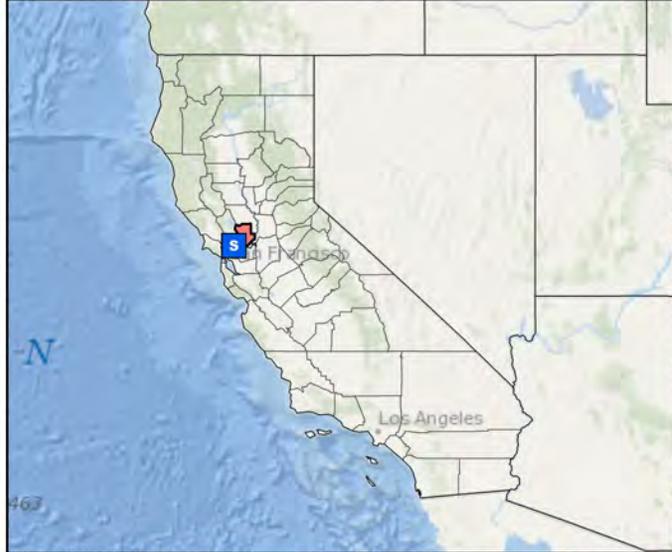
4.0 Weather Conditions

Figure 12 in attachment C contains meteorological data and a wind rose depicting wind speed and direction for this reporting period. Data was acquired from California Irrigation Management System (CIMIS) meteorological station #170 located in Concord to the southeast of the Benicia Refinery.



Attachment A

CTEH Air Sampling and Monitoring Locations

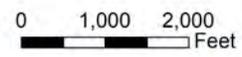


Legend

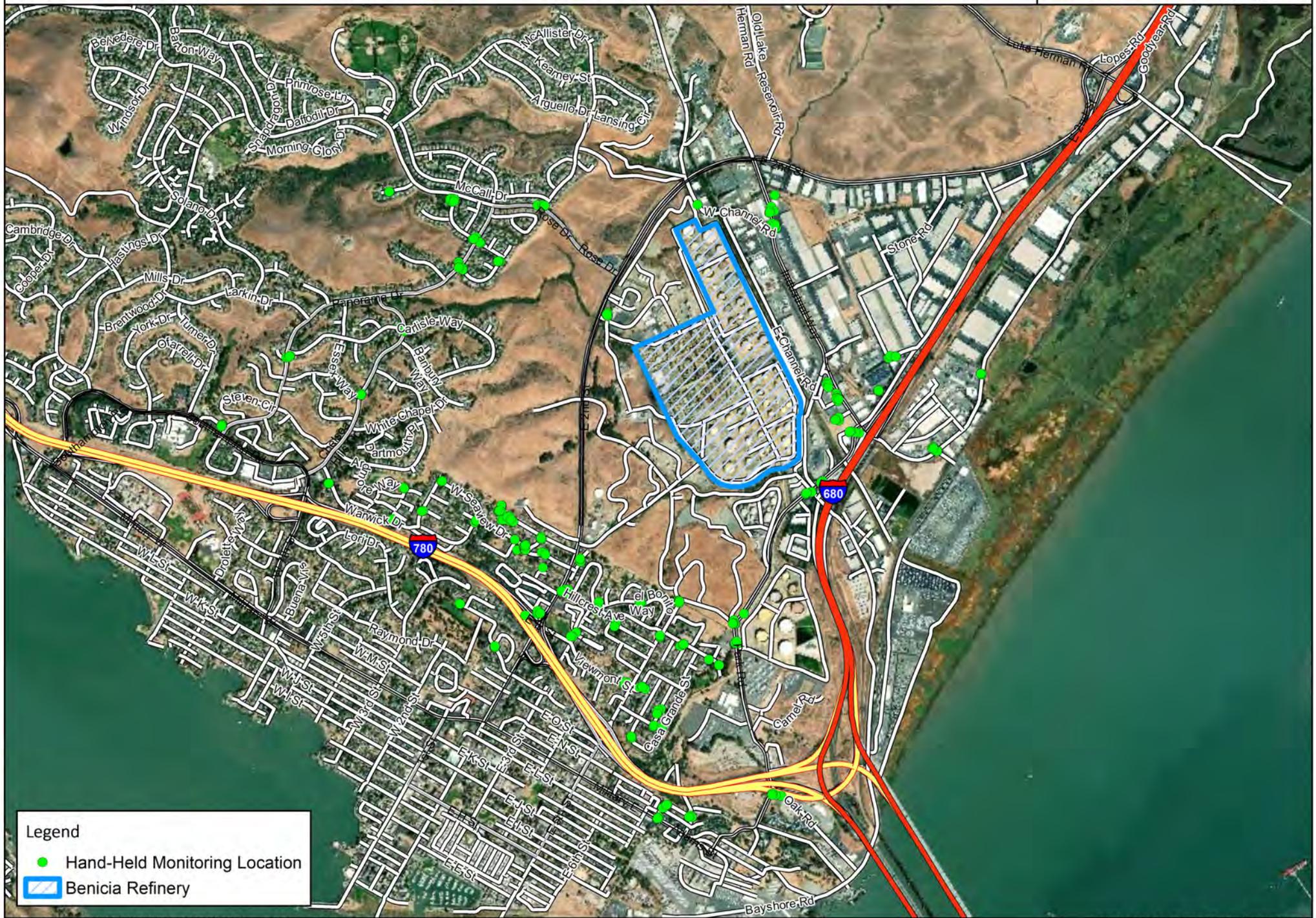
- Valero Benicia Refinery Location
- Benicia Refinery



Figure 2: Hand-Held Real-Time Monitoring Locations
Benicia Refinery Particulate Release

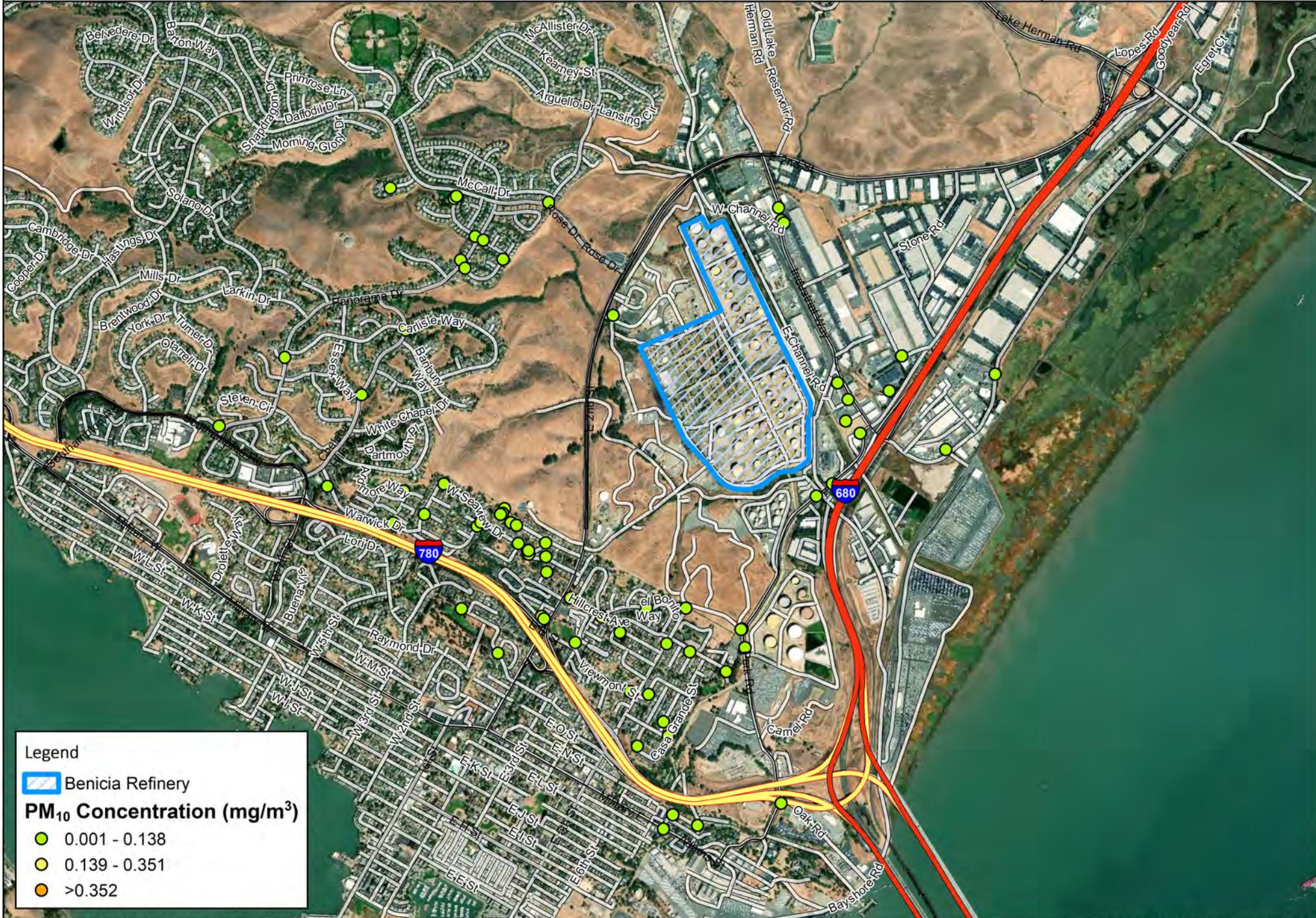


Project: 111342
Client: Valero Energy
City: Benicia, AR
County: Solano



Legend

- Hand-Held Monitoring Location
- Benicia Refinery



Legend

- Benicia Refinery
- PM₁₀ Concentration (mg/m³)**
- 0.001 - 0.138
- 0.139 - 0.351
- >0.352

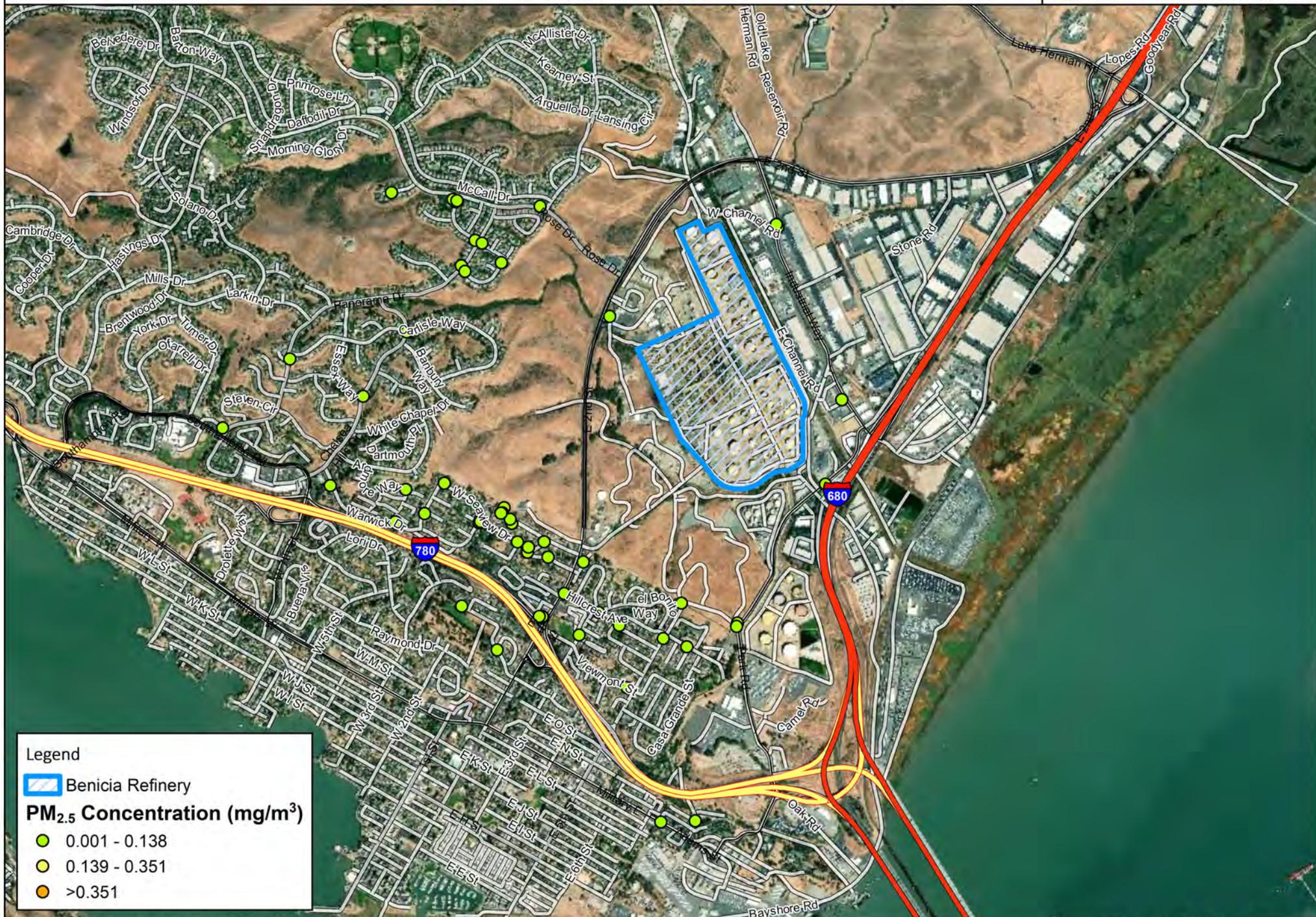


Figure 4: Hand-Held Real-Time Monitoring Locations (PM_{2.5})
Benicia Refinery Particulate Release

0 1,000 2,000
Feet

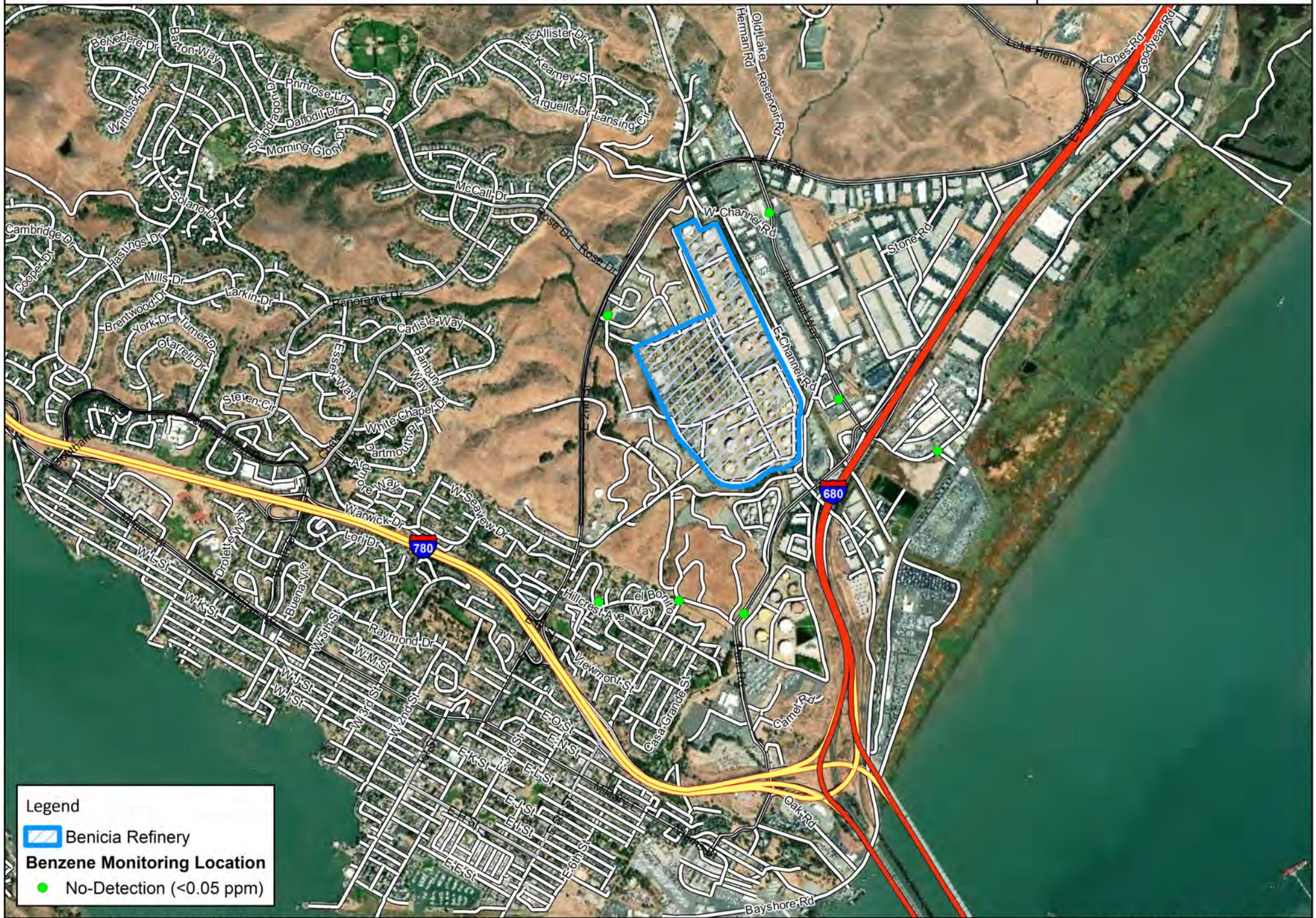


Project: 111342
Client: Valero Energy
City: Benicia, AR
County: Solano



Legend

- Benicia Refinery
- PM_{2.5} Concentration (mg/m³)**
- 0.001 - 0.138
- 0.139 - 0.351
- >0.351

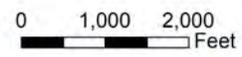


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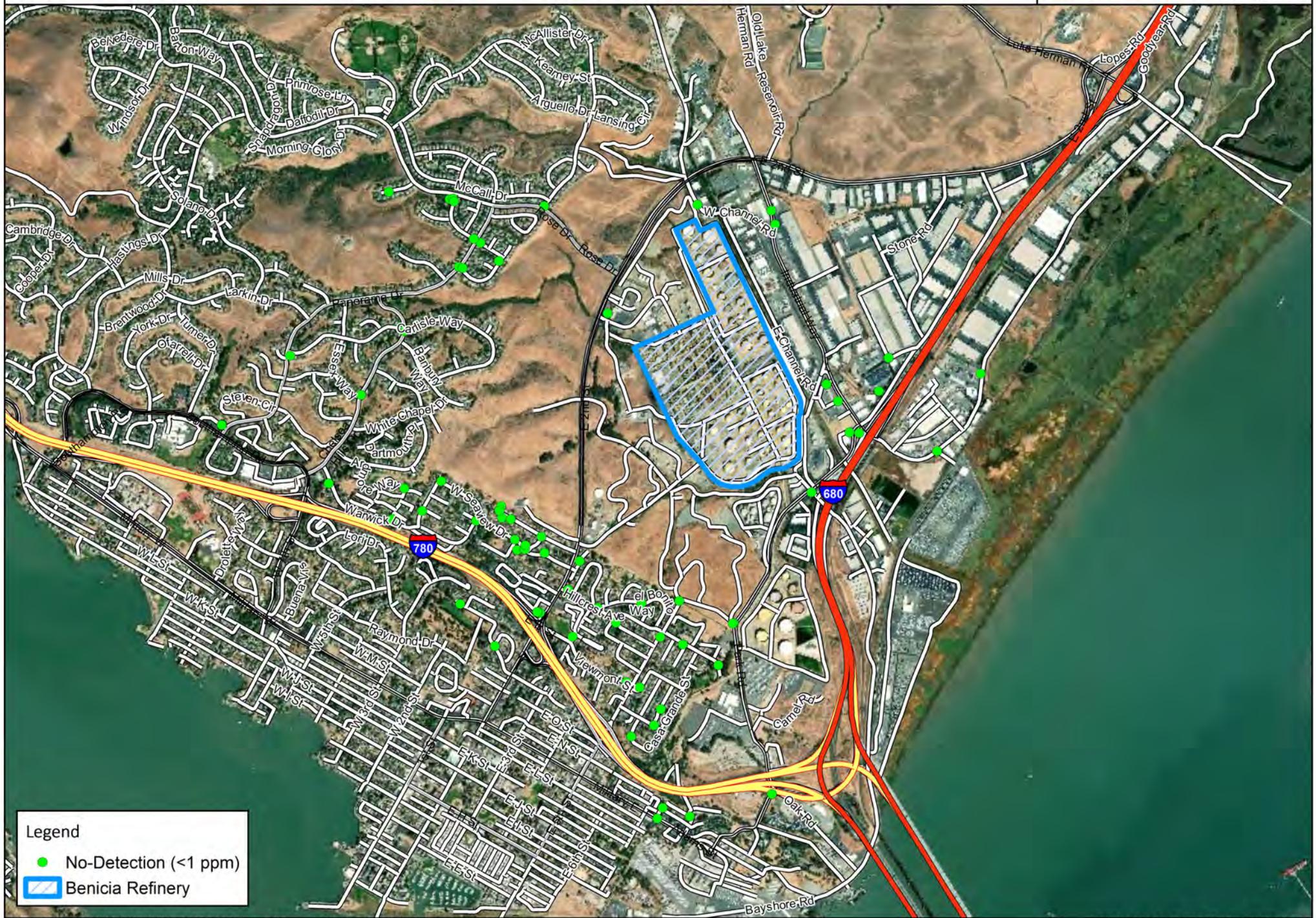
-  Benicia Refinery
- Benzene Monitoring Location**
-  No-Detection (<0.05 ppm)



Figure 6: Hand-Held Real-Time Monitoring Locations (CO)
Benicia Refinery Particulate Release

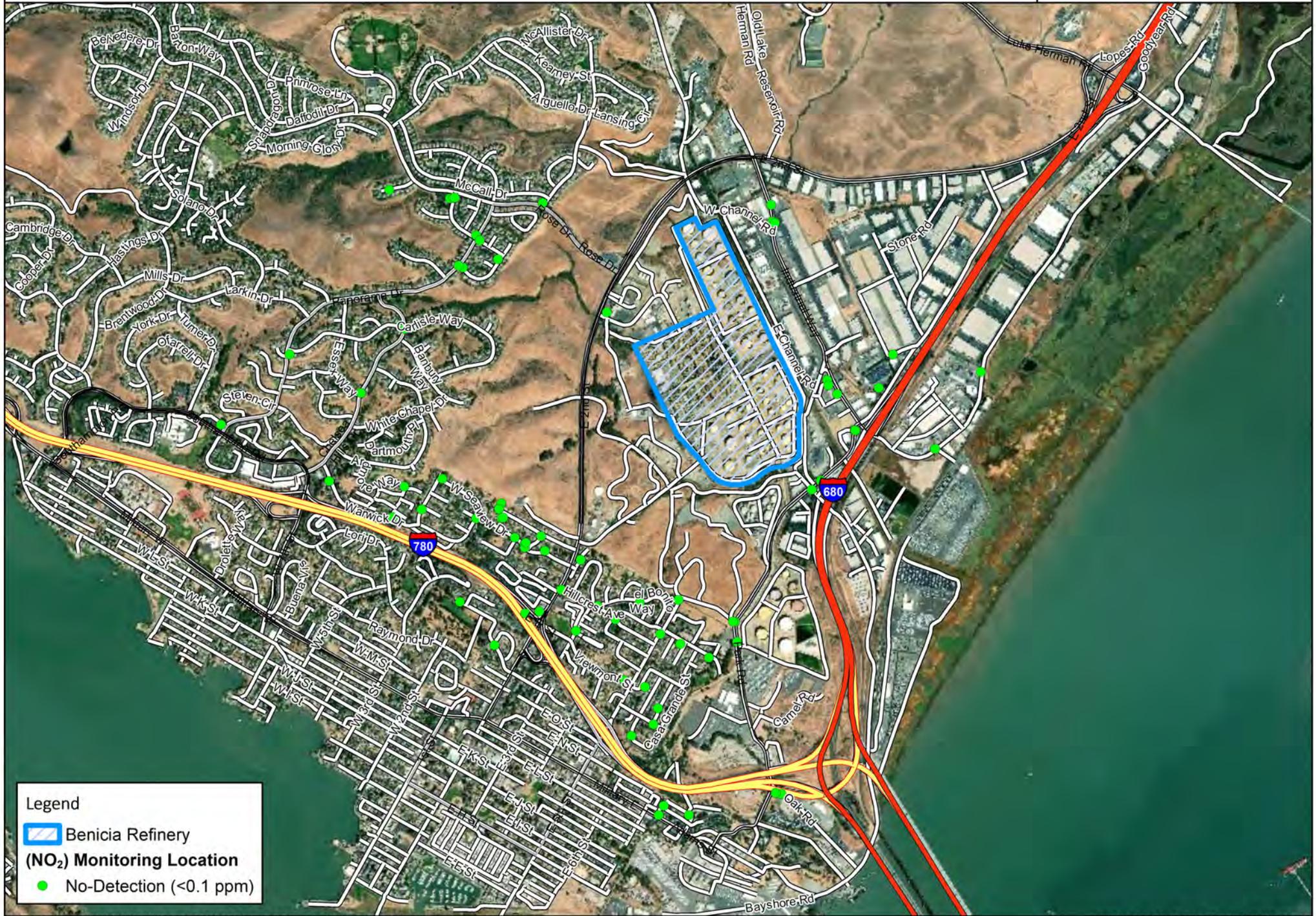


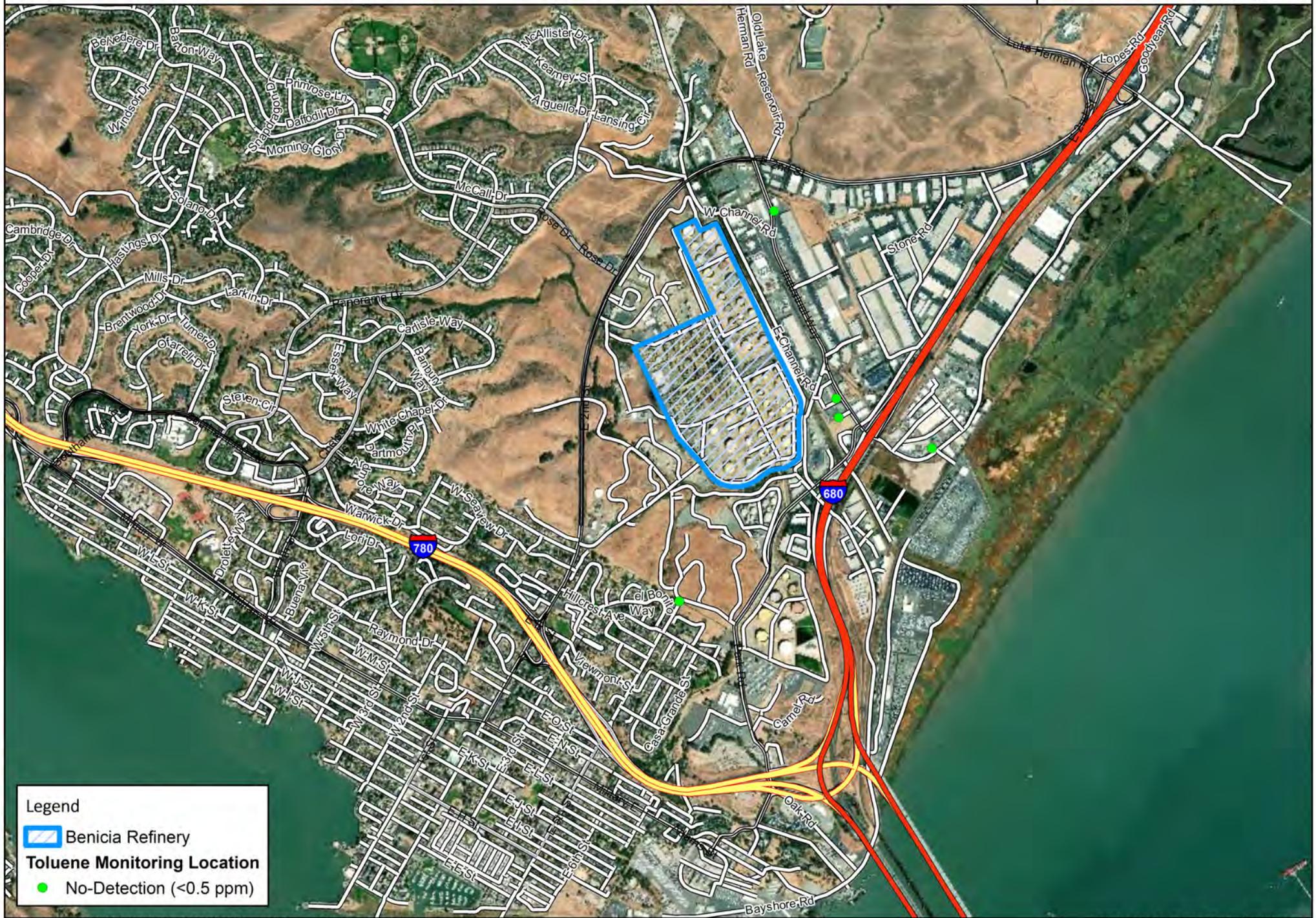
Project: 111342
Client: Valero Energy
City: Benicia, AR
County: Solano



Legend

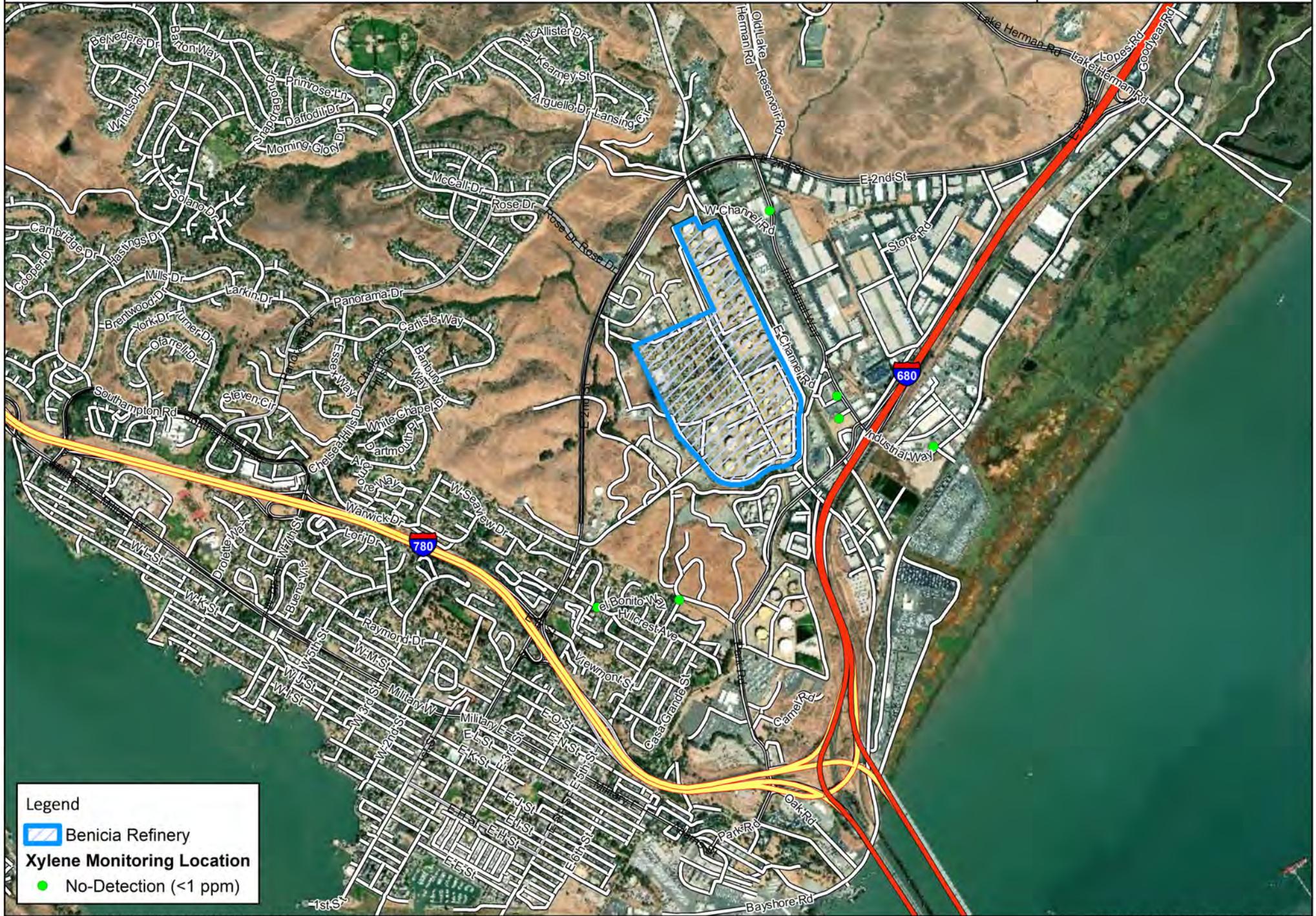
- No-Detection (<1 ppm)
- Benicia Refinery





