BROADBENT
8 West Pacific Ave., Henderson, NV 89015
[T] 702-563-0600 [F] 702-563-0610
broadbentinc.com

April 23, 2024

Project No. 14-01-156

Alan Pineda, PE
Professional Engineer
Bureau of Industrial Site Cleanup
Nevada Division of Environmental Protection
375 E. Warm Springs Rd., Ste. 200
Las Vegas, NV 89119

Attn: Mr. Pineda

Re: Perimeter Air Monitoring Plan, Revision 1
Three Kids Mine, Henderson, Nevada

Dear Mr. Pineda:

Broadbent & Associates, Inc. (Broadbent) is pleased to submit this *Perimeter Air Monitoring Plan, Revision 1* for the Three Kids Mine located in Henderson, Nevada.

Please do not hesitate to contact us if you should have any questions or require additional information.

Sincerely,
BROADBENT & ASSOCIATES, INC.

Kirk Stowers, CEM
Principal Geologist

cc: JD Dotchin, NDEP
Joe McGinley, McGinley & Associates, Inc.
Caitlin Jelle, McGinley & Associates, Inc.
Ann Verwiel, ToxStrategies
Robert Unger, Lakemoor Ventures LLC
Mindy Unger-Wadkins, Lakemoor Ventures LLC
Leo Drozdoff, Drozdoff Group, LLC
Karen Gