Lodi Gas Storage LLC

Kirby Hills Underground Natural Gas Storage Facility Monitoring Plan

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Revised: June 28, 2024

Title 17 California Code of Regulations (CCR) Division 3, Chapter 1, Subchapter 10, Article 4, Rule 13 Section 95668(h)(1)&(2)
Natural Gas Underground Storage Facility Monitoring Requirements

For Submittal to:
California Air Resources Board

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1. Introduction and Purpose

The following monitoring plan has been prepared by Lodi Gas Storage (LGS) for the Kirby Hills Facility as required by the California Air Resources Board (CARB) Greenhouse Gas Emission Standard for Crude Oil and Natural Gas Facilities, referred to herein as the CARB Oil and Gas Rule or Rule.[1]

The monitoring plan addresses the following three key areas, as outlined in Section 95668(h)(4) of the Rule:

(a) Continuous Ambient Monitoring;
(b) Wellhead Daily or Continuous Monitoring; and
(c) Well Blowout Procedures.

In 2018, LGS submitted the Kirby Hills monitoring plan to CARB and the Bay Area Air Quality Management District (BAAQMD). LGS received approval from CARB and BAAQMD for the most recent version of the monitoring plan on February 8, 2019. LGS is submitting this updated monitoring plan to CARB by July 1, 2024, in accordance with Section 95668(h)(1)(B) of the Rule.

Within 180 days of CARB approval of the updated monitoring plan, and consistent with Section 95668(h)(3) of the Rule, LGS will begin monitoring at the Kirby Hills Facility according to the approved updated monitoring plan. LGS will continue to monitor the Kirby Hills Facility in accordance with the previously approved plan while awaiting CARB's approval for the updated monitoring plan.

2. Facility Description

As shown in Figure 1, the Kirby Hills Facility is located in the Montezuma Hills of southeastern Solano County, approximately 8 miles southeast of Fairfield, California and 6 miles west of Rio Vista, California. Montezuma, California is approximately 5 miles to the southeast. The Facility is under the jurisdiction of BAAQMD. Hilly agricultural space surrounds the Facility. The predominant geological feature nearby is the Sacramento-San Joaquin River Delta, immediately to the north. Montezuma/Nurse Slough is on the west, and Shiloh Road is on the east.

LGS receives natural gas via pipeline and operates four compressors at a centralized facility. Compressor motors are natural gas fired. Gas is injected into underground reservoirs for storage. Seven well pads are located onsite, containing eighteen wells used for injection or withdrawal of natural gas. Figure 2 includes a site map showing the compressor station and well pad locations. The Facility also includes two three-phase separators, two reboilers with thermal oxidizers and vents, and an emergency generator. A design max of 15 billion cubic feet of working gas can be stored at the Facility.

[1] Rule is promulgated under 17 California Code of Regulations, Division 3, Chapter 1, Subchapter 10, Article 4, Rule 13, Section 95668(h)(2).

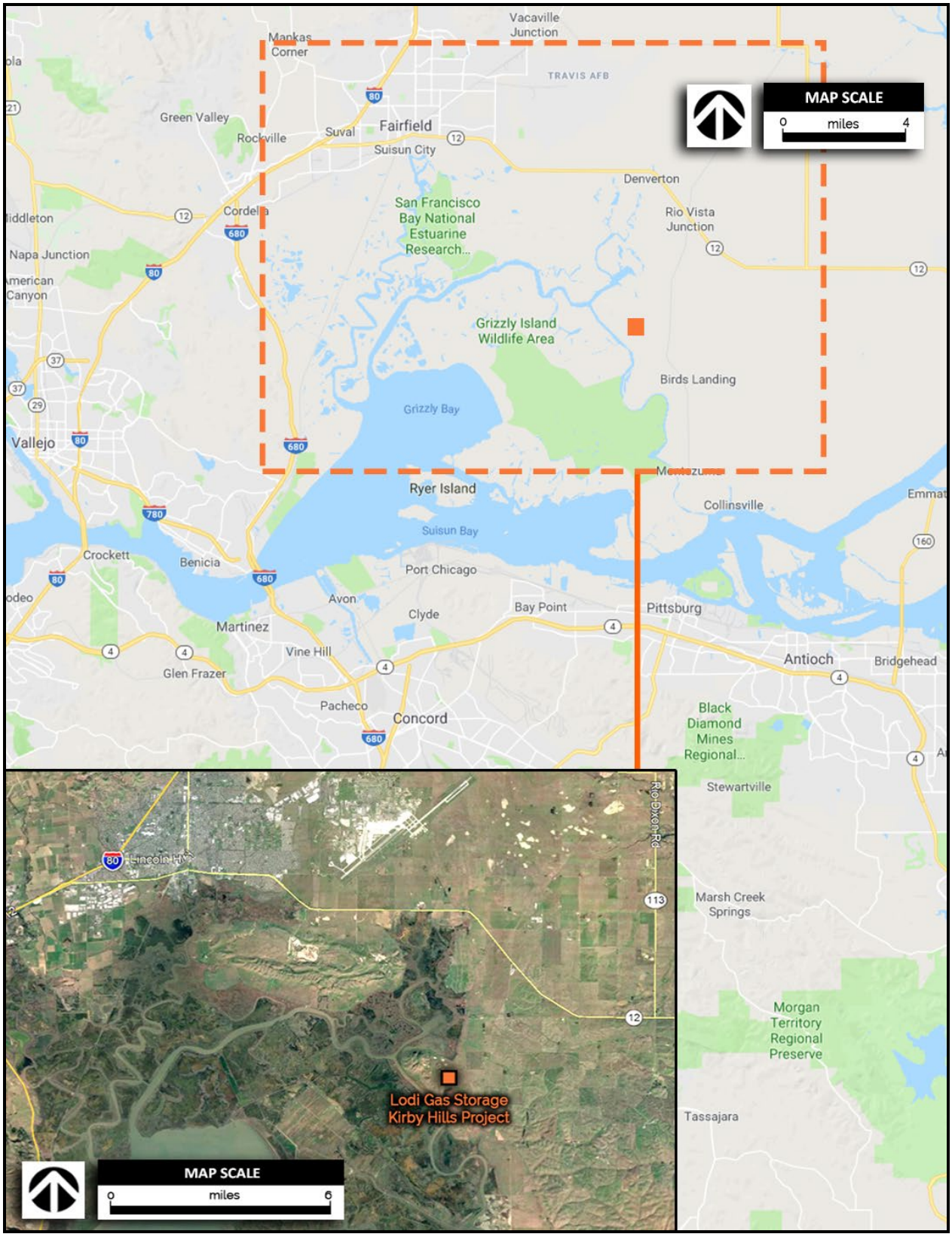


Figure 1: Location Map of Kirby Hills Facility

3. Continuous Ambient Monitoring

3.1 Ambient Air Monitor Technology and Operation

3.1.1 Technology

As required by Section 95668(h)(4)(A)(1)(a) of the Rule, and approved by CARB in February 2019, LGS owns and operated four ambient air monitors, one at the predominant upwind location and three at predominant downwind locations. To determine upwind and downwind emissions baselines, the ambient monitoring instruments are capable of measuring a minimum of 250 ppb for ambient methane concentrations with resolution of one-minute data, as required by the CARB Oil and Gas Rule. In accordance with the previously approved monitoring plan, LGS installed ABB LGR-ICOS gas analyzers (or equivalent). Furthermore, LGS will have secondary monitoring systems that will be used as replacement devices in the event of a malfunction of the primary systems. The systems will be SENSIT Gas Trac fixed methane detectors (FMDs). The FMD uses tunable diode laser spectroscopy (TDLAS) technology and are capable of detecting methane as low as 200 ppb. These monitors will provide a minimum methane detection level of 10 ppb, surpassing the required 250 ppb accuracy. Detailed instrument specifications have been provided in Appendix B.

All monitor placement and siting comply with requirements found in 40 CFR Part 58, Appendix E. The sites are characterized as a microscale type monitoring station according to spatial scale definitions found in 40CFR Part 58, Appendix D. As such, the inlet probes are placed between two and seven meters above ground level. LGS placed the inlet probes at approximately 2.5 meters above ground level and at a distance of at least one meter vertically and horizontally from any supporting structure.

3.1.2 Operation

As required by Section 95668(h)(4)(A)(1)(b) of the Rule, LGS will calibrate the ambient air monitors at least once annually or at the manufacturer's recommended frequency. LGS will continue to repair or replace any defective air monitors within 14 calendar days from the date of calibration or discovery of malfunction. In the event that parts or equipment needed to complete the necessary repairs are unavailable in this timeframe, LGS will notify the CARB Executive Office and request an extension to the replace or repair timeline in accordance with Section 95670.1 of the Rule.

As required by Section 95668(h)(4)(A)(10) of the Rule, LGS shall keep records of any time the monitoring system is inactivated, including an explanation of the reason for the system being inactivated. LGS shall also record when the system is reactivated.

3.2 Placement of Ambient Air Monitors

Figure 3 identifies LGS's the upwind and downwind locations for the ambient monitors at the Kirby Hills Facility, as well as the location of the meteorological tower. These monitoring locations are as follows:.

- Upwind Monitoring Station (Site 10): 10, 594962, 4224220 UTM; Elevation: 196 ft
- Downwind Monitoring Station 1 (Site 23): 10, 595166, 4224961 UTM; Elevation: 48 ft
- Downwind Monitoring Station 2 (Site 22): 10, 595562, 4224825 UTM; Elevation: 14 ft
- Downwind Monitoring Station 3 (Site 21): 10, 595673, 4224622 UTM; Elevation: 22 ft
- Meteorological Monitoring Station: 10, 594963, 4224220 UTM; Elevation: 196 ft

The prevailing wind direction at the Kirby Hills Facility is out of the southwest. Wind roses, based on annual data, are shown in Figure 2. Seasonal wind roses are included in Appendix A. In addition, a dispersion modeling analysis was performed to determine monitor placement. A detailed discussion of the dispersion modeling analysis is included in Section 3.2.2 below.
To suitably capture any leaks from the LGS Kirby Hills Facility, LGS is proposing to place downwind end of the facility (WS-21, WS-22, and WS-23).
Upwind and meteorological monitors would be at the top of Kirby Hills to limit interference from surrounding terrain. LGS believes these locations are suitable for establishing baseline background concentrations and are minimally impacted by LGS emission sources.

The ambient monitoring locations were chosen to meet the requirements of Section 95668(h)(4)(A) of the Rule. Guidance presented in the following documents was utilized in monitor site selection:

- 40 CFR Part 58, Appendices A & E;
- EPA's Meteorological Monitoring Guidance for Regulatory Modeling Applications;
- EPA's Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II: Ambient Air Quality Monitoring Program; and
- EPA's Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV: Meteorological Measurements Versions 2.0.

The monitoring sites are selected based on suitability of terrain and distance from obstructions to ensure that representative data are collected. Meteorological sensors are sited at a distance beyond the influence of obstructions such as buildings and trees. Availability of power and accessibility to the site was also considered in choosing the locations of the monitors. LGS believes that the locations of the ambient monitors (as shown in Figure 3) continue to act as a suitable methane monitoring network for the Kirby Hills Facility.

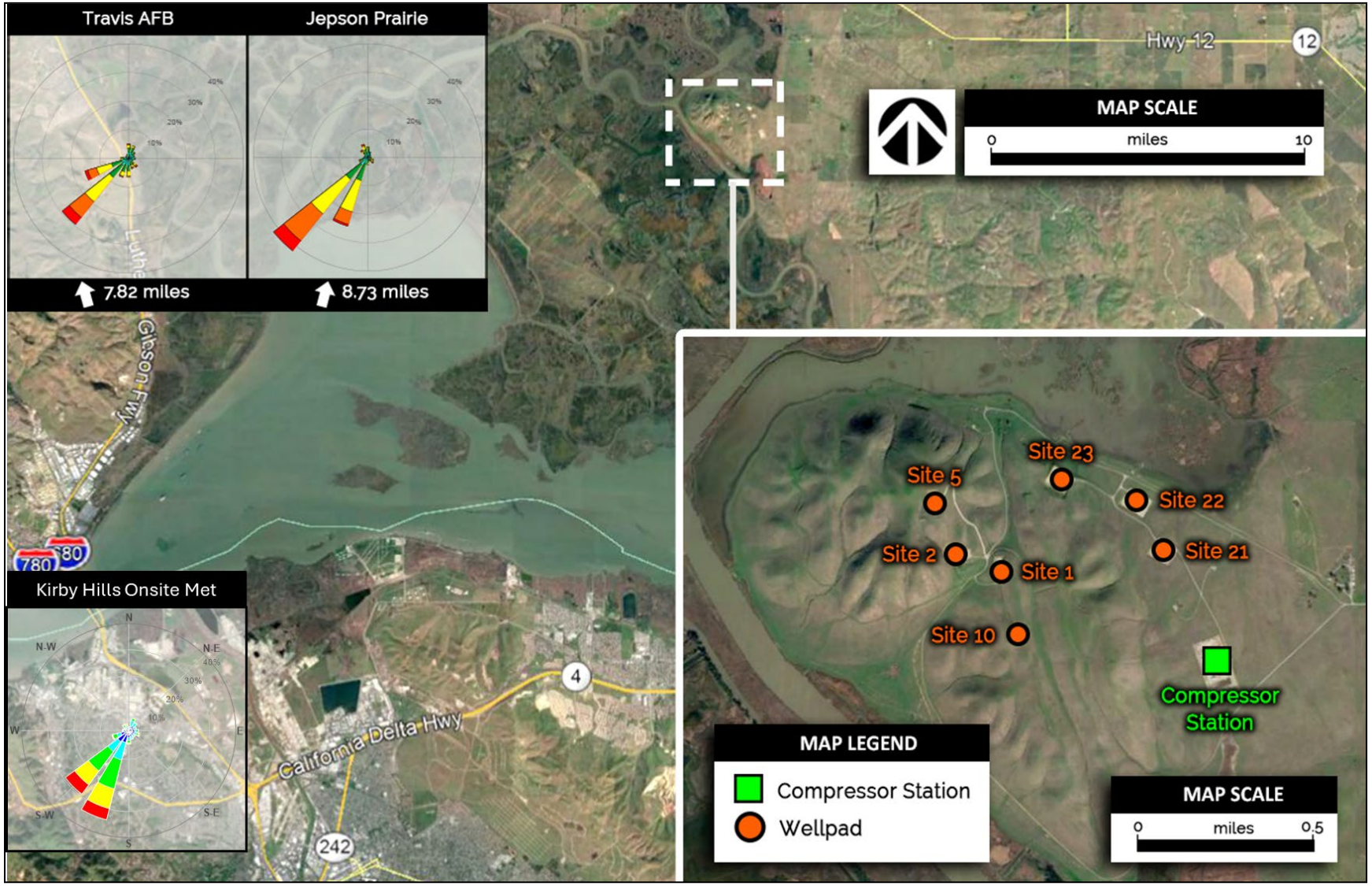


Figure 2: Compressor Station and and Well Pad Locations with Annual Wind Data

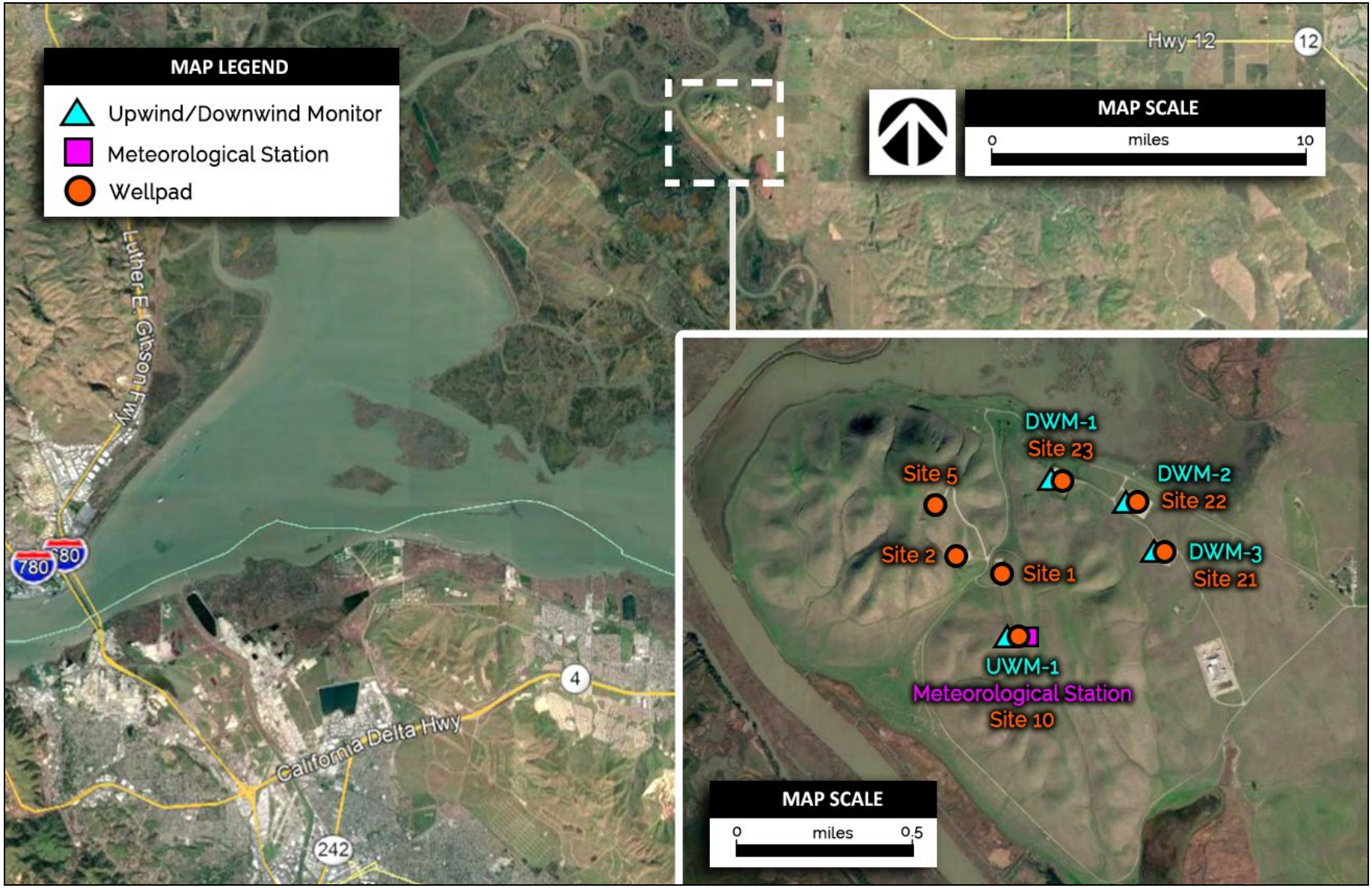


Figure 3: Locations of Ambient Monitors and Meteorological Station at Kirby Hills Facility

3.2.1 Supporting Wind Data

Wind roses referenced in the initial monitor placement review were generated using meteorological data from the following established stations: Jepson Prairie Road, and Travis Air Force Base. Locations of these established wind monitors are summarized in Table 1. Upwind and downwind monitor locations were determined based on the subsequent wind roses.

Table 1. Established Meteorological Stations

Station	Coordinates (UTM)	Elevation (ft)	Distance from Facility
Jepson Prairie Road	10, 602583, 4236263	17	8.73 mi NE
Travis Air Force Base	10, 591860, 4235928	84	7.82 mi NW

LGS installed a meteorological station to monitor meteorological parameters at the Facility. Wind data from the monitoring network were evaluated and compared from 2023. Winds from the LGS tower show predominant winds out of the south-southwest and southwest.

3.2.2 Supporting Dispersion Modeling Data

Dispersion modeling was conducted to optimize monitor placement by characterizing emissions transport from each well head location. Near-field dispersion modeling was conducted using the AERMOD modeling system (version 18081) which is a steady-state Eulerian, Gaussian mathematical plume model.

Meteorological data used in the analysis were processed in AERMET (version 18081). Five-years (2013-2016) of Integrated Surface Hourly (ISH) data from Travis Air Force Base was obtained from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC). Corresponding upper air data from the Oakland upper air station were from the NOAA Earth Systems Research Laboratory. Travis Air Force base is located approximately 6.7 miles north of the facility and is deemed representative of conditions at the facility.

Well pad emissions were modeled as volume sources with initial vertical and lateral dimensions that were close to the ground to represent emissions from a well casing. Since the intent of the modeling was to evaluate transport of emissions from the locations of the well pads, each volume source was given an emission rate of one gram per second. Initial volume source dimensions are provided below:

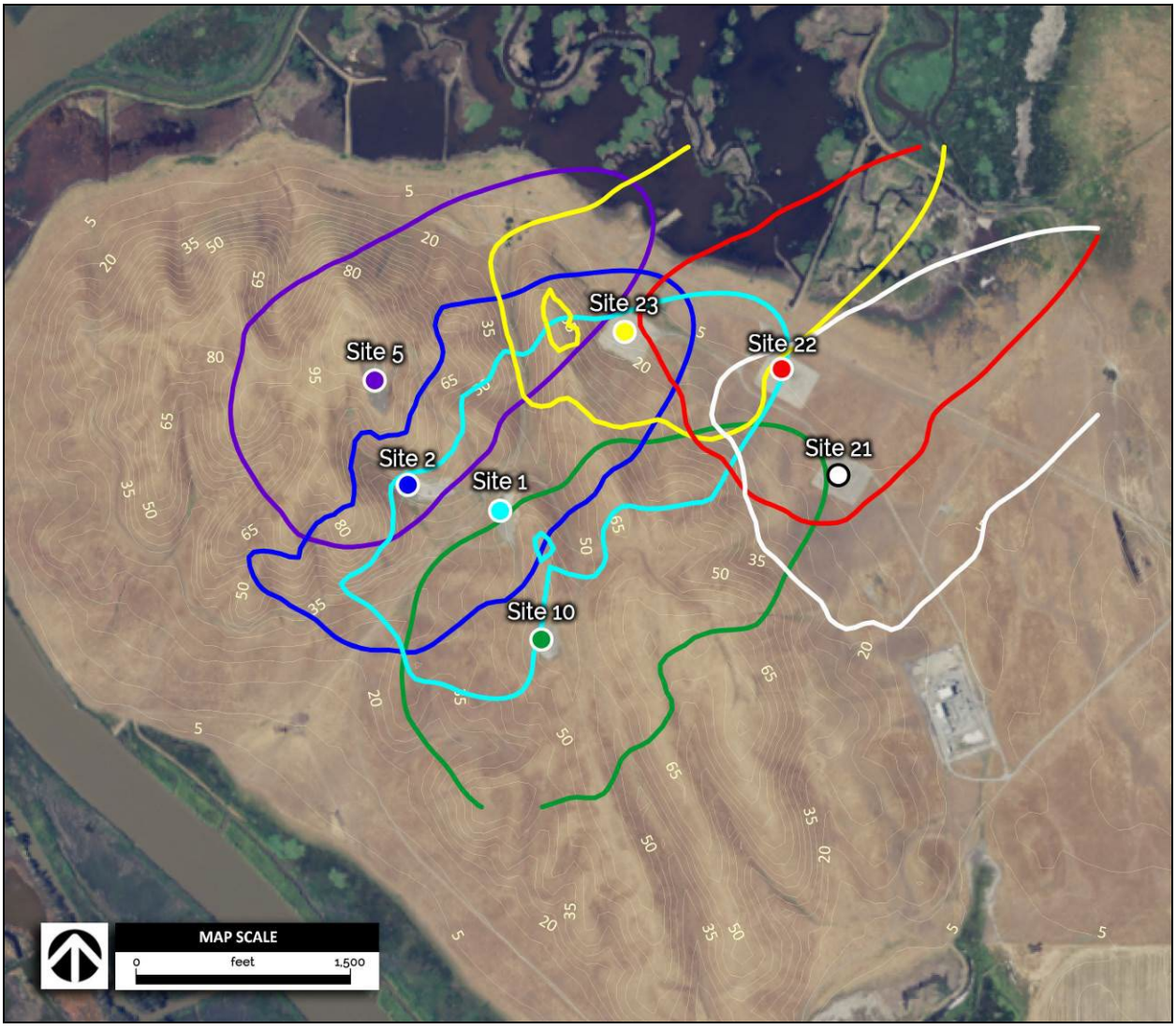
- Initial vertical dimension: 2.15 meters,
- Initial lateral dimension: 4.3 meters,
- Release height: 1.07 meters.

The receptor grid surrounding the well pads consisted of a 50 receptor wide (east-west) by 30 receptor long (north-south) rectangular grid with receptors evenly spaced every 50 meters. Concentration isopleth plots were generated for each well pad location to show pollutant transport from the location. Although each pad can have multiple well heads, only one well head was selected to represent pollutant transport for the entire pad. Figure 4 presents colored isopleth plots for each well pad location. Detailed concentration isopleths, broken into six color variations with pink showing the highest concentrations and dark blue showing the lowest concentrations,

are included in Appendix C. For this analysis, concentrations in the cyan coloring regime were considered to be a level of significance where a monitor located within this region would be able to detect a well casing blowout.

From this analysis, LGS determined that downwind monitors located at Sites 21, 22, and 23, and an upwind monitor located at Site 10 were sufficient to capture emissions from well pads at the LGS Kirby Hills facility.

Figure 4: Isopleth Map for Modeled Potential Emissions



3.3 Meteorological Measurements

As required by Section 95668(h)(4)(A)(2) of the Rule, an ambient monitoring system includes instrumentation that allows for continuous measurement and recording of ambient temperature, ambient pressure, relative humidity, wind speed, and wind direction. LGS operates a10-meter meteorological measurement tower at the Facility to measure the aforementioned meteorological parameters. LGS believes that one station is adequate to provide sufficient meteorological data that are representative of conditions at the Facility due to the elevation level of the tower, avoiding obstruction from the hilly terrain surrounding Kirby Hills Facility. LGS installed the meteorological station at the same location as the upwind ambient air monitor at Site 10. The station is located in an open area with minimal obstructions and surrounded by low level vegetation.

Table 2 summarizes the meteorological instrumentation (or equivalent) installed at the Kirby Hills Facility upwind monitoring station.

Table 2. Kirby Hills Facility Meteorological Equipment

Parameter (Manufacturer/Model)	Specified Accuracy
Wind Speed - MetPak Base Station/ Sensit RAMP	±0.20 m/s or 1% of reading
Wind Direction - MetPak Base Station/ Sensit RAMP	±3 degrees
Temperature - MetPak Base Station/ Sensit RAMP	±0.2°C @ 23°C
Relative Humidity - MetPak Base Station/ Sensit RAMP	±1.3% RH @ 23°C
Barometric Pressure - MetPak Base Station/ Sensit RAMP	±0.3 mb @ +20°C

3.4 Data Handling

3.4.1 Data Validation and Storage

The necessary practices and procedures in the following EPA documents will be utilized to validate data being captured by the ambient monitoring system:

- 40 CFR Part 58, Appendix A – Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards (NAAQS);
- Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, EPA-454/B-08-002, March 2008;
- Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II: Ambient Air Quality Monitoring Program, EPA-454/B-17-001, January 2017; and
- Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, February 2000.

The procedures outlined in the reference documents listed above represent best practices for ambient air quality monitoring and provide sound data validation protocols.

Methane and meteorological data are routinely checked for irregularities during daily data reviews. This aids in determining the validity of the data that is collected within the ambient monitoring network, and the validity of triggered alarms. The various items included during daily data reviews include:

- Check maintenance logs, field notes, blowdown logs, etc. and compare methane or meteorological data with the above to indicate any monitored events.
- Check for power failures.
- Check traces exhibiting noise, spikes, non-varying data, or influences of other equipment (e.g., air conditioner).
- Check for instrument alarms or warnings.
- Data associated with any calibration run which produces readings of zero or span outside the specified tolerance.
- Check for data outside the plausible ranges.
- Investigate the cause of unexpected outlier measurements.
- Check measurements for consistency with other monitoring stations in the region if available.
- Flag data that are missing, invalid, or questionable.
- Record all validation steps for quality control.

All erroneous data identified are documented and will be removed, as necessary, from the final data set. Additionally, results of calibration test as well as diagnostic information from the analyzer and meteorological sensors will be used for determining the validity of the data that are collected within the ambient monitoring network.

To perform sampling and analysis operations consistently, standard operating procedures (SOPs) for the LGS monitoring network have been developed. The SOPs ensure consistent performance with organizational practices; serve as training aids; provide ready reference and documentation of proper procedures; reduce work effort; reduce error occurrences in data; and improve data comparability, credibility and defensibility. For ease of use, each SOP is sufficiently clear and written in a step-by-step format.

Pursuant to Section 95668(h)(4)(A)(3) of the Rule, LGS's ambient air monitoring system (including the meteorological station) has the ability to store at least 24 months of continuous data with the capability to generate hourly, daily, weekly, monthly, and annual reports.

3.4.2 Data Reporting

Pursuant to Sections 95668(h)(4)(A)(5) and 95673(a)(11) of the Rule, LGS will provide an annual report of all meteorological data and ambient air data collected at the Facility to CARB electronically at oilandgas@arb.ca.gov with the subject line "Natural Gas Underground Storage Reporting". Additionally, LGS will make meteorological data and ambient air data available at the request of the CARB Executive Officer.

3.5 Alarm System and Monitoring Baseline Conditions

Pursuant to Section 95668(h)(4)(A)(4) of the Rule, LGS has established an integrated alarm system connected to the ambient air monitors that will be continuously audible and visible in the control room at LGS, and any remote control rooms, as necessary. Per Section 95668(h)(4)(A)(7) of the Rule, the alarm system will be triggered under the following conditions:

- The 1-hour average concentration, for a full operating hour, is greater than or equal to four times the monitor baseline, or
- An alternative scenario agreed upon in consultation with CARB is met.

Pursuant to Section 95668(h)(4)(A)(6) of the Rule, LGS has established a baseline monitoring value for the facility using 12 months of continuous monitoring data. The baseline condition was established from the 98th percentile of the 12-month continuous period of 1-hour measurements.

A summary of the baseline concentration values at the Kirby Hills monitoring stations is presented in Table 3 below in parts per million by volume (ppmv).

Table 3. Kirby Hills Storage Facility Baseline Concentration Values

	S10[2]	WS21	WS22	WS23
Approved Baseline Value (ppmv)	2.57	2.46	2.67	3.01
Alarm Threshold (ppmv)[1]	10.28	9.84	10.68	12.04

1. Alarm system is triggered when the sensor detects a reading that is greater than or equal to 4 times the baseline concentration value.
2. Baseline concentration in Table 3 reflects a proposed update in a June 28, 2024 letter for Site 10 being revised based on the last 12-months of data collected.

For the purposes of determining the ambient air monitor 1-hour values, a full operating hour will be considered as at least 45 valid 1-minute data points that will be used to calculate the hourly average. Hourly data will not include partial operating hours (any clock hour with less than 45 minutes of monitor operation) and hours when maintenance or quality-assurance activities are performed on the monitors. Pursuant to Section 95668(h)(4)(A)(9), LGS recognizes that the baseline conditions may be re-evaluated every 12 months for changes in local conditions and must be approved by CARB.

In the event that an alarm is triggered, LGS will confirm that an alarm condition has occurred and then contact the following agencies within 24 hours of the alarm trigger in accordance with Section 95668(h)(4)(A)(8):

- CARB;
- California Department of Conservation Geologic Energy Management Division (CalGEM); and
- BAAQMD.

The following represent examples of scenarios where, if an alarm is triggered, LGS will investigate the cause of any resultant alarms, document the cause of the alarm, and provide CARB, CalGEM, and BAAQMD a notification via email within 24 hours. LGS will include an explanation for the alarm condition in the notification when an explanation is available:

1. Natural gas blowdown events;
2. Natural gas releases due to maintenance activities or emergency shutdowns;
3. Leaks at or below 1,000 ppmv total hydrocarbons.

If any of the above scenarios lead to an alarm, LGS will provide CARB, CalGEM, and BAAQMD with a courtesy notification via email within 24 hours. The email will notify CARB that an alarm was triggered but that the associated cause of the alarm is not believed to be an alarm condition for the purposes of the CARB Oil and Gas Rule. A detailed explanation for the cause of the alarm will be included in the notification.

4. Wellhead Daily Monitoring and Reporting

4.1 Daily or Continuous Monitoring

In accordance with Section 95668(h)(4)(B)(1) of the Rule, LGS has been conducting and will continue to conduct daily monitoring at each injection/withdrawal wellhead and attached pipelines using portable monitoring instruments approved by the CARB Executive Officer. Monitoring may be suspended in cases such as, but not limited to, emergencies, extreme weather, and unsafe working conditions. Monitoring will resume as soon as possible after a suspended monitoring event. Under the DOGGR approved inspection and leak detection protocol (provided in Appendix D), LGS currently performs daily leak surveys. LGS proposes to continue to follow these procedures to meet the monitoring requirement in the CARB Oil & Gas Rule. The monitor is described in detail in Section 4.1.1.

Should LGS choose to use continuous leak instrumentation to meet the requirements of Section 95668(h)(4)(B) of the Rule, LGS will submit a request to CARB to amend the monitoring plan to reflect the use of this instrumentation in lieu of the daily leak survey.

Pursuant to Section 95668(h)(4)(B)(1)(a) of the Rule, LGS will report a delay of inspection if wildlife is found to be present on a component and inspection must be halted or postponed within a certain distance of the wildlife in order to comply with state and federal wildlife regulations. LGS will report the delay of the inspection to CARB within 24 hours of discovering the wildlife. The notification will include a description of the type of wildlife and the regulations required work to be halted. Once the reason for the inspection delay is resolved, LGS will resume inspection and notify CARB within 24 hours of resuming the daily leak inspections.

4.1.1 Monitoring Technology

LGS currently uses a MSA Altair 5X Multi-gas Detector to conduct daily leak screening at the wellheads. The Altair 5X instrument uses high performance infrared technology to ensure the integrity of sampling and meets the monitoring requirements of Section 95668(h)(4)(B)(1) of the Rule. LGS will continue using the Altair 5X for leak monitoring purposes but will also introduce the RKI GX-Force personal monitor. These monitors are utilized at Rockpoint Gas Storage's other U.S. facilities and would allow for greater flexibility and harmonization between Rockpoint's U.S. facilities. Detailed specifications for the Altair 5X and the RKI GX-Force personal monitor are included in Appendix E.

4.2 Monitoring Discovery and Repair

4.2.1 Monitoring Discovery

Per Section 95668(h)(4)(B)(3) of the Rule, within 24 hours of detecting a leak through the daily monitoring procedures, LGS will perform leak measurements in accordance with EPA Method 21, excluding the use of PID instruments. LGS currently uses an OVA 88 flame ionization detector to perform these measurements. In addition, LGS proposes to add both the Bascom-Turner Instruments Model CCD-201 and the RKI Eagle 2, which are utilized at Rockpoint Gas Storage's other U.S. facilities and meet the requirements of Section 95668(h)(4)(B)(1) of the Rule, as EPA Method 21 monitoring devices that may be used to perform leak measurements. Detailed specifications for all three monitors are included in Appendix F.

Pursuant to Section 95669(i) of the Rule, the following procedures will be completed upon leak detection:

- LGS will affix a weatherproof readily visible tag that identifies the date and time of leak detection and the measured leak concentration to the leaking component.

- The tag shall remain affixed to the component until the leaking component has been successfully repaired or replaced, after which the tag shall be removed.
- Successful repair shall be confirmed by re-measuring the component using US EPA Reference Method 21 (October 1, 2017) as specified in Section 95669(b) to determine that the component is below the minimum leak threshold after repair or replacement.

4.2.2 Leak Repair

After determining the leak rate using EPA Method 21, LGS will repair the leak according to the timelines shown below, as outlined in Sections 95669(h) and (i) of the Rule.

Leak Rate	Repair Time Period
1,000 – 9,999 ppmv	First attempt at repair within 5 calendar days and successful repair within14 calendar days
10,000 – 49,999 ppmv	5 calendar days
≥ 50,000 ppmv	2 calendar days
Critical Component or Critical Process Unit Leak	By next process shutdown or within 12 months, whichever is sooner

4.3 Leak Reporting and Recordkeeping

4.3.1 Individual Leak Reporting

In accordance with Section 95668(h)(4)(B)(6) of the Rule, LGS will report the following individual leaks to CARB, CalGEM, and BAAQMD within 24 hours of measurement:

- Leaks > 50,000 ppmv total hydrocarbons; and
- Leaks > 10,000 ppmv total hydrocarbons for more than 5 continuous calendar days.

4.3.2 Leak Recordkeeping

In accordance with Section 95668(h)(4)(B)(7) of the Rule, LGS will maintain and make available to the CARB Executive Officer records of the initial and final leak concentration measurements for leaks identified during the daily monitoring process that are above the thresholds specified in Section 4.2. LGS will utilize the record format as specified in Appendix A, Table A5 of the CARB Oil and Gas Rule.

5. Well Blowout Procedures

Per Section 95667(a)(3) of the Rule, “blowout” means the uncontrolled flow of gas, liquids, or solids (or a mixture thereof) from a well onto the surface.

5.1 Optical Gas Imaging (OGI) Procedures

Per Section 95668(h)(4)(C) of the Rule, LGS will direct a qualified technician (with training in basic thermal science, OGI camera operation and safety, and OGI inspections) to obtain daily OGI video footage of a leak resulting from a well blowout according to the timeline specified below.[3]

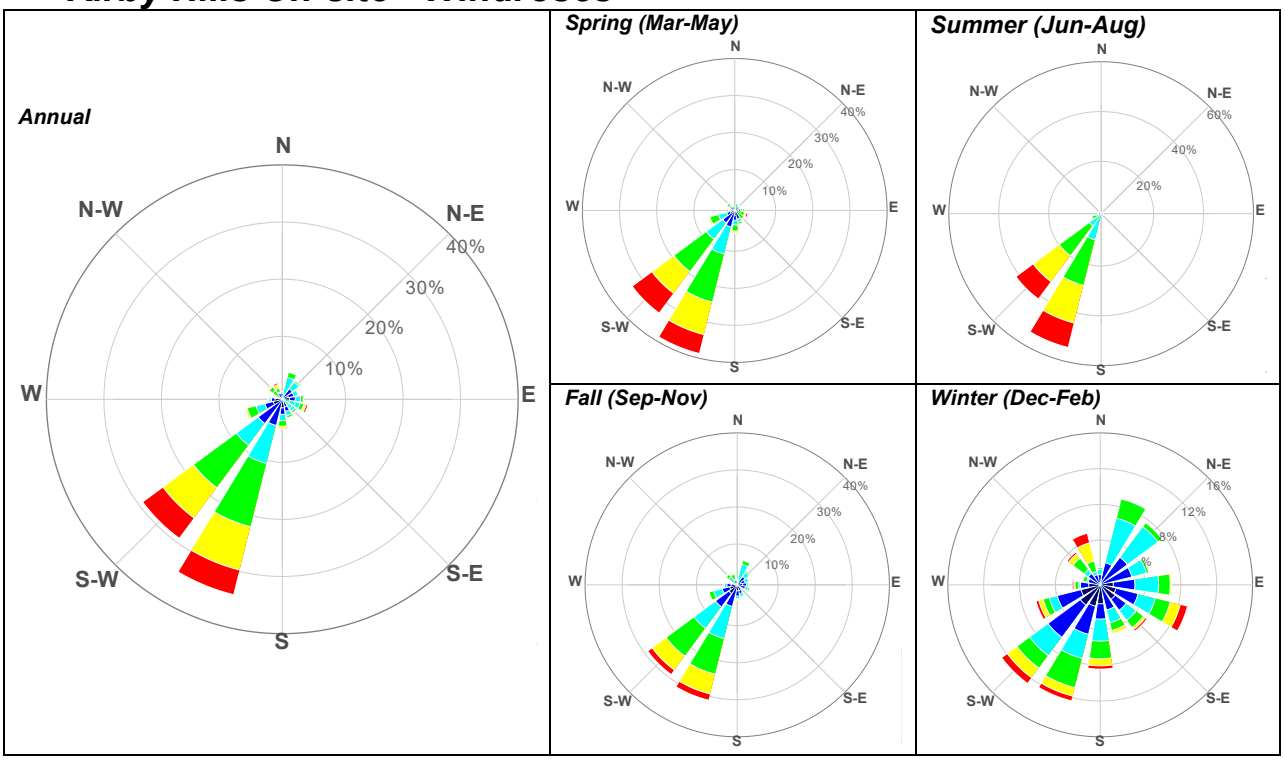
[3] In the event of a well blowout, LGS will utilize an outside contractor to capture the required OGI footage. Therefore, the specifications for OGI equipment cannot be provided in this Plan. Prior to collecting the footage, LGS will ensure the OGI equipment meets the criteria in 40 CFR 60.5397a.

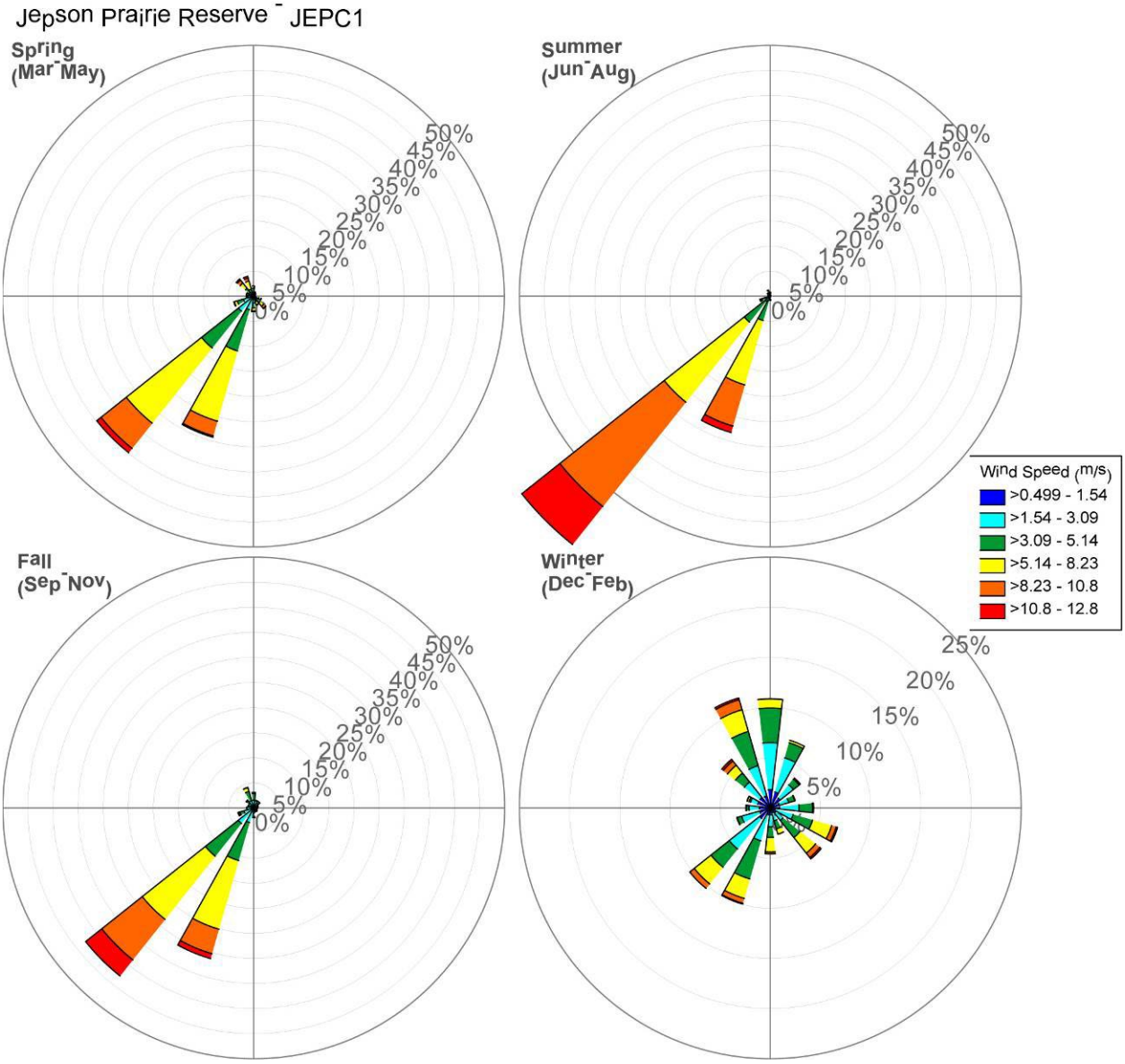
- After LGS has confirmed that a well blowout event has occurred, a qualified technician will collect 10 minutes of OGI video footage of the leak resulting from a confirmed well blowout event.
- The qualified technician will continue to record OGI video footage of the leak for a minimum of 10 minutes every four (4) hours until the blowout is capped.
- Within one business day after recording OGI video footage, LGS will post the video footage on a facility-maintained public internet website.

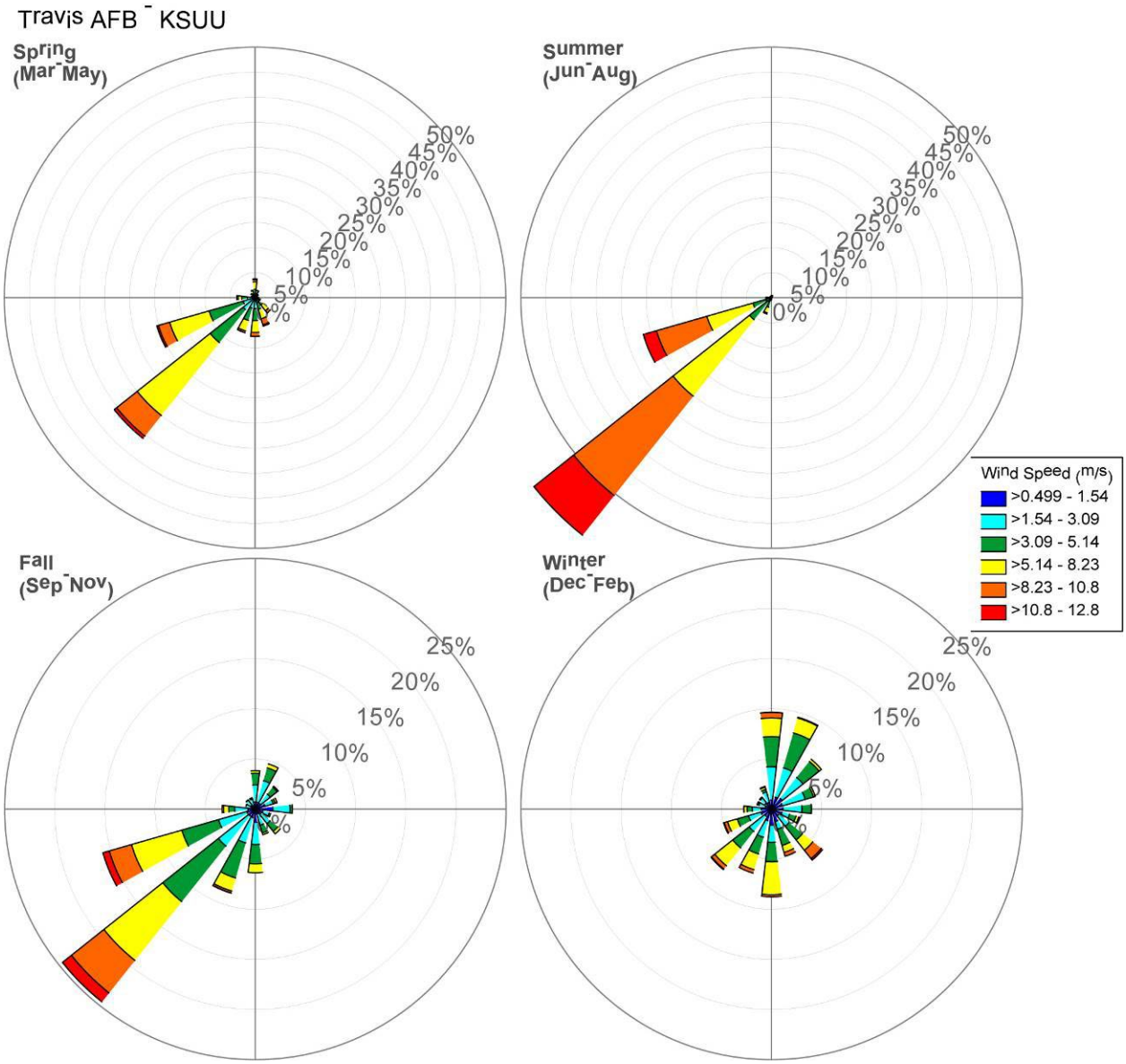
Pursuant to Section 95668(h)(4)(C)(3) of the Rule, LGS will provide OGI video footage to the CARB Executive Officer upon request, for publication on a CARB-maintained public internet web site.

Appendix A – Seasonal Wind Roses

Kirby Hills On-site - Windroses




Jepson Prairie Reserve - JEPC1
Spring
(Mar-May)
Summer
(Jun-Aug)
Fall
(Sep-Nov)
Winter
(Dec-Feb)
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
Wind Speed (m/s)
>0.499 - 1.54
>1.54 - 3.09
>3.09 - 5.14
>5.14 - 8.23
>8.23 - 10.8
>10.8 - 12.8


Travis AFB - KSUU
Spring
(Mar-May)
Summer
(Jun-Aug)
Fall
(Sep-Nov)
Winter
(Dec-Feb)
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Wind Speed (m/s)
>0.499 - 1.54
>1.54 - 3.09
>3.09 - 5.14
>5.14 - 8.23
>8.23 - 10.8
>10.8 - 12.8

Appendix B – Ambient Air Monitor Specifications

ABB MEASUREMENT & ANALYTICS | DATA SHEET

LGR-ICOS™ M-GGA-918

Microportable Greenhouse Gas Analyzer

LGR-ICOS™ M-GGA-918 microportable analyzer

Sensitive, fast and compact analyzer for field measurement of CH_4, CO_2 and H_2O

Measurement made easy

Features and benefits

- Lightweight, less than 6 Kg (13 pounds)
- Continuous measurements
- Data reported every second with high sensitivity
- Ideal for soil flux studies and field measurements of greenhouse gases
- Extremely wide linear range, CH_4 range up to 10% (optional)
- No cross interferences
- Operates directly on DC power
- Fast gas flow response time (3 seconds, 1/e)
- Records data within 20 seconds after power on
- Multiple data outputs and internet connectivity

Overview

The ABB LGR-ICOS gas analyzers build on the heritage and extensive track record of Los Gatos Research analyzers, using patented Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS) technology, the latest evolution in tunable diode laser absorption spectroscopy.

ABB's new Microportable Gas Analyzer (M-GGA-918) reports measurements of methane, carbon dioxide and water vapor simultaneously in a package that is compact, crushproof and travels anywhere. Small enough to be hand-carried (even on-board aircraft) and requiring less than 35 watts, the M-GGA-918 offers opportunities to measure greenhouse gases anywhere.

As with all LGR-ICOS analyzers, the M-GGA-918 is fast and simple to use which makes it ideal for field studies, compliance monitoring, air quality studies and soil flux studies, and wherever sensitive measurements of greenhouse gases are needed.

… Overview

The M-GGA-918 begins recording data within 20 seconds after power on so users do not have to wait for a long warm-up period for the system to thermally equilibrate.

ABB's patented OA-ICOS technology, a fourth-generation cavity enhanced absorption technique, has many advantages (simpler, easier to build and operate, more rugged) over older, conventional and delicate cavity ringdown spectroscopy and direct absorption techniques. As a result, LGR-ICOS analyzers provide higher performance and reliability at lower cost.

The M-GGA-918 analyzer has an internal computer that can store data practically indefinitely on an SD card and send real time data to a tablet, smartphone or other WiFi device. The analyzer includes control and analysis software.

Accessories, Maintenance & Options

ACC-MICRO-KIT	**Accessory kit for microportable** Includes shoulder strap and collapsible wand
ACC-MICRO-AC	**AC Power adapter for microportable**
ACC-WIFI-iPad	**Wireless User Interface - Apple iPad with WiFi router** Provides full instrument control and provides touch-screen video display, keyboard and mouse.
ACC-WIFI-Android	**Wireless User Interface - Samsung Galaxy Tab S3 with WiFi** router provides full instrument control and provides touch-screen video display, keyboard and mouse.
MTN-MICRO	**Maintenance kit for microportable**
MTN-CLEAN-M	**Mirror cleaning kit for microportable**
MIU-8	**Multiport Inlet Unit 8 channels -** External hardware (includes 8 solenoid valves) and internal software package which enables fully integrated, programmable selection from up to 8 separate sources.

*Batteries purchased separately, contact factory for Microportable external DC power cases for 4-hours and 12-hours batteries

Ordering information

- LGR-ICOS™ M-GGA-918

Specifications

Precision (1σ, 1 sec / 10 sec / 100 sec):
CH_4: 4 ppb /1.2 ppb / 0.5 ppb
CO_2: 0.6 ppm / 0.25 ppm / 0.1 ppm
H_2O: 200 ppm / 60 ppm / 30 ppm

Measurement rate:
0.01 – 1 Hz (user selectable)

Measurement ranges (meets all specifications):
CH_4: 0 – 100 ppm (standard range)
CH_4: 0 – 10% (extended range)
CO_2: 0 – 20000 ppm
H_2O: 0 – 30000 ppm

Sampling conditions:
Sample temperature: -40 – 50 °C
Operating temperature: 5 – 45 °C
Ambient humidity: 0 - 98% relative humidity non-condensing

Flow time response:
3 seconds (1/e)

Data outputs:
WiFi, Ethernet, USB, MIU connection (8 ports), Serial(RS-232)

Power requirements:
10-30 VDC or 110/240 VAC
35 watts
100W Power supply/charger included

Dimensions:
12cm H x 34 cm W x 29.5 cm D
6 in. H × 13.4 in. W × 11.6 in. D

Weight:
5.0 kg (11 pounds) without internal battery
5.4 kg (12 pounds) with internal 2-hours battery*
+1.4 kg (3 pounds) with external DC power pack and 4-hours battery*
+6.4 kg (14 pounds) with external DC power pack and 12-hours battery*

ABB Inc.
Measurement & Analytics
3400, Rue Pierre-Ardouin
Quebec (Quebec)
Canada G1P 0B2
Tel: +1 418 877-2944
Mail: icos@ca.abb.com

abb.com/analytical

DS/LGR-ICOS/MGGA-EN Rev. C 05.2018

GAS TRAC® FMD

FIXED METHANE DETECTOR

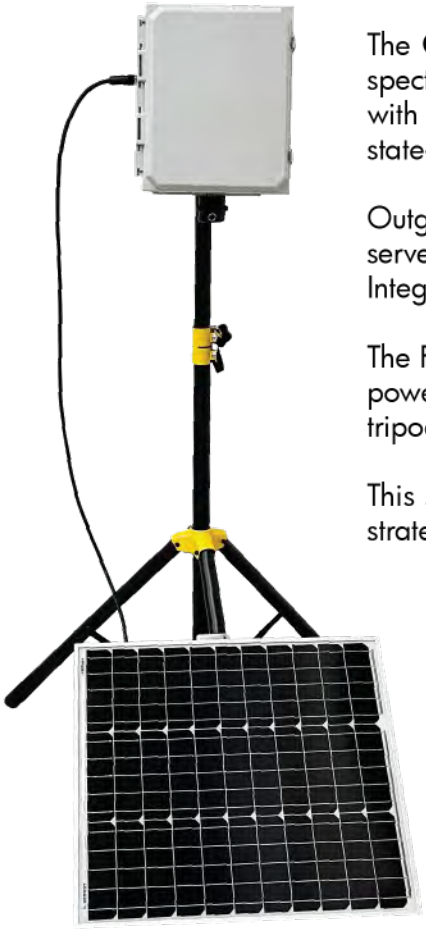
ADVANCED METHANE MONITORING SYSTEM

SENSIT Technologies

GAS•TRAC® FMD

FIXED METHANE DETECTOR

REMOTE METHANE MONITORING PLATFORM



The **GAS•TRAC® FMD** is an active sampling system equipped with a tunable diode laser spectroscopy (TDLAS) cell capable of detecting methane as low as 200 PPB. When equipped with an anemometer, the **FMD** is capable of localizing leaks, as well as providing state-of-the-art data to aid in quantification.

Outgoing data is transmitted via cellular to either **SENSITConnect** or the user's chosen server. Advanced analytics, alarms, and automated alerts are available via **SENSITConnect**. Integration with other software infrastructure is available upon request.

The FMD is designed for autonomous and continuous operation via solar panel or connected power. Setup is quick and easy. The **FMD** weighs 15 pounds and can be deployed on a tripod, providing easy portability, or it can be permanently mounted to a pole.

This system is the perfect addition to any continuous compliance monitoring or event survey strategy.

STANDARD FEATURES

- Methane Selective Internal Optical Assembly for Local Detection
- Built-in Sampling Pump
- Built-in Rechargeable Battery
- Wireless Communication to Secure Server
- Continuous Datalogging

APPLICATIONS

- **Greenhouse Gas Emissions Monitoring**
- **Periodic Environmental Compliance**
- **Leak Detection and Localization**

STANDARD KIT

Controller Box
Tripod
Solar Panel
Instruction Manual

OPTIONAL HARDWARE:

Ultrasonic Anemometer
Vane Anemometer
Indicator Alarm Light
Alarm Siren
Calibration Gas

PRODUCT SPECIFICATIONS

Size: Fully assembled with anemometer and antenna D x W x H (8in x 12in x 24in)
Weight: Base unit: 15 lbs approx
Operational Temp: -20°C to 50°C (-4°F to 122°F)
Operating Humidity: 0% and <95% non-condensing
Storage Temp: -40°C to 60°C
Battery Life: 8 Days without Recharging via Solar Panel
Power Requirement: Built in Rechargeable Battery Maintained by Solar Panel
Power Consumption: Less than 2 Watts
Environmental Pressure: 68kpa-115kpa
Laser Safety: Class IIIr
Enclosures: NEMA 4X Fiber Reinforced Enclosure
Communication Interface: Local USB and Cellular. Local wireless available upon request.

DETECTOR SPECIFICATIONS

PARAMETER	DESCRIPTION
Technologies	Near IR TDLAS with Multi-pass Cell
Wavelength	~1650 nm
Methane Range	0-100 vol.%
Methane Resolution	0.2 PPM (200 PPB)
Methane Accuracy	10% (+/- 0.5 ppm min)
Methane T90	<10 seconds
Laser Life	>5 years
Pre-Filter Life	6 months estimated
Internal-Filter Life	6 months estimated
Pump Life	10,000 hours

6 FMDS DEPLOYED AT A SIMULATED OIL AND GAS SITE. CONTROLLED EMISSIONS INTRODUCED.

ADVANCED METHANE DETECTION SYSTEM CAPABLE OF IDENTIFYING AND LOCATING INTRODUCED EMISSIONS.

GAS•TRAC® FMD
Accessories & Replacement Parts

GAS•TRAC® FMD	Part # 932-00000-50
Controller Box	Part # 832-00000-50
Laser Assembly	Part # 870-00103
Vane Anemometer	Part # 882-00187
Solar Panel	Part # 870-00110
Ultrasonic Anemometer	Part # 870-00114
Indicator/ Alarm Light	Part # 870-00107
Alarm Siren	Special Request
Tripod	Part # 870-00149

SENSIT Technologies

851 Transport Drive
Valparaiso, IN 46383-8432

Phone: 888 4SENSIT
888 473 6748
219 465 2700

Fax: 219 465 2701
www.GasLeakSensors.com

MADE IN THE USA
WITH GLOBALLY SOURCED COMPONENTS

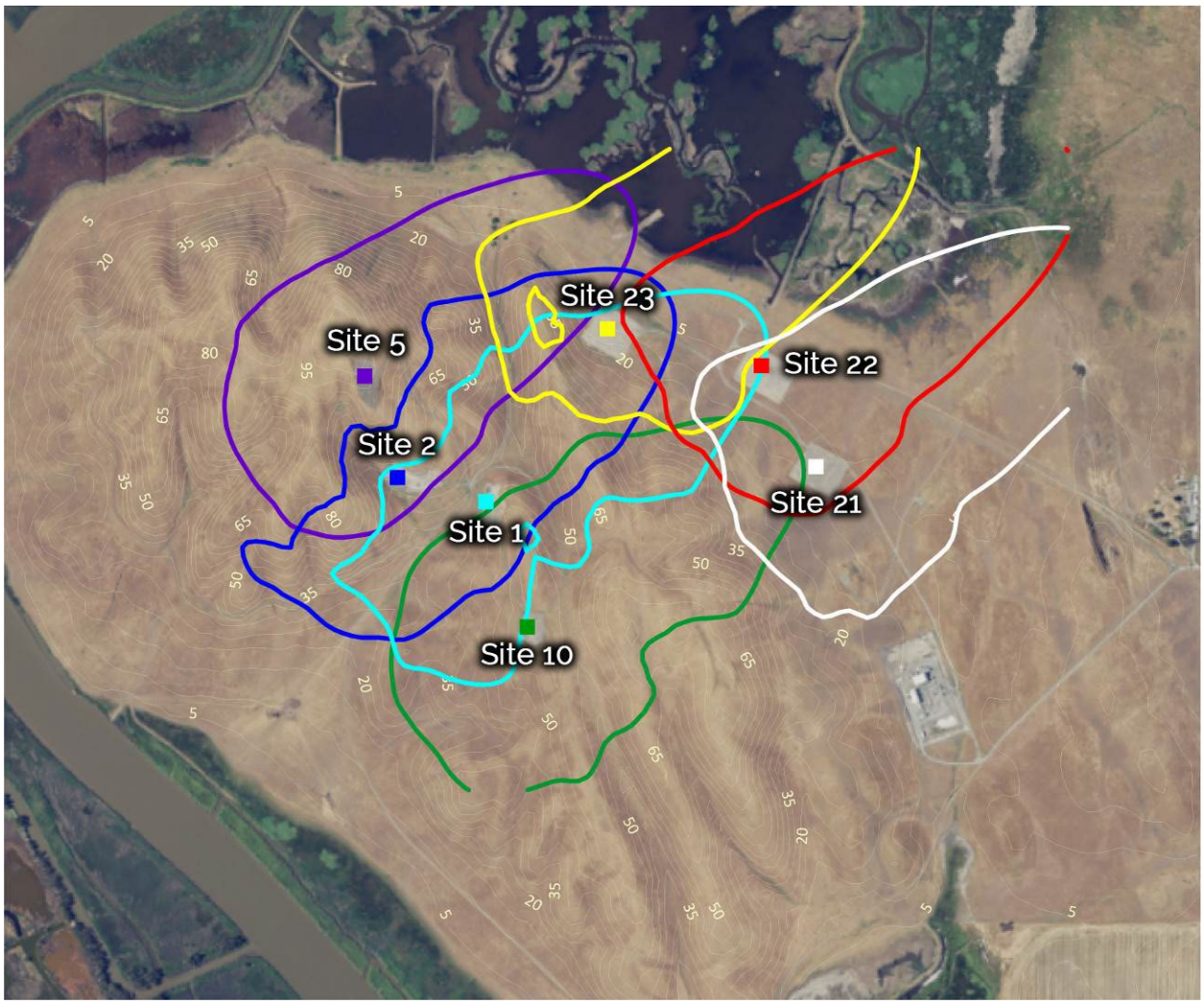
SENSIT Technologies
is an ISO 9001:2015 certified company.

Distributed by:

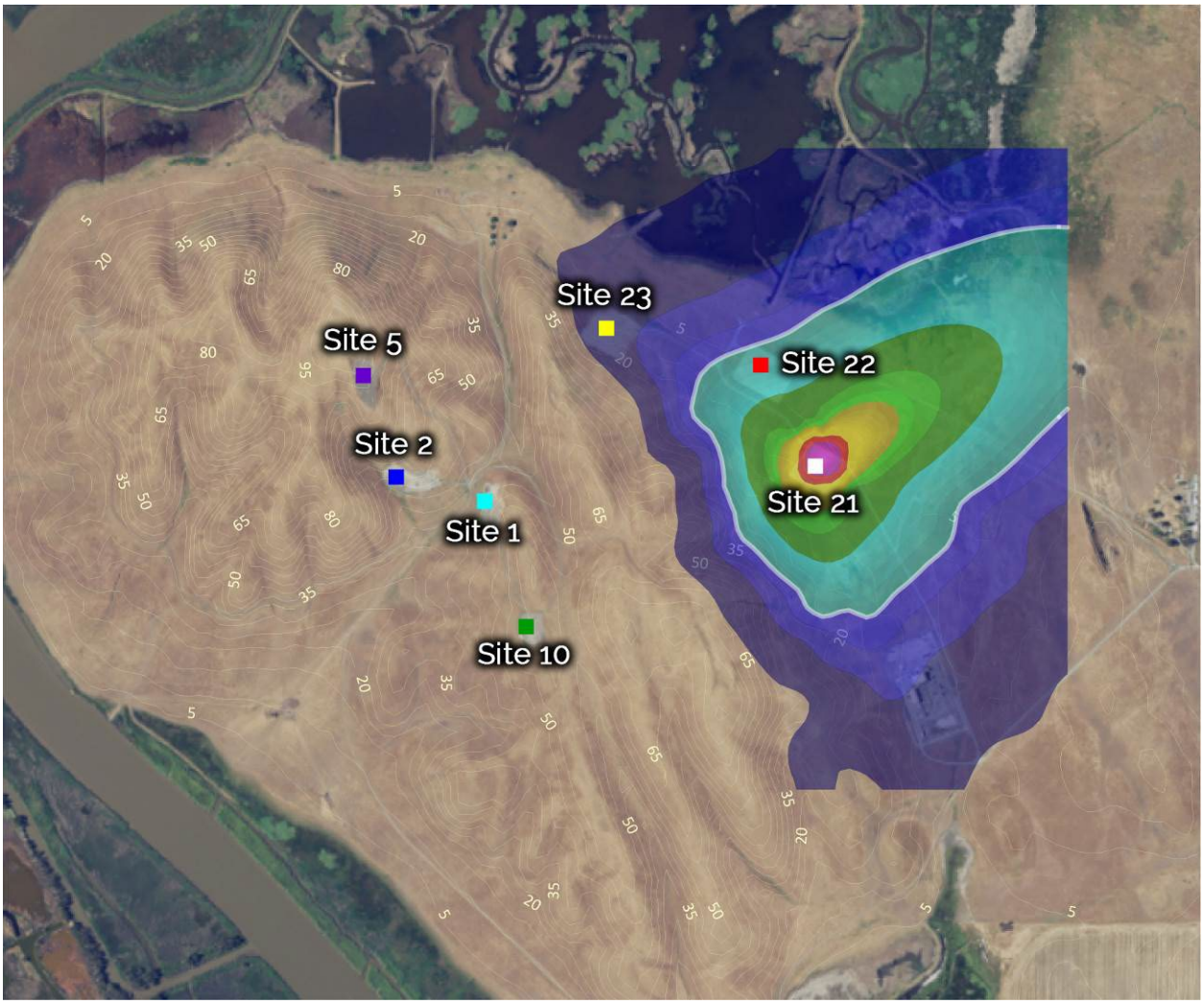
 ISSUED: 8-4-2022 REV: 5-15-2023

Appendix C – Isopleth Maps

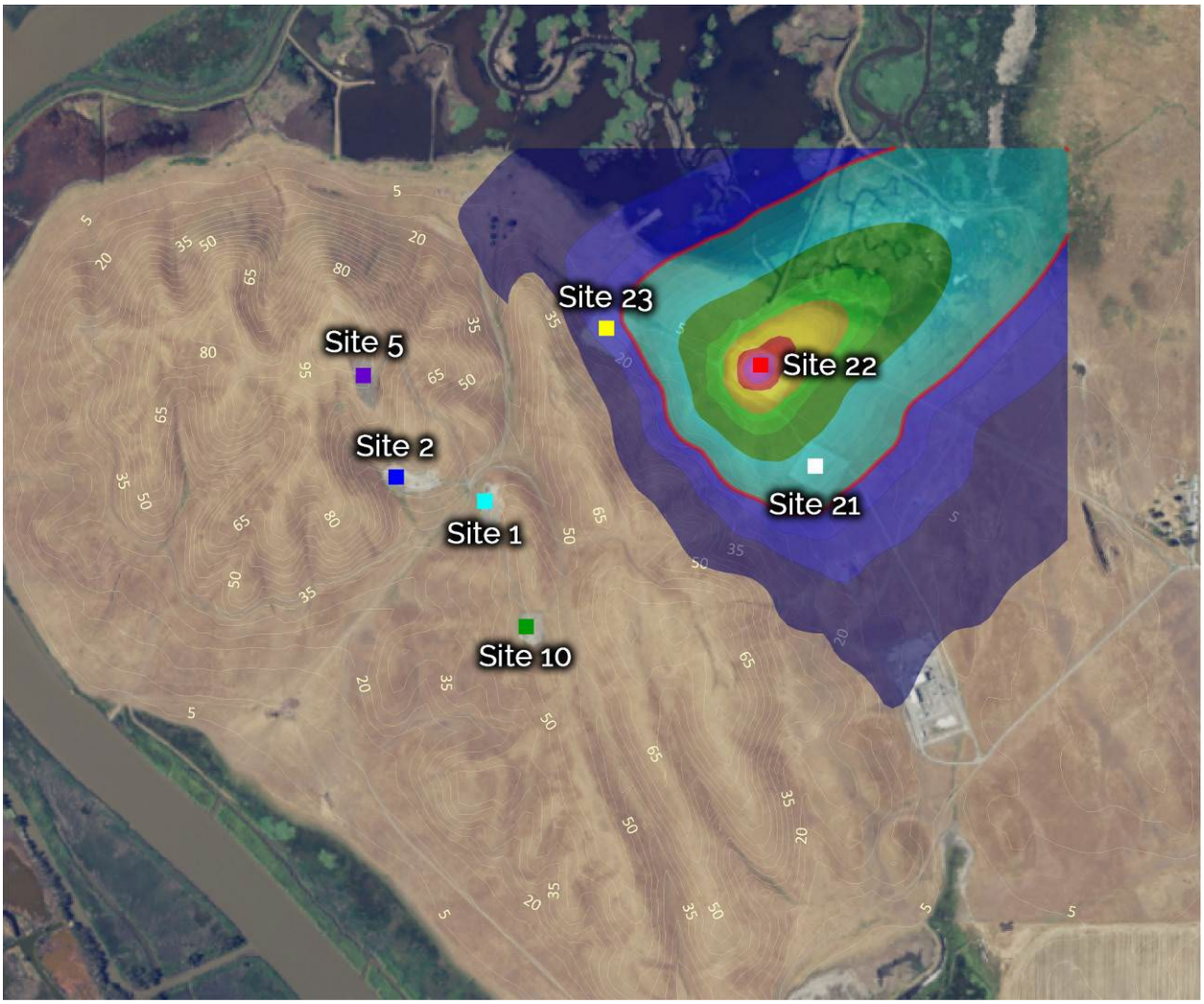
Kirby Hills – All Contours



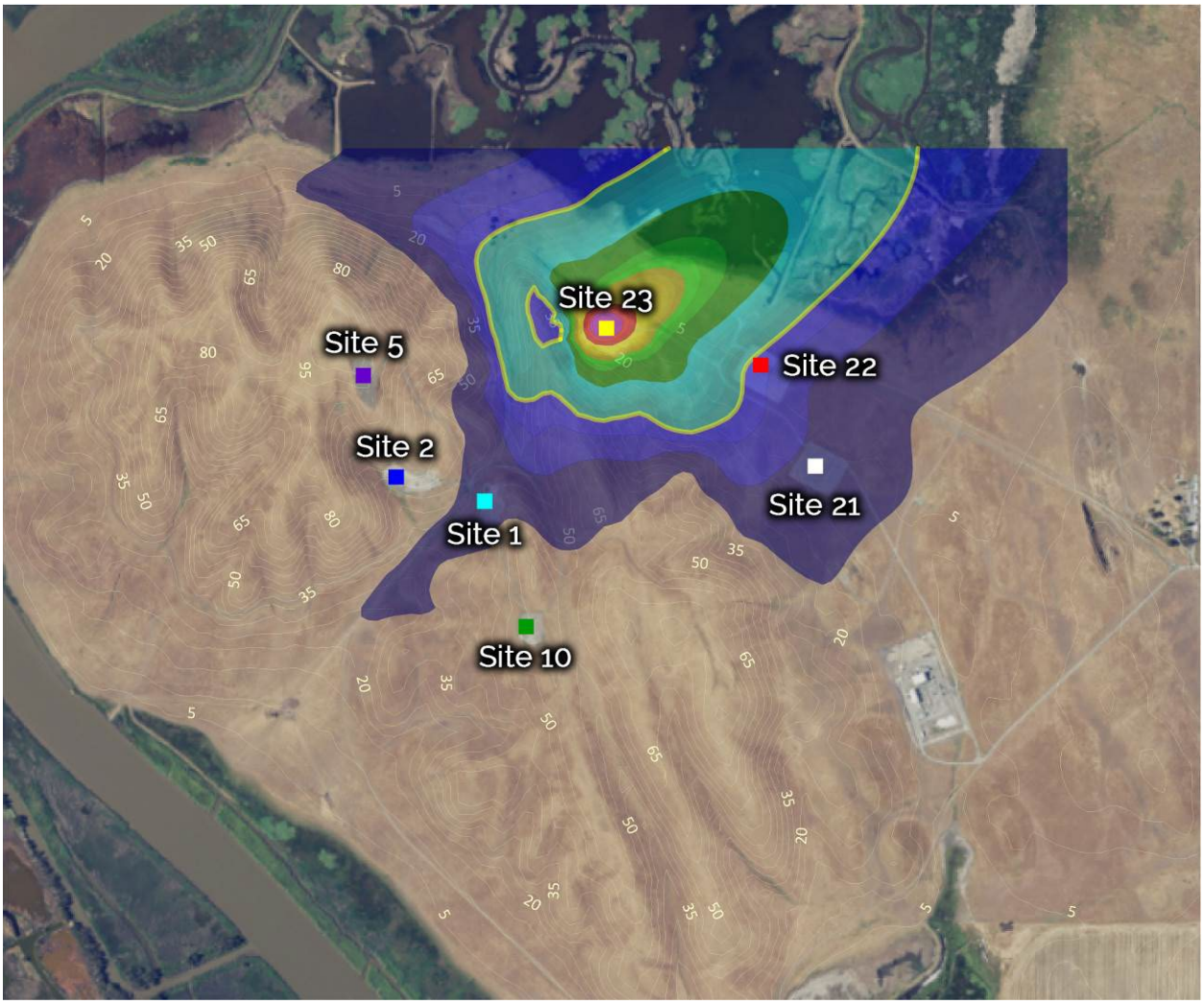
Kirby Hills – Site 21



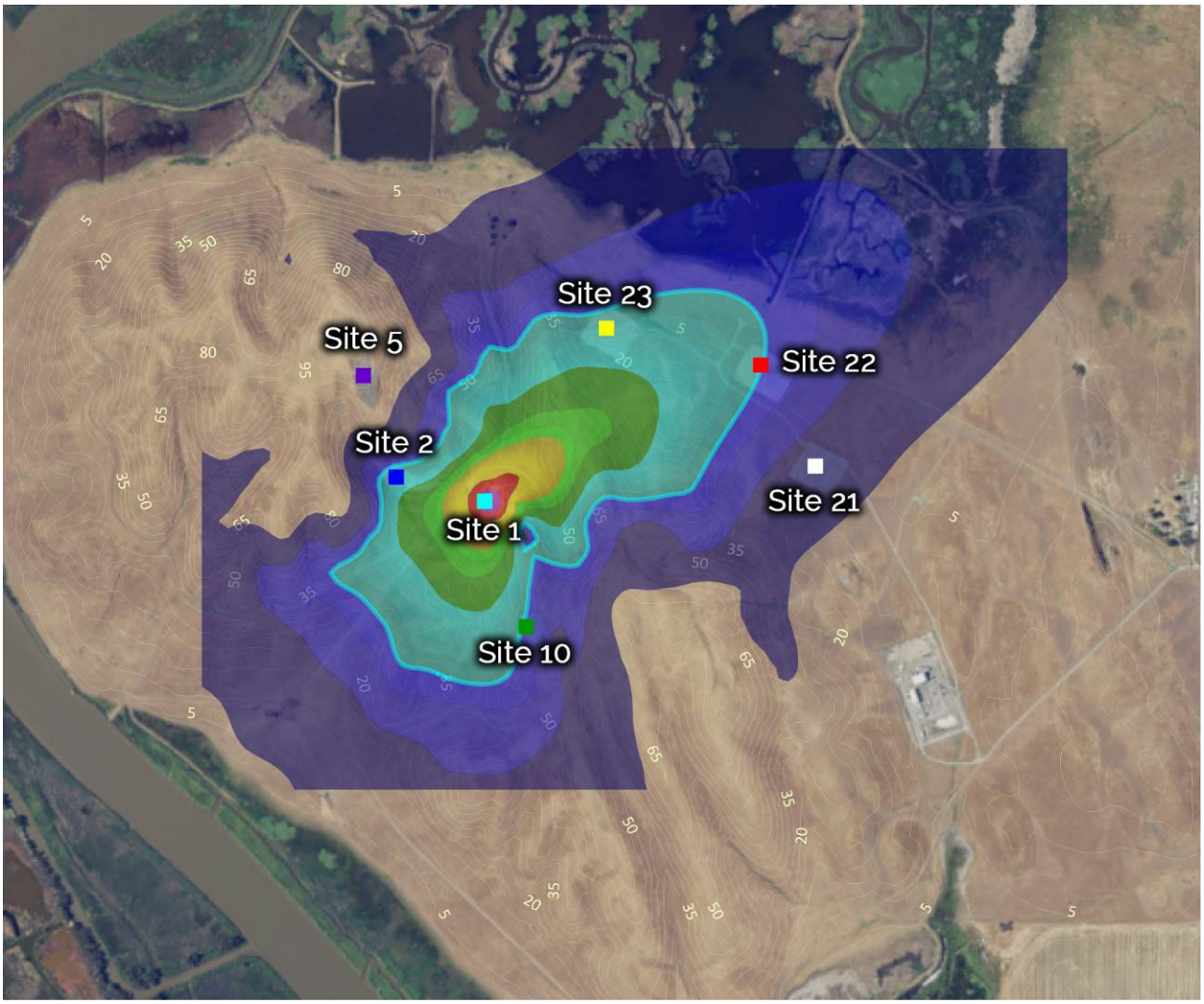
Kirby Hills – Site 22



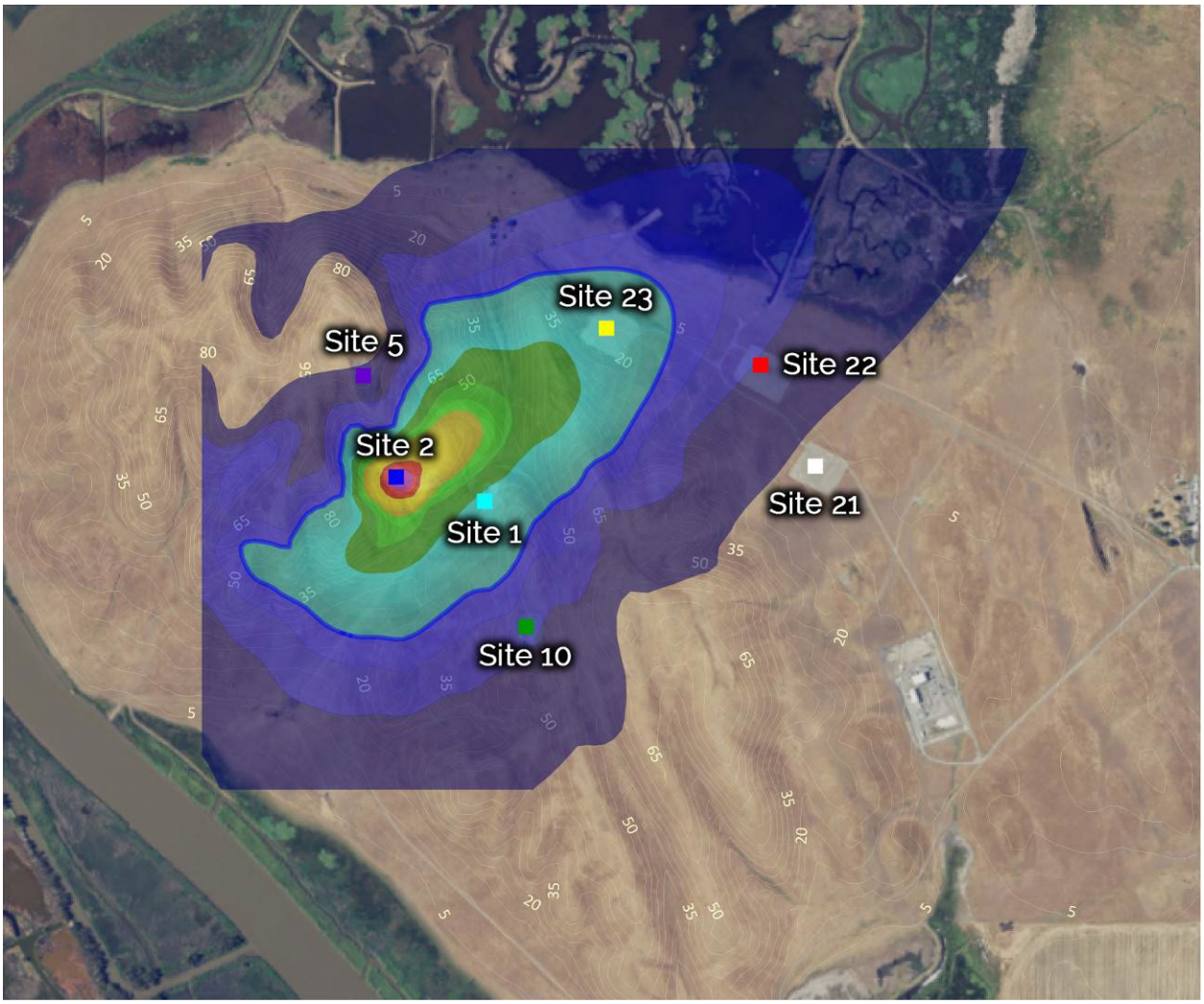
Kirby Hills – Site 23



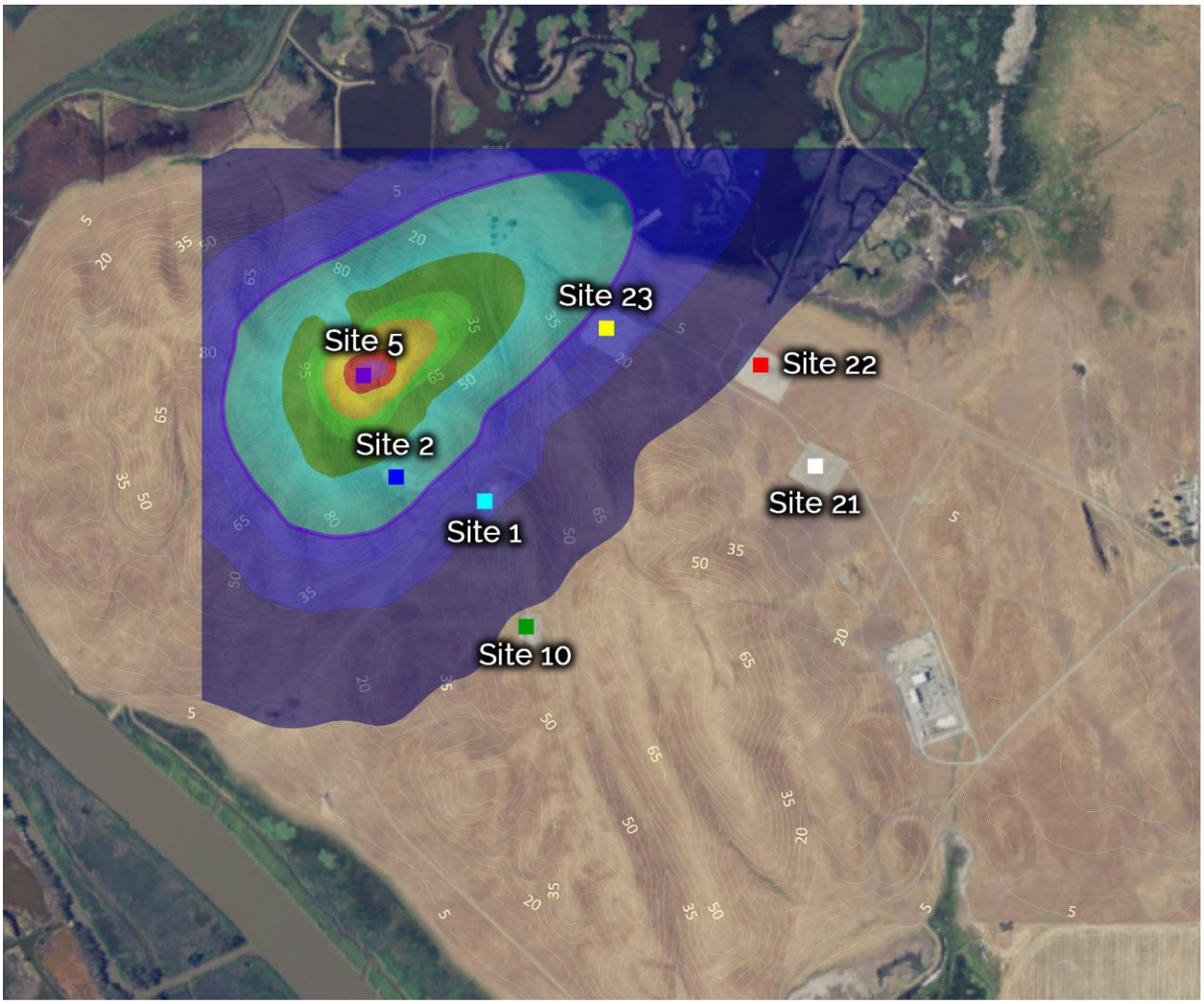
Kirby Hills – Site 1



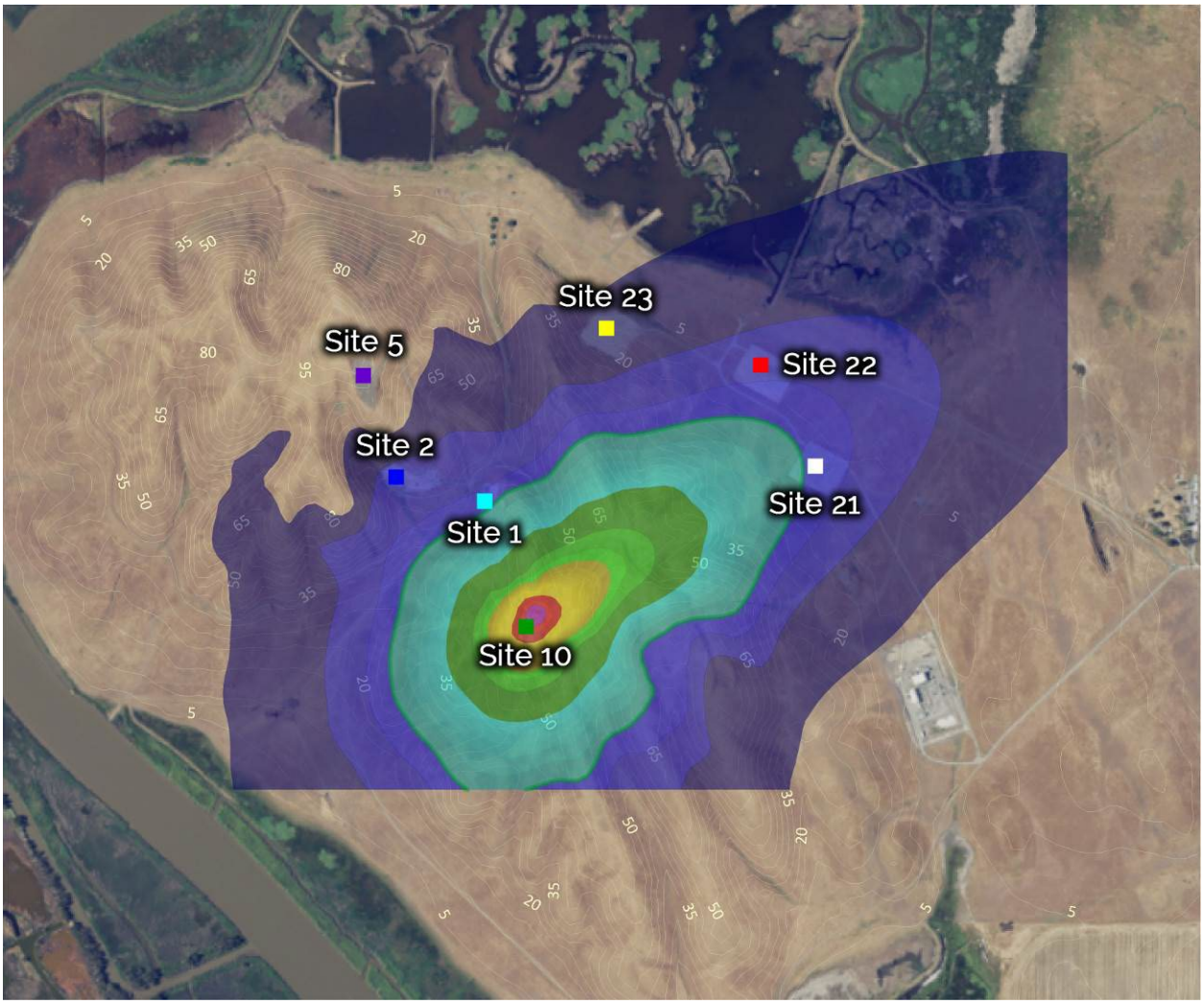
Kirby Hills – Site 2



Kirby Hills – Site 5



Kirby Hills – Site 10



Appendix D – Daily Leak Monitoring Procedure

LGS
Lodi Gas Storage, L. L. C.
INNOVATORS IN NATURAL GAS

May 20, 2016

Division of Oil, Gas, and Geothermal Resources – District 6
801 K Street, MS 18-05
Sacramento, California 95814
Dogdist6@conservation.ca.gov

VIA ELECTRONIC MAIL

RE: Lodi Gas Storage, L.L.C. Inspection and Leak Detection Protocol

Dear Sir or Madam:

Lodi Gas Storage, L.L.C. (LGS) submits this inspection and leak detection protocol to the Division of Oil, Gas, and Geothermal Resources (DOGGR) pursuant to §1724.9(e). LGS shall implement the following protocol:

Daily Inspection:

- Once per day LGS shall conduct a sight/sound/smell inspection aided by a Multi-Gas Detector (e.g., MSA Altair 5x or similar). Please see Attachment #1 for instrument specification information.
- The daily inspection shall include inspection of the wellhead assembly and attached pipelines for each well, and the surrounding area within the well pad. Well sites to be screened for leaks shall include all wells used for the gas storage project, including idle wells and observation wells.
- In several locations, LGS is limited by obstructions to monitoring only the well pad area. Each well pad perimeter is fenced as a security measure, and the well pad area within the fence may be less than exactly 100' surrounding each well. The area outside of the well pad perimeter fence is sometimes a cliff (at Kirby Hills) and sometimes a vineyard to which LGS does not have encroachment rights (at Lodi). However, LGS contends that monitoring of the well pad area at these obstructed locations is appropriate for detecting leaks; given LGS's well completion methods and local geology a casing leak would most likely be detected within proximity of the wellhead.
- Any leak discovered during the inspection shall be repaired upon discovery if possible. If a leak cannot be repaired upon discovery, LGS shall notify DOGGR within 24 hours of discovery and also provide DOGGR with a repair plan. Notification to all other appropriate agencies (e.g., California Public Utilities Commission) shall be made if that respective agency's reporting threshold criteria have been met for a given leak.
- In the event that monitoring shows no evidence of leaks for 30 consecutive days, LGS proposes that the monitoring frequency could be adjusted to weekly. This change in frequency would be substantiated by inspection documentation and subject to approval by DOGGR. If a weekly monitoring event subsequently detects a leak, the well would

be returned to a daily monitoring frequency until again showing no evidence of leaks for 30 consecutive days. Please note that this adjustment to inspection frequency is consistent with the concepts included in the Air Resources Board's Draft Regulation for Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities.

Quarterly Inspection:

- Once per quarter LGS shall utilize a qualified contractor to conduct monitoring at each well pad using an EPA Reference Method 21 approved device. LGS anticipates using a flame ionization detector (FID) with calibration certification for this monitoring. Please see Attachment #1 for instrument specification information.
- In the event that monitoring shows no evidence of leaks (as defined by Air Resources Board's Draft Regulation for Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities in Section 95669) for five consecutive quarters, LGS proposes that the monitoring frequency could be adjusted to annually. This change in frequency would be substantiated by documentation and subject to approval by DOGGR. If an annual monitoring event subsequently detects a leak, the well would be returned to a quarterly monitoring frequency until again showing no evidence of leaks for five consecutive quarters. Please note that this adjustment to inspection frequency is consistent with the concepts included in the Air Resources Board's Draft Regulation for Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities.

Training & Recordkeeping:

- All facility personnel conducting leak detection procedures shall complete approved training courses for each instrument utilized as part of this inspection and leak detection protocol. Approved training courses include those offered by the instrument manufacturer or designated manufacturer-approved contractor.
- Recordkeeping of all leak detection data shall be retained and transmitted to the California Air Resources Board (CARB) and DOGGR quarterly.

If you have any questions, or require more information, please contact me at gclark@lodistorage.com or at (209) 368-9277 x21.

Sincerely,

Gregory N. Clark
Compliance Manager

Enclosure (Attachment #1)

cc: File #S8.09
B.G. Tackett (via e-mail)
A. Anderson, S. Dupéré, E. Kuykendall, R. Russell (via e-mail)

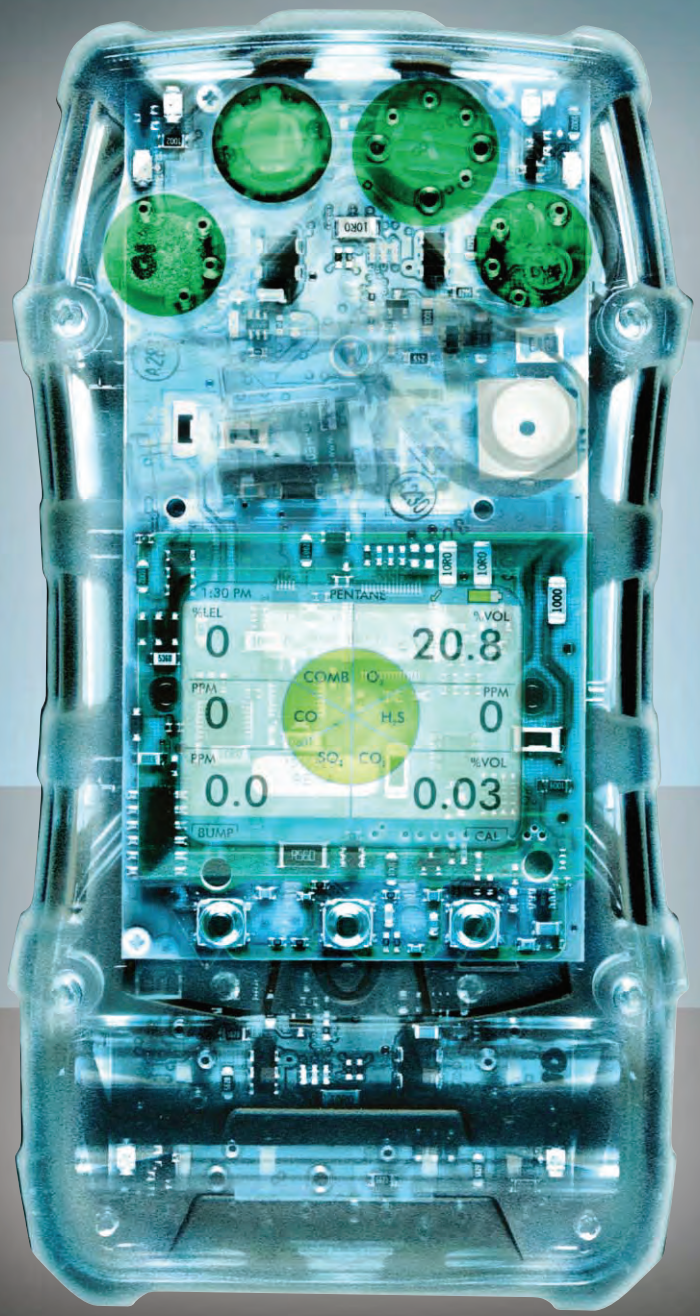
Appendix E – MSA Altair 5X Multi-gas Detector and RKI GX-Force Personal Monitor Wellhead Monitoring Equipment Specifications

MSA
The Safety Company

ALTAIR® 5X

IT'S WHAT'S INSIDE THAT COUNTS

ALTAIR 5X Multigas Detector
With MSA XCell® Sensor Technology



Fully compatible with MSA Link™ Software and MSA GALAXY® GX2 Automated Test System

Variety of optional MSA infrared sensors

Robust integral pump for consistent flow

High contrast color or monochrome display

18 language options

Large buttons for easy operation

Advanced MotionAlert and InstantAlert features

High performance MSA XCell Sensors

24-hour bump checkmark

End of XCell Sensor life warning

Durable, rubberized housing for secure grip

■ MSA-exclusive feature

IT'S WHAT'S INSIDE THAT COUNTS

WORKERS who face potentially hazardous situations deserve the best protection available. At MSA, we work tirelessly to build smarter, better gas detection instruments upon which people of the world rely. First we introduced MSA's advanced technology with the ALTAIR 4X Multigas Detector with XCell Sensors. Now we're proud to offer the most advanced sensor technology available in a six-gas portable instrument:

the ALTAIR 5X Multigas Detector with XCell Sensor Technology.

Built on Durability

The ALTAIR 5X Multigas Detector for LEL, O_2 and toxic gas detection is as tough and functional as it looks. A rugged polycarbonate housing provides unsurpassed durability, including the ability to survive a 10-foot drop. Inside, a field-proven integral pump provides consistent gas flow without the problems of externally-attached components. Ergonomic design, glove-friendly buttons and high-contrast display make the ALTAIR 5X Multigas Detector easy to use for all applications.

Powered by Performance

Toughness and durability aren't the whole story. The real strength of the ALTAIR 5X Multigas Detector comes from new sensor technology. MSA XCell Sensors have a typical life of more than double the industry average, and are engineered using MSA's proprietary application-specific integrated circuit (ASIC) design. By miniaturizing the sensor controlling electronics and placing them inside the sensor itself, MSA XCell Sensors offer superior stability, accuracy and repeatability.

MSA XCell Sensors are a breakthrough in chemical and mechanical sensor design, enabling faster response and span calibration times. With less time spent on calibration and bump tests, you save calibration gas, maintenance costs and in turn, save money. But most importantly, in your industry, saving seconds on response time can also mean saving lives.

In addition to MSA XCell Sensors, the ALTAIR 5X Multigas Detector can also be equipped with our wide variety of IR sensors covering many gases and ranges including CO_2.

Flexibility to Meet Your Needs

MSA's ALTAIR 5X Multigas Detector provides many options to fit various applications. The detector is configurable with either a high-resolution color or monochrome LCD display with multilingual capabilities. MSA's Logo Express® Service option is available to customize the color display. The detector is easily configurable with interchangeable plug-and-play sensor slots for MSA XCell Sensors. Up to six gases can be monitored simultaneously.

Furthermore, this multigas detector offers optional glow-in-the-dark instrument housing for IR sensor-equipped units. The ALTAIR 5x Multigas Detector's lithium-ion battery lasts up to 20 hours, allowing it to be used over multiple shifts. An alkaline battery pack is also available as an accessory. MSA's ALTAIR 5X Multigas Detector is fully compatible with the MSA GALAXY GX2 Automated Test System and MSA Link™ Pro and MSA Link Software.

"We liked how the total cost of ownership package was presented to us."