Legend

-  Benicia Refinery
-  Toluene Monitoring Location
-  No-Detection (<0.5 ppm)

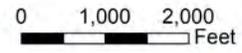


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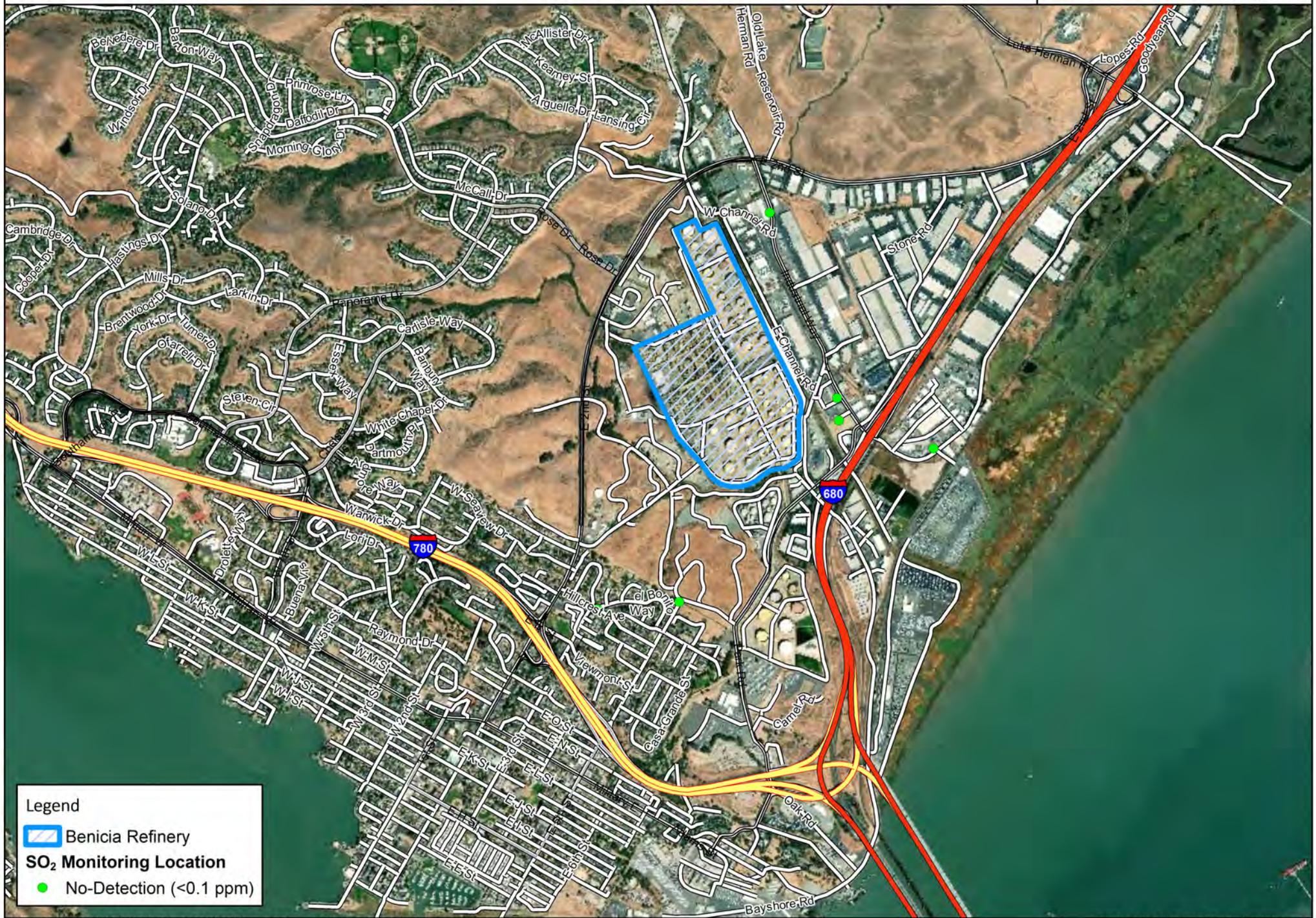
-  Benicia Refinery
- Xylene Monitoring Location**
-  No-Detection (<1 ppm)



Figure 10: Hand-Held Real-Time Monitoring Locations (SO₂)
Benicia Refinery Particulate Release

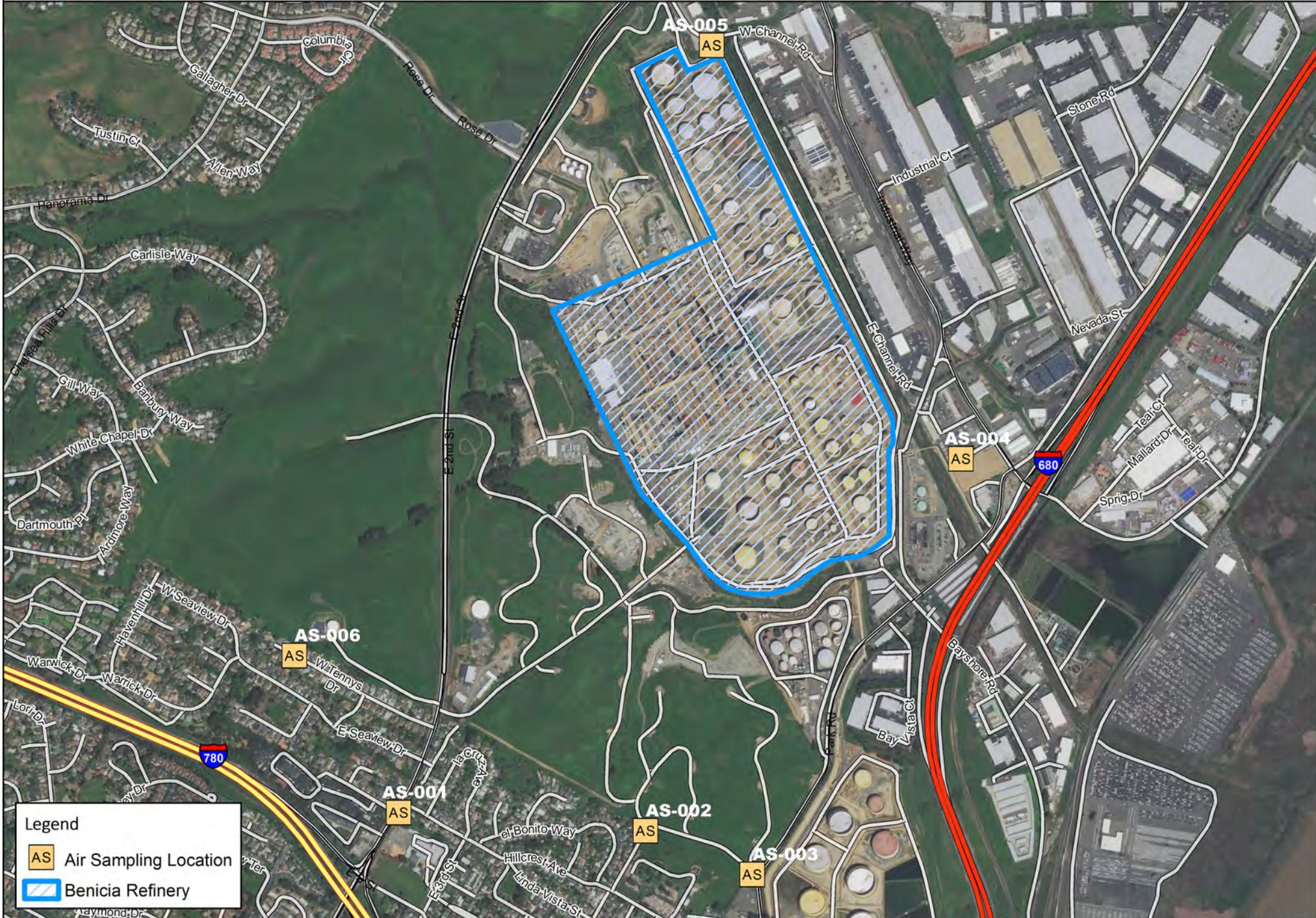


Project: 111342
Client: Valero Energy
City: Benicia, AR
County: Solano



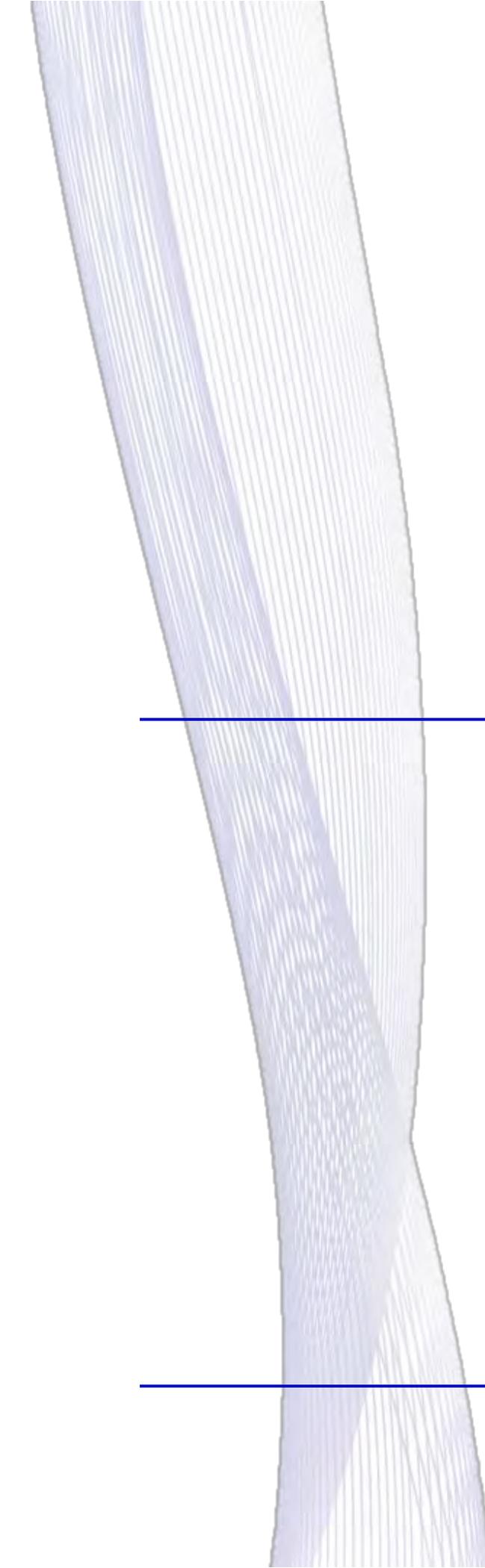
Legend

- Benicia Refinery
- SO₂ Monitoring Location**
- No-Detection (<0.1 ppm)



Legend

- Air Sampling Location
- Benicia Refinery



Attachment B

Directional Averages

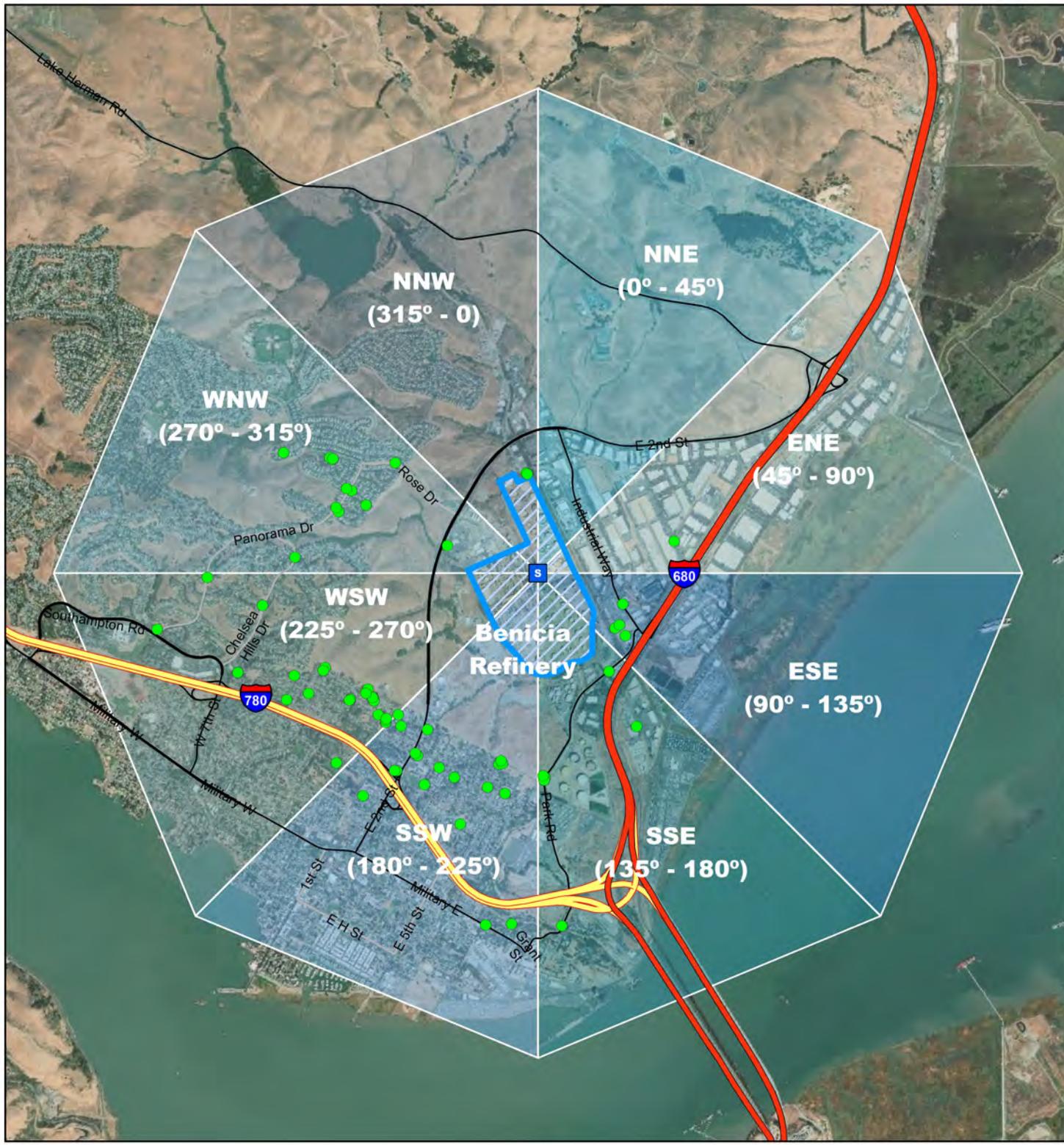


PM_{2.5} Directional Averages
Benicia Refinery Particulate Release

PM_{2.5} Avg. for 24 Hour Period
March 15 00:00 - March 16 00:00¹

Direction	# Readings	# Detections	Avg (mg/m ³)	Range (mg/m ³)	AQI Category Equivalent
ENE	1	1	0.008	0.008	Good
ESE	4	4	0.0088	0.006 - 0.011	Good
SSE	7	7	0.0087	0.004 - 0.012	Good
SSW	19	19	0.0135	0.003 - 0.033	Good
WSW	22	22	0.0135	0.006 - 0.028	Good
WNW	12	12	0.0123	0.005 - 0.02	Good
NNW	2	2	0.008	0.008 - 0.008	Good

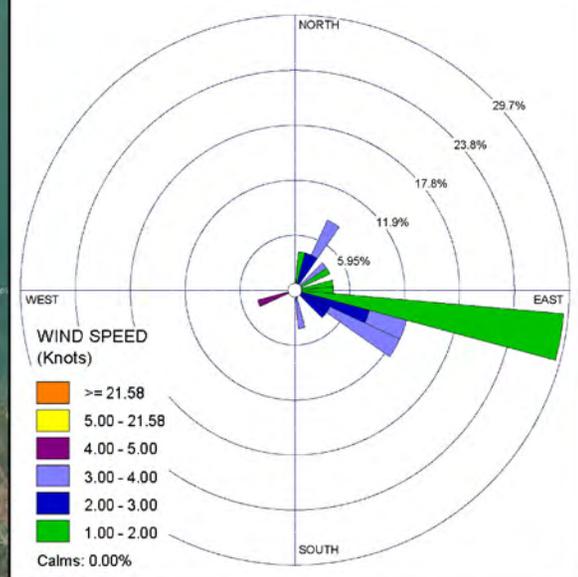
¹The EPA has eliminated spatial averaging provisions as part of the annual National Ambient Air Quality Standards (NAAQS) to avoid potential disproportionate impacts on at-risk populations. Additionally, due to the uneven temporal distribution of particulate matter monitoring data at these locations, averages may be biased and are not directly comparable to the NAAQS.