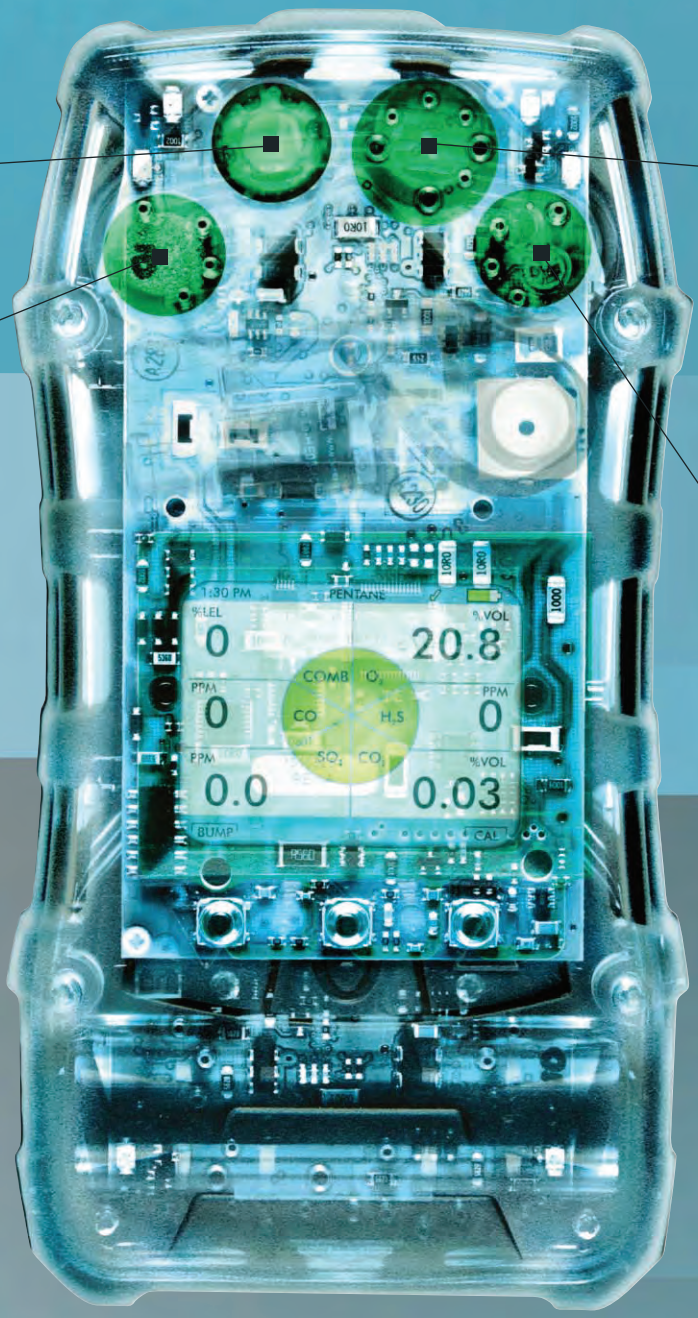
– Safety director at energy company

MSA

XCell® SENSORS

MSA XCell O_2 Sensor

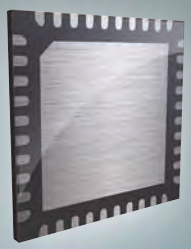
MSA XCell Ex Sensor, combustible



MSA XCell SO_2, Cl_2, or NH_3 Sensor

Additional exotic sensors: ClO_2, HCN, PH_3, NO_2

MSA XCell CO/H_2S Sensor



Adding microelectronics inside the sensors provides more control and higher performance than previous generations.

MSA XCell Sensors are a breakthrough in chemical and mechanical sensor design, enabling faster response and span calibration times.

THE MSA COMMITMENT. FROM THE LATEST IN SENSOR TECHNOLOGY TO INSTRUMENT DESIGN AND MANUFACTURING, MSA HAS THE CAPABILITIES AND EXPERTISE TO SUPPORT YOUR PORTABLE GAS DETECTION CHALLENGES.

www.MSAsafety.com/ALTAIR5X | 1.800.MSA.2222

MSA XCell Technology:

Save Time, Save Money, Save Lives

Building on years of sensor design experience, MSA has revolutionized sensor technology with design breakthroughs that improve performance.

- New XCell exotic SO_2, Cl_2 and NH_3 Sensors for expanded monitoring applications
- Sensor response and clear times in less than 15 seconds for most common sensor configurations
- Bump test in less than 15 seconds for most common sensor configurations
- Span calibration time of 60 seconds for most common sensor configurations
- Greater signal stability and repeatability under changing or extreme environmental conditions
- All XCell Sensors are capable of plug-and-play capabilities for easy reconfiguration

With reliable, extended-life XCell Sensors, there's no need to replace sensors after two years.

- Typical life greater than four years for combustible, O_2, CO/H_2S, and SO_2 sensors
- Typical life greater than three years for NH_3 and Cl_2 sensors
- Combustible sensor proprietary operating mode helps poison-resistance over the life of the sensor
- End-of-sensor-life warning gives advanced notice to user, reducing service outages

Three-year back-to-back instrument warranty includes $CO/H_2S/O_2/LEL/SO_2$ and IR sensors

Two-year warranty on NH_3 and Cl_2; minimum 12-month warranty on other sensors

Count on the ALTAIR 5X Detector

Exclusive MotionAlert™ and InstantAlert™ features make the ALTAIR 5X Multigas Detector ideal for applications such as confined space monitoring . MotionAlert feature activates when a user becomes disabled and motionless, quickly alerting others to the disabled user's location. And with a simple push of a button, InstantAlert feature enables users to manually alert others to potentially hazardous situations.

The ALTAIR 5X Multigas Detector outlasts the competition. To prove it,the instrument comes with a full three-year warranty*, an entire year longer than the industry average, so that you can depend upon the ALTAIR 5X Multigas Detector to withstand the wear and tear that other portable gas detectors can't.

* Three-year warranty is for most common sensor configurations.

Online Training and Product Simulation

MSA's online training and web content include the new ALTAIR 5X Multigas Detector media simulator that takes viewers through instrument operation. This tool is found at http://www.msasafety.com/altair5x.

"The three-year warranty is huge."

– Safety manager at energy company

MSA

Technical Specifications

Gas type	Range	Resolution
Combustible	0-100% LEL	1% LEL
	0-5% Vol, CH_4	0.05% Vol CH_4
Oxygen	0-30%Vol	0.1%Vol
Carbon monoxide	0-2000 ppm	1 ppm
Hydrogen sulfide	0-200 ppm	1 ppm
Sulfur dioxide	0-20 ppm	0.1 ppm
Chlorine	0-10 ppm	0.05 ppm
Ammonia	0-100 ppm	1 ppm
Nitrogen dioxide	0-20 ppm	0.1 ppm
Chlorine dioxide	0-1 ppm	0.01 ppm
Phosphine	0-5 ppm	0.05 ppm
Hydrogen cyanide	0-30 ppm	0.5 ppm
Carbon dioxide, CO_2	0-10%Vol	0.01%Vol
Butane, C_4H_{10}	0-25%Vol	0.1%Vol
Methane, CH_4	0-100%Vol	1%Vol
Propane, C_3H_8	0-100%Vol	1%Vol

Drop test	10 feet
Housing	Rugged rubberized armor
Weight	1 lb (without IR sensor)
Dimensions (L x W x D)	6.69" H x 3.49" W x 1.79" D without belt clip or IR sensor
Audible alarm	>95 dB typical
Visual alarm	2 ultra-bright LEDs, on top
Vibrating alarm	Standard
MotionAlert & InstantAlert features display	Standard High-contrast monochrome or color display
Backlight	Adjustable time-out
Battery	RechargeableLi-ION or AA alkaline
Run time	20 hrs @ room temperature
Charging time	≤ 6 hours
Operating temperature	–20˚C to + 50˚C
Short-period operation	–40˚C to + 50˚C
Humidity	15-90% RH non-condensing
Ingress protection	IP65
Data log	Adjustable, 200 hrs minimum
Event log	Standard 1000 events
Standard warranty	3 years on CO, H_2S, LEL, O_2, SO_2, and IR sensors 2 years on NH_3, Cl_2 sensors 1 year on other sensors

For additional customized versions and calibration gases, use MSA's ATO ordering sheet or contact MSA Customer Service at 1-800-MSA-2222.

ALTAIR 5X Detector with 3-year warranty, monochrome display, data logging, charger, integral pump, and tubing

Approvals		
U.S.	***Canada***	***Configuration***
ALTAIR 5X Detector Economy Kits - monochrome display		
10116924	10115118	LEL, O_2, CO, H_2S
10116925	10115119	LEL, O_2, CO, H_2S, SO_2
ALTAIR 5X Detector Industrial Kits - monochrome display,10-ft sampling line, and 1-ft probe		
10116926	10115120	LEL, O_2, CO, H_2S
10116927	10115141	LEL, O_2, CO, H_2S, SO_2
ALTAIR 5X Detector Deluxe Kits - color display, 10-ft sampling line, and 1-ft probe		
10116928	10115142	LEL, O_2, CO, H_2S
10116929	10115143	LEL, O_2, CO, H_2S, SO_2

ALTAIR 5X GALAXY GX2 Automated Test System

N. America	***Configuration***
10128626	1 cylinder, charging
10128625	Up to 4 cylinders, charging
10128628	1 cylinder, non-charging
10128627	Up to 4 cylinders, non-charging

Calibration Gas

10048280	Calibration gas cylinder (34L) 1.45% CH_4, 15% O_2, 60 ppm CO, 20 ppm H_2S
10045035	Calibration gas cylinder (54L) 1.45% CH_4, 15% O_2, 60 ppm CO, 20 ppm H_2S
10098855	Calibration gas cylinder (34L), 1.45% CH_4, 15% O_2, 60 ppm CO, 20 ppm H_2S, 10 ppm SO_2
10117738	Calibration gas cylinder (58L), 1.45% CH_4, 15% O_2, 60 ppm CO, 20 ppm H_2S, 10 ppm SO_2

Replacement Sensors

10080222	ClO_2 sensor	10106726	XCell NH_3 sensor
10080224	NO_2 sensor	10106727	XCell SO_2 sensor
10106375	HCN sensor	10106728	XCell Cl_2 sensor
10106722	XCell Ex Sensor, combustible	10106729	XCell O_2 sensor
10106725	XCell CO/H_2S Sensor	10116638	PH_3 sensor

Accessories

10082834	USB IR receiver	10114837	Battery pack, alkaline
10088099	MSA Link Software CD		

Approvals

USA / Canada
Class I, Division 1, Groups A, B, C & D
Class II, Division 1, Groups E, F & G
Class III, Division 1
Ambient temperature: -40˚C to +50˚C; T4
ALTAIR 5X Multigas Detector with alkaline battery pack T3/T4
ALTAIR 5X or ALTAIR 5X iR Multigas Detector with rechargeable battery pack T4

USA / Canada
Class I, Division 1, Groups A, B, C & D
CAN/CSA C22.2 No. 152 Combustible Gas Detection Instruments
C22.2 No. 152 Performance Ambient Temperature: -20˚C to +50˚C
C22.2 No. 157 Intrinsic Safety Ambient Temperature: -40˚C to +50˚C
ALTAIR 5X Multigas Detector with alkaline battery pack T3/T4
ALTAIR 5X or ALTAIR 5X iR Multigas Detector with rechargeable battery pack T4

ID 0802-46-MC / May 2013

MSA Corporate Center
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Cranberry Township, PA 16066 USA
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MSA
The Safety Company

SAMPLE DRAW 4 GAS MONITOR

Gas Detection For Life

GX-Force Model

Features

- **2 Operating modes**
  — Normal and Leak Check
- **Internal sample pump with 100' sample range**
- **30 hours of operation (Lithium-ion battery)**
- **USB C charging and data connection**
- **Easy to grip lightweight design**
  — 2.5" W x 6.81" H x 1.85" D, 9.87 ounces
- **Water and dust resistant design, IP67**
- **Field replaceable sensors & filters**
- **Impact resistant body**
- **Intrinsically safe**
- **Large LCD Auto-backlit display**
- **3 Year warranty**

Applications

- **Personal monitoring**
- **Confined spaces**
- **Refineries/petrochemical**
- **Utilities**
- **Oil and Gas**
- **Water/wastewater**
- **Fire services**
- **Construction**

The GX-Force is RKI's smallest personal 1-4 gas monitor with a strong internal sample pump capable of a 100' sampling range. Weighing only 9.8 ounces, the GX-Force can monitor the standard confined space gases (LEL combustibles, Oxygen, Carbon Monoxide, and Hydrogen Sulfide). Utilizing the same micro-sensor technology, which are compatible with the GX-3R, GX-3R Pro, 04 Series, and Gaswatch 3 instruments.

With the GX-Force, you have multiple tools in one instrument. Having 2 operating modes, the GX-Force can be used for confined space, safety monitoring in its Normal Operating mode. A Leak Check mode is the solution for leak investigations. In Leak Check Mode, the GX-Force can monitor for combustibles in the ppm range.

The GX-Force operates 30 hours on a Li-ion battery, and has a large LCD display showing all gas readings, battery level, current time and automatically backlights in alarm conditions. Standard alarm types include vibration, visual, and audible alarms, which can be set to latching or non-latching. Controlled by a microprocessor, the GX-Force continuously checks itself for sensor connections, low battery, circuit trouble, low flow, and calibration errors.

Calibration and bump test intervals and reminders are user adjustable and can be set to either go into alarm or to lock the user out of normal measurement mode once a calibration period has expired. Calibration can be done individually or in a group.

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GX-Force Model

Model	GX-Force
Sampling Method	Internal sample pump, flow rate nominal 0.5 LPM, includes hydrophobic filter
Suction Flow Rate	Minimum 0.35 L/min (open flow rate)
Gas Alarm Pattern	Lamp flashing, continuous modulating buzzer sounding, gas concentration display flashing, vibration
Gas Alarm Reset Operation	Self-resetting or latching
Fault Alarm/Self-Diagnosis	System, clock, or sensor abnormality; battery voltage drop; calibration failure; pump abnormality; low flow rate
Fault Alarm Pattern	Lamp flashing, intermittent buzzer sounding, detail display
Fault alarm reset operation	Self-resetting
Display	LCD digital (7-segment + 14-segment + icons) with backlight
Individual Operations	Operational status, clock, battery level, peak reading, pump status, calibration notification
Sound Pressure	Approx. 90 dB (30 cm)
Data Logger Function	Maximum storage capacity: 3,600 items Interval: 5 minutes (adjustable)
Communication Specifications	USB, 2.0 (for data logger) Connector: Type-C
Power Source	Rechargeable lithium ion battery
Continuous Operating Time	Approx. 30 hours (25 °C, fully charged, no alarm, no backlight)
Operating Ambient Temperature / Humidity Range	-20 °C to +50 °C (no sudden changes), 0 - 95 % RH (no condensation) (-4 °F to +122 °F)
Approvals	Intrinsically safe construction IECEx (Ex da ia IIC T4 Ga/Ex ia IIC T4 Ga) ATEX (II1G Ex da ia IIC T4 Ga/II1G Ex ia IIC T4 Ga)
Certifications	ATEX / IECEx, QPS (pending)
Protection Level	IP67 equivalent
External Dimensions / Weight	Approx. 2.52 (W) × 6.81 (H) × 1.85 (D) (excluding protrusions) / Approx. 9.87 oz.
Warranty	Three years material and workmanship

Detection target gas	Combustible gas (CH4 or HC)	Oxygen (O2)	Carbon monoxide (CO)	Hydrogen sulfide (H2S)
Detection principle	Catalytic combustion	Electrochemical type		
Detection range	0 - 100 % LEL	0.0 - 40.0 vol %	0 - 2,000 ppm	0.0 - 200.0 ppm
Resolution	1 % LEL	0.1 vol %	1 ppm	0.1 ppm
Alarm setpoints (User-defined setting)	1st alarm: 10 % LEL 2nd alarm: 25 % LEL 3rd alarm: 50 % LEL OVER alarm: 100 % LEL	L alarm: 19.5 vol % LL alarm: 18.0 vol % H alarm: 23.5 vol % OVER alarm: 40.0 vol %	1st alarm: 25 ppm 2nd alarm: 50 ppm 3rd alarm: 1200 ppm TWA alarm: 25 ppm STEL alarm: 200 ppm OVER alarm: 2,000 ppm	1st alarm: 5.0 ppm 2nd alarm: 30.0 ppm 3rd alarm: 100.0 ppm TWA alarm: 1.0 ppm STEL alarm: 5.0 ppm OVER alarm: 200.0 ppm
Response time (T90)	CH4: Within 30 seconds, HC: Within 40 seconds	Within 20 seconds	Within 30 seconds	Within 30 seconds

RKI INSTRUMENTS
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Appendix F – Century OVA 88 Analyzer, Bascom-Turner Instruments Model CCD-201, and RKI Eagle 2 Specifications

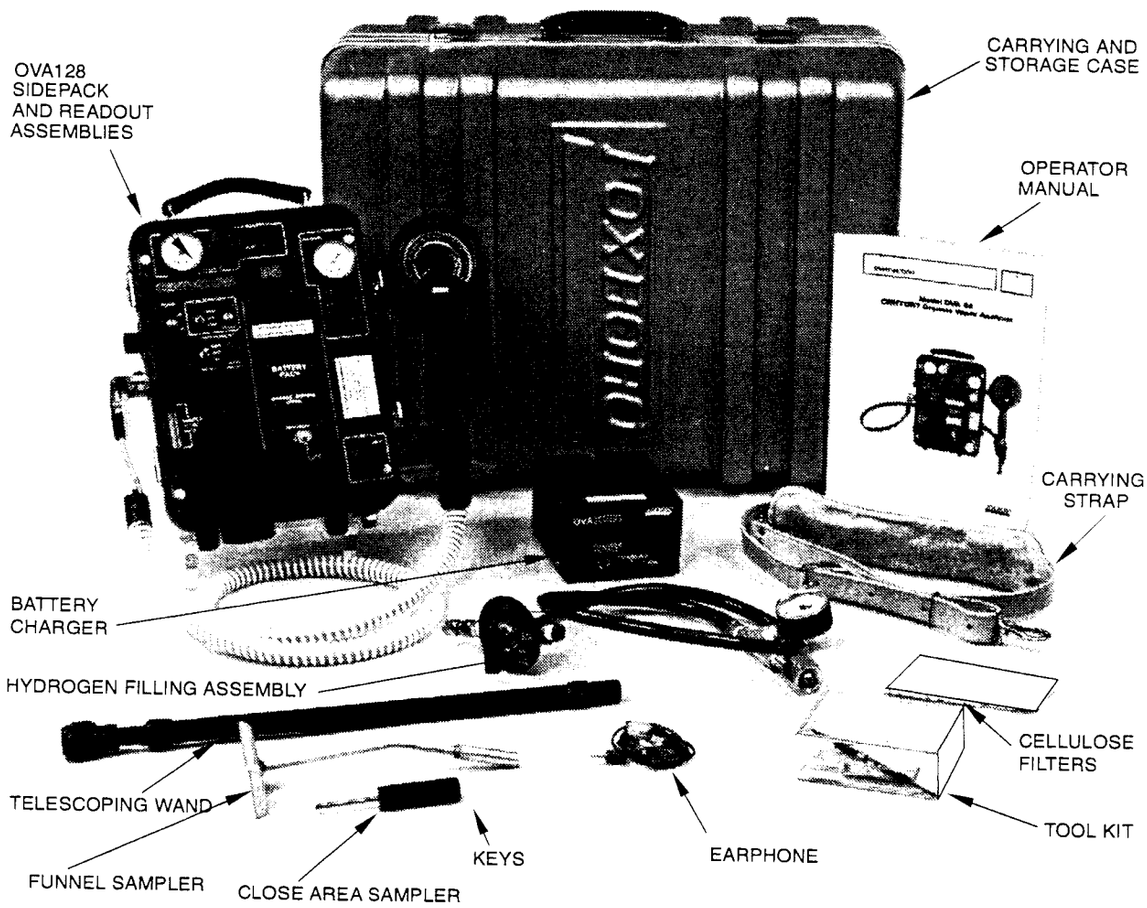

Figure 1-2. OVA 88 Analyzer Components

Standard Specifications

Readout

1 to 100,000 ppm (logarithmic)

Sample Flow Rate

Approximately 1 L/min at 22 °C and 760 mm (72 °F and 29.92 in) using Close Area Sampler

Response Time

Approximately 2 seconds for 90% of final reading.

Primary Electrical Power

12 Volt (nominal) lead, acid gel battery pack.

Fuel Supply

Approximately 75 mL volume tank of pure hydrogen, maximum pressure 15.9 MPa (2300 psig), fillable in case.

Hydrogen Supply Pressure Range

55 to 83 kPa (8 to 12 psig).

Service Life

Eight hours minimum with battery fully charged, hydrogen pressure at 12.4 MPa (1800 psig).

Detection Alarm

Audible alarm plus meter indication. User preset to desired level.

Flame-out Alarm

Audible alarm plus meter indication (needle drops off scale in negative direction).

Battery Test

Battery charge condition indicated on readout meter.

Filters

In-line sintered bronze and cellulose particle filters. Filters remove particles larger than 10 microns.

Operating Temperature Range

10 to 40 °C (50 to 104 °F).

Minimum Ambient Temperature

15 °C (59 °F) for Flame Ignition (cold start).

Accuracy

±20% of full scale.

Relative Humidity

5 to 95%.

Flame Ionization Detector (FID)

Century Organic Vapor Analyzer Style C, Model OVA 88

Minimum Detectable Limit (Methane)

1 ppm.

Recorder Output

0 to 5 V dc.

Nominal Dimensions

229 x 305 x 127 mm (9 x 12 x 5 in) Sidepack Assembly only.

Approximate Mass

5.5 kg (12 lb) Sidepack Assembly and Hand-Held Readout Assembly.

Bascom-Turner Instruments

CCD-201 VOC Monitoring Instruments Specifications for Method 21

This document references:

- Method 21 – Determination of Volatile Organic Compound Leaks
  Title 40 / Chapter I / Subchapter C / Part 60 / Appendix A-7 to Part 60

CCD-201 Equipment and Supplies Specifications for Method 21

Per Method 21 Section 2.1, a portable instrument is used to detect VOC leaks from individual sources. The instrument detector type is not specified, but it must meet the specifications and performance criteria contained in Section 6.0. Section 6.0 and select Section 8.0 specifications are listed below:

Section	Method 21 Equipment and Supplies Specifications	CCD 201 Specifications
6.1	The VOC instrument detector shall respond to the compounds being processed.	Responds to wide range of combustible gases and vapors. See the response factor table for specific details
6.1	Detector types that may meet this requirement include, but are not limited to, catalytic oxidation, flame ionization, infrared absorption, and photoionization.	Catalytic oxidation
6.2	The instrument shall be capable of measuring the leak definition concentration specified in the regulation.	Instrument range covers the EPA leak definition, 0-40,000 ppm of Methane.
6.3	The scale of the instrument meter shall be readable to ±2.5 percent of the specified leak definition concentration.	The CCD-201 is a ±1 ppm unit (for CH4). This resolution exceeds the requirements: 2.5% of leak definition (±12.5 ppm for 500 ppm leak definition of CH4)
6.4	The instrument shall be equipped with an electrically driven pump to ensure that a sample is provided to the detector at a constant flow rate. The nominal sample flow rate, as measured at the sample probe tip, shall be 0.10 to 3.0 l/min (0.004 to 0.1 ft3/min) when the probe is fitted with a glass wool plug or filter that may be used to prevent plugging of the instrument.	The CCD-201 has a pump flow rate of 0.5 l/min
6.5	The instrument shall be equipped with a probe or probe extension or sampling not to exceed 6.4 mm (1/4 in) in outside diameter, with a single end opening for admission of sample.	The probe diameter is 3/16'' OD
6.6	The instrument shall be intrinsically safe for operation in explosive atmospheres as defined by the National Electrical Code by the National Fire Prevention Association or other applicable regulatory code for operation in any explosive atmospheres that may be encountered in its use. The instrument shall, at a minimum, be intrinsically safe for Class 1, Division 1 conditions, and/or Class 2, Division 1 conditions, as appropriate, as defined by the example code. The instrument shall not be operated with any safety device, such as an exhaust flame arrestor, removed.	The CCD-201 is Intrinsically Safe – Class 1, Division 1
8.1.1	Response Factor. A response factor must be determined for each compound that is to be measured, either by testing or from reference sources. The response factor tests are required before placing the analyzer into service, but do not have to be repeated at subsequent intervals.	A full list of CCD-201 response factors is listed in the table that follows. This information meets the requirements described in Method 21 Section 8.1.1.3.
8.1.3.2	The instrument response time shall be equal to or less than 30 seconds. The instrument pump, dilution probe (if any), sample probe, and probe filter that will be used during testing shall all be in place during the response time determination.	The response time for the CCD-201 is ≤6s to 90% for methane.

Response Factors

Per Section 8.1.1, a response factor must be determined for each compound that is to be measured, either by testing or from reference sources. The response factor tests are required before placing the analyzer into service, but do not have to be repeated at subsequent intervals. As response factors for the CCD-201 have been published for the compounds of interest, the response factor determination test is not required. The table below describes the CCD-201 response factors and thus meets the Method 21 response factors test requirement (described in Section 8.1.1.3.)

CCD-201 sensor responds to a wide range of combustible gases but cannot distinguish between them. However, response of the sensor varies for different combustible gases. If the sensor is calibrated using CH4, then the reading of the sensor needs to be multiplied with appropriate response factor, Rf, to get the correct concentration of the target gas. For example, if the response factor of a target gas is 0.8 and the reading shows 1250ppm, then the concentration of the target gas is 1000ppm (1250 x 0.8 = 1000).

To obtain the response factor the instrument is first calibrated using methane, then a known concentration of the target gas is measured. The response factor, Rf, is then given by:

$$R_f = \frac{Known\ Gas\ Concentration}{Instrument\ Reading}$$

If the measured gas is known, then the device should be calibrated using the target gas. The readings of the instrument will then match the actual concentration of the measured gas.

The table below provides the measured values of response factor, R_f, for different types of gases.

Chemical	LEL (%)	MW	Rf
Hydrogen	4	1	**0.83**
methane	5	16.04	**1.00**
Acetylene	2.5	26.04	*1.27*
Ethylene	2.7	28.1	*0.75*
Ethane	3	30.07	**0.80**
Methanol	6	32.04	*1.59*
Propene	2.4	42.08	*0.65*
propane	2.1	44.1	**0.73**
iso-butylene	1.8	56.11	*0.64*
n-Butane	1.6	58.1	**0.70**
n-propanol	2.2	60.1	*0.78*
iso-propanol	2	60.1	**0.81**
Ethylene Glycol	3.2	62.1	*1.33*
i-pentane	1.4	72.2	*0.64*
Neo-pentane	1.4	72.2	*0.64*
n-pentane	1.5	72.2	**0.67**
n-hexane	1.1	86.2	**0.69**
Toluene	1.1	92.14	*0.69*
n-heptane	1.05	100.2	*0.66*
Xylene	1	106.16	*0.74*
n-Octane	1	114.2	*0.69*
n-nonane	0.8	128.3	*0.68*

Bold: Measured
Italics: Predicted

Detailed Description and Typical Performance			
Gases Detected	*Combustible Gases in Air*	**Warm-Up Time**	*60 seconds*
Sensors	*Dual Catalytic Combustion Thermal Conductivity*	**Operating Temperature**	*-20°C to 40°C (0°F to 105°F)*
Range	*0 to 40,000 ppm by volume*	**Storage Temperature**	*-40°C to 60°C (-40°F to 140°F)*
Accuracy (5° to 45°C)	*±2% (20PPM) for PPM scale*	**Operating Time per Battery Set**	*10 hours, typical (25°C)*
Flow Rate	*0.5L/min*	**Humidity**	*0 to 95% RH (non-condensing)*
Response Time	*0.6s for methane*	**Power Supply**	*Two C-size rechargeable Batteries (NiMH)*
Resolution	*1 ppm from 0 to 40,000 ppm*	**Instrument Weight**	*1.5 lb (0.68 kg)*
GPS	*Horizontal resolution 2.5m Max update rate 10Hz*	**Bluetooth**	*Transmit Class 2, 10m Certified to FCC regulation*
Intrinsic Safety	*Class 1, Division 1*		

ONE TO SIX GAS PORTABLE MONITOR

Gas Detection For Life

EAGLE 2 Model

Features

- **Monitor up to 6 different gases**
- **PPM, % LEL, or % Vol. auto-ranging combustible detection**
- **Specialty Sensors**
  - **PID (Photoionization Detector)**
    - Low or high range for VOC detection
    - Fence Electrode Technology for humidity and contamination resistance
  - **Infrared (IR)**
    CO2, % LEL CH4, % Vol. CH4, % LEL HC, % Vol. HC
  - **Thermal Conductivity (TC)**
    % Vol. H2, % Vol. CH4
  - **Smart toxic, plug and play sensors**
    NH3, AsH3, Cl2, HCN, PH3, & SO2
  - **Hydrogen specific LEL / ppm sensor**
- **Powerful long-life pump up to 125' range**
- **Low flow pump shut off and alarm**
- **Methane elimination for environmental use**
- **Alkaline 18 hours or NiMH 20 hours capability**
- **EPA Method 21 VOC Monitoring**
- **Internal hydrophobic dust filter**
- **External probe with hydrophobic filter**
- **Multilingual (5 languages)**
- **Ergonomic RFI / EMI / chemical / weather resistant enclosure**
- **Intrinsically safe design, CSA approval**
- **Datalogging standard**

The EAGLE 2 is the solution for just about any portable gas monitoring situation. Equipped with features that are not available on competitive units, the EAGLE 2 is a powerful instrument that does more than just offer the standard confined space protection for LEL, O2, H2S and CO. The EAGLE 2 offers easy access to controls such as autocalibration, alarm silence, demand zero, peak hold, and methane elimination. Each channel has two alarm levels plus TWA and STEL alarms for toxic channels. The two alarm levels are user adjustable and can be latching or self resetting.

The EAGLE 2 available features include a PID sensor for detecting high or low ppm levels (0-50 & 0-2,000) of VOC gases; % volume capability for CH4 and H2 using a TC (thermal conductivity) sensor; PPM or LEL hydrocarbon detection at the push of a button; infrared sensors for CO2 (ppm or % volume), methane or hydrocarbons in LEL and % volume ranges; methane elimination feature for environmental applications; and a variety of super toxic gases. The EAGLE 2 has a strong internal pump with a low flow auto pump shut off and alarm, which can draw samples from up to 125 feet. This allows for quick response and recovery from distant sampling locations. The EAGLE 2 will continuously operate for over 18 hours on alkaline batteries or 20 hours on NiMH. A variety of accessories are also available to help satisfy almost any application such as long sample hoses, special float probes for tank testing, and dilution fittings, just to name a few. Datalogging is a standard feature for all sensors on all versions.

The Eagle 2 is ideal for performing EPA Method 21 fugitive emission monitoring of VOC leaks from process equipment.. EPA Method 21- Determination of Volatile Organic Compound Leaks, is a test method used for the determination of leaks of VOCs from process equipment. The Eagle 2 meets the equirements for portable instruments used for this purpose as outlined in Sections 6 and 8 of Method 21.

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EAGLE 2 Model

Enclosure	Weatherproof, chemical resistant, RFI / EMI coated high impact polycarbonate-PBT blend. Can operate in 2.0" of water without leakage. Ergonomically balanced with rugged top mounted handle. Water & dust resistant equivalent to IP64.
Dimensions	9.5" L x 5.25" W x 5.875" H
Weight	3.8 Lbs (standard 4 gas with batteries).
Detection Principle	Catalytic combustion, electrochemical cell, galvanic cell, infrared, Photoionization detector, and thermal conductivity.
Sampling Method	Powerful, long-life internal pump (over 6,000 hours) can draw samples over 125 feet. Flow rate approximately 2.0 SCFH.
Display	3 display modes: display all gases, large font-autoscroll, or large font-manual scroll. Polyurethane protected overlay. Backlight, illuminates for alarms and by demand, with adjustable time.
Language	Readout can display in 5 languages (English, French, German, Italian, or Spanish).
Alarms	2 Alarms per channel plus TWA and STEL alarms for toxics. The two alarms are fully adjustable for levels, latching or self reset, and silenceable.
Alarm Method	Buzzer 95 dB at 30 cm, four high intensity LED's.
Controls	4 External glove friendly push buttons for operation, demand zero, and autocalibration. Buttons also access LEL/ppm, alarm silence, peak hold, TWA/STEL values, battery status, conversion factors, and many other features.
Continuous Operation	At 70°F, 18 hours using alkaline batteries, or 20 hours using NiMH.
Power Source	4 alkaline or NiMH, size C batteries (Charger has alkaline recognition to prevent battery damage if charging is attempted with alkalines).
Operating Temp. & Humidity	-20°C to 50°C (-4°F to 122°F), 0 to 95% RH, non-condensing.
Environmental	IP-64
Response Time	30 Seconds to 90% (for most gases) using standard 5 ft hose.
Safety Rating	Intrinsically Safe, Class I, Groups A, B, C, D. Approval: CSA
Standard Accessories	Shoulder strap, alkaline batteries, hydrophobic probe, and 5 foot hose, internal hydrophobic filter.
Optional Accessories	• Dilution fitting (50/50) • NiMH batteries • Battery charger, 115 VAC, 220 VAC, or 12 VDC (charge time 4 hours) • Continuous operation adapter, 115 VAC or 12 VDC • Extension hoses • IRDA cable for datalogging download
Warranty	Two year material and workmanship, one year for PID sensor.

Gas	Measuring Range	Accuracy * Which ever is greater
Gases & Detectable Ranges		
Standard Confined Space Gases		
Hydrocarbons (CH_4, std)	0 - 100% LEL	± 5% of reading or ± 2% LEL (*)
	0 - 5% Vol. (CH_4)	
	0 - 50,000 ppm	± 50 ppm or ± 5% of reading (*)
Oxygen (O_2)	0 - 40% Vol.	± 0.5% O2
Carbon Monoxide (CO)	0 - 500 ppm	± 5% of reading or ± 5 ppm CO (*)
Hydrogen Sulfide (H_2S)	0 - 100 ppm	± 5% of reading or ± 2 ppm H2S (*)
Toxics		
Ammonia (NH_3)	0 - 75 ppm	± 10% of reading or ± 5% of full scale (*)
Arsine (AsH_3)	0 - 1.5 ppm	
Chlorine (Cl_2)	0 - 3 ppm	
Hydrogen Cyanide (HCN)	0 - 15 ppm	
Phosphine (PH_3)	0 - 1 ppm	
Sulfur Dioxide (SO_2)	0 - 6 ppm	
IR Sensors		
Carbon Dioxide (CO_2)	0 - 10,000 ppm 0 - 5% Vol. 0 - 60% Vol.	± 5% of reading or ± 2% of full scale (*)
Methane (CH_4)	0 - 100% LEL/ 0 - 100% Vol.	
Hydrocarbons	0 - 100% LEL/ 0 - 30% Vol.	
PID Sensors		
VOC	0 - 2,000 ppm 0 - 50 ppm	—
TC Sensors		
Methane (CH_4)	0 - 100% Vol.	± 5% of reading or ± 2% of full scale (*)
Hydrogen (H_2)	0 - 10% Vol. 0 - 100% Vol.	
Hydrogen Specific		
Hydrogen (H_2)	0-100% LEL 0-40,000 ppm	± 5% of reading or ± 2% of full scale (*)

The EAGLE 2 can be configured with up to 6 gas sensors from the above list.

Specifications subject to change without notice.

Made in the USA

RKI INSTRUMENTS

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