Benicia Refinery
 PM_{2.5} Real-Time Monitoring Location

Monitoring Direction

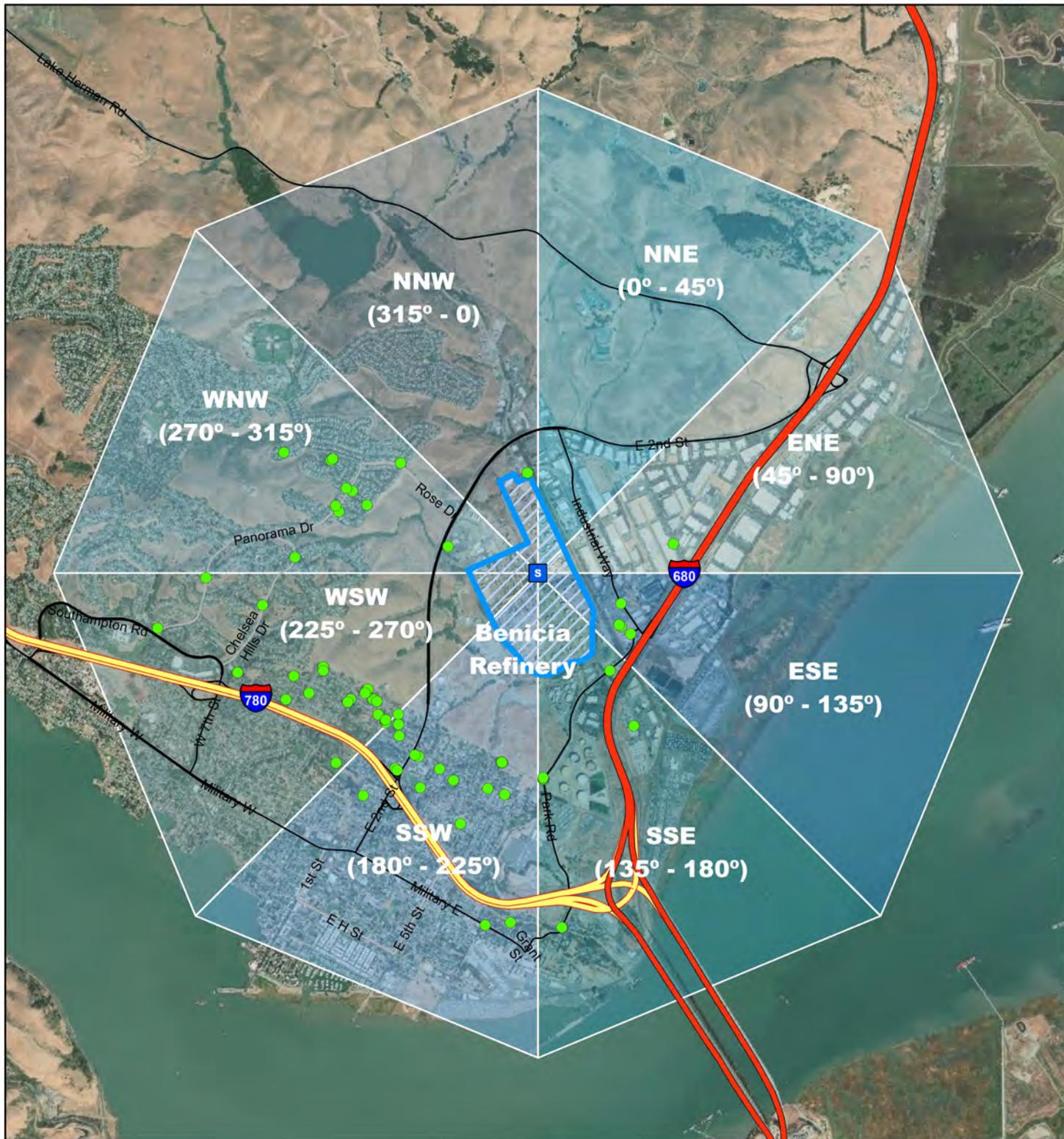
	ENE		NNW		WNW
	ESE		SSE		WSW
	NNE		SSW		



PM₁₀ Avg. for 24 Hour Period
March 15 00:00 - March 16 00:00¹

Direction	# Readings	# Detections	Avg (mg/m ³)	Range (mg/m ³)	AQI Category Equivalent
ENE	1	1	0.005	0.005	Good
ESE	4	4	0.0065	0.004 - 0.01	Good
NNW	2	2	0.0025	0.002 - 0.003	Good
SSE	7	7	0.0076	0.007 - 0.009	Good
SSW	19	19	0.0119	0.006 - 0.028	Good
WNW	12	12	0.0105	0.004 - 0.017	Good
WSW	22	22	0.0136	0.006 - 0.04	Good

¹The EPA has eliminated spatial averaging provisions as part of the annual National Ambient Air Quality Standards (NAAQS) to avoid potential disproportionate impacts on at-risk populations. Additionally, due to the uneven temporal distribution of particulate matter monitoring data at these locations, averages may be biased and are not directly comparable to the NAAQS.

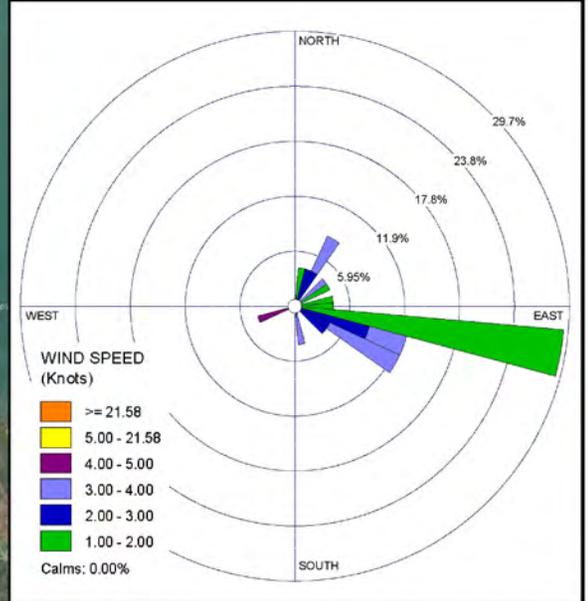


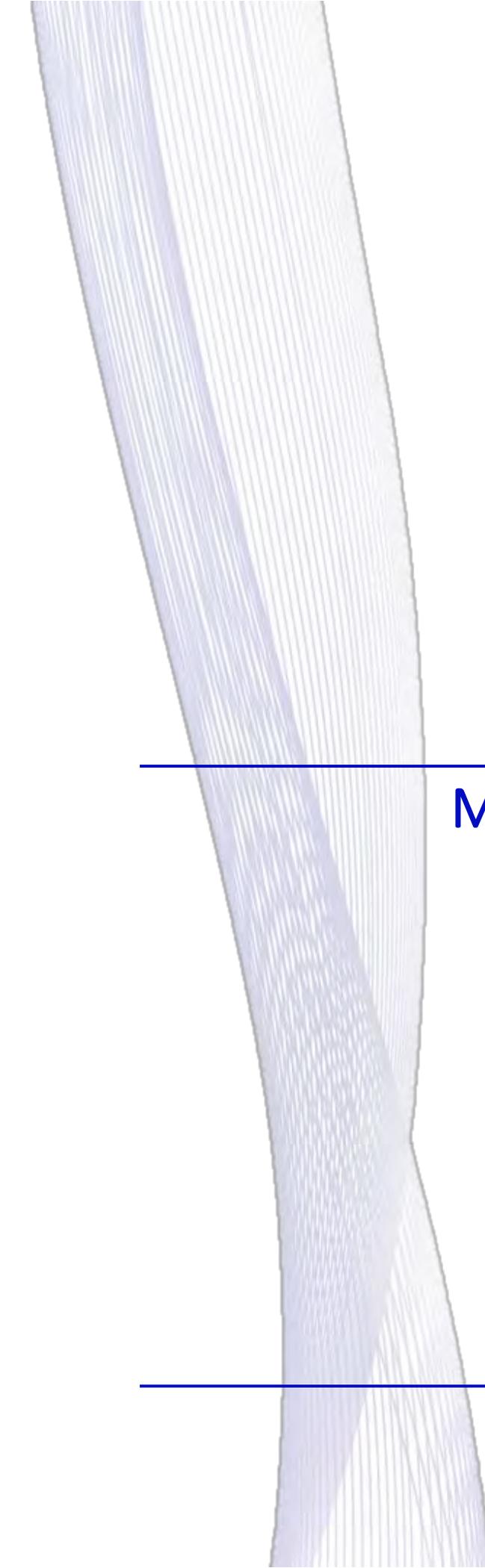
Benicia Refinery

PM₁₀ Real-Time Monitoring Location

Monitoring Direction

	ENE		NNW		WNW
	ESE		SSE		WSW
	NNE		SSW		



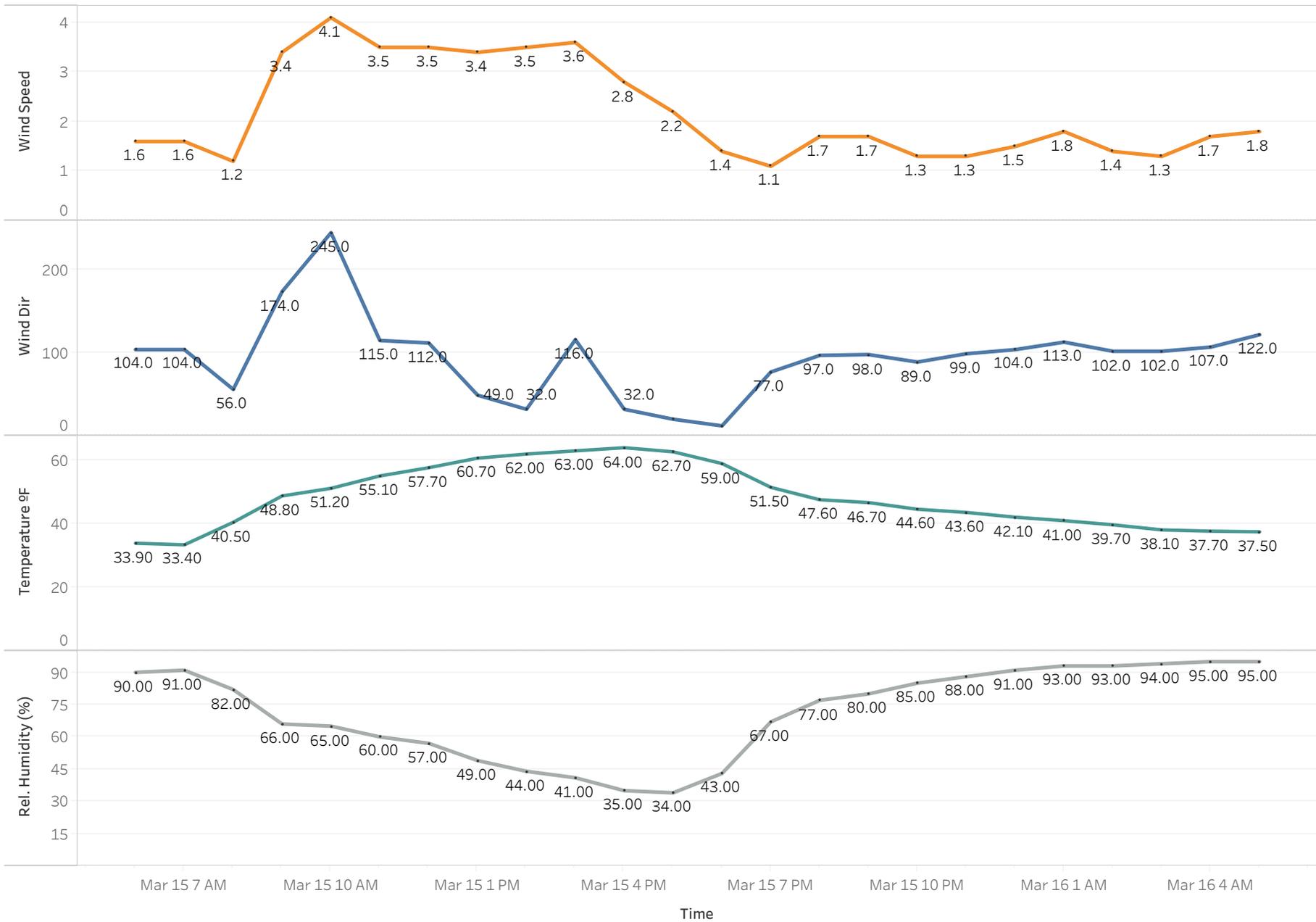


Attachment C

Meteorological Conditions

Figure 12: CIMIS Concord Meteorological Conditions

Mar 15 06:00 - Mar 16 07:00

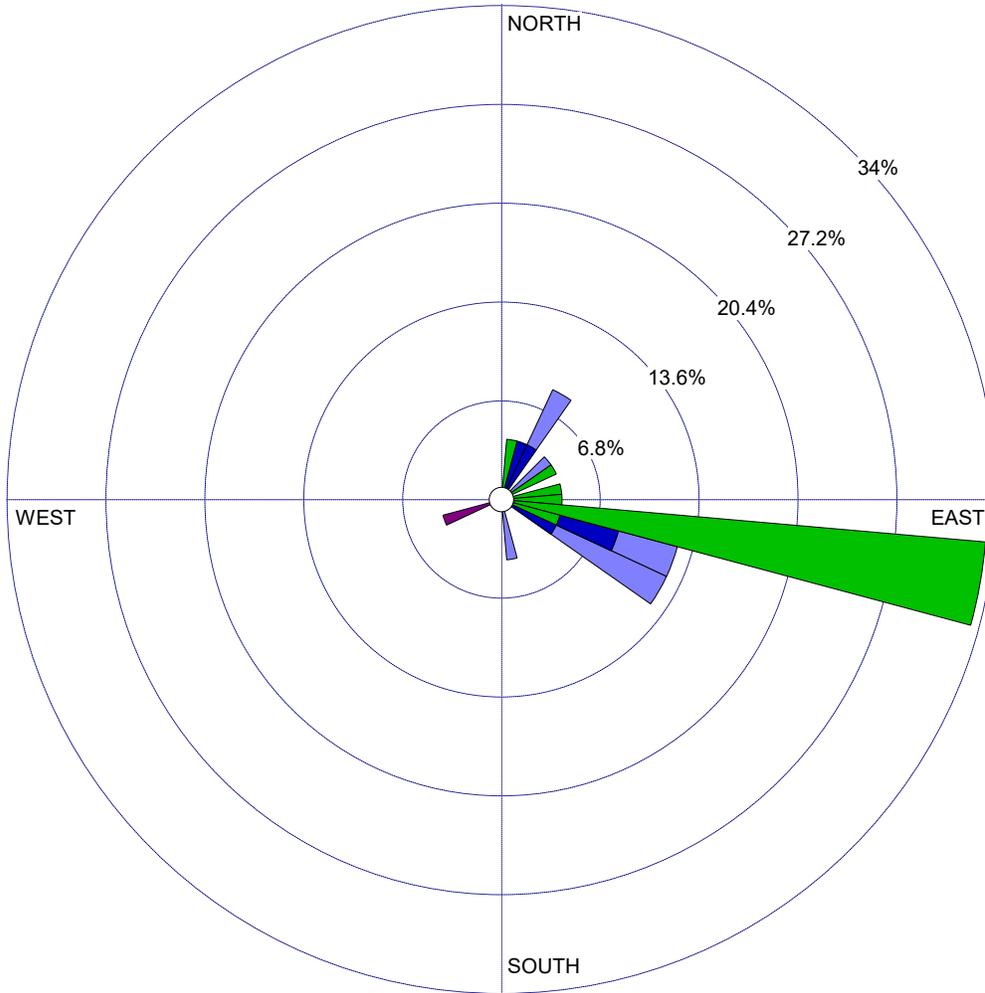


WIND ROSE PLOT:

Station #**CIMIS**

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(Knots)

- >= 21.58
- 5.00 - 21.58
- 4.00 - 5.00
- 3.00 - 4.00
- 2.00 - 3.00
- 1.00 - 2.00

Calms: 0.00%

COMMENTS:

DATA PERIOD:

Start Date: 3/15/2019 - 06:00
End Date: 3/16/2019 - 05:00

COMPANY NAME:

MODELER:

CALM WINDS:

0.00%

TOTAL COUNT:

24 hrs.

AVG. WIND SPEED:

1.79 Knots

DATE:

3/16/2019

PROJECT NO.:

111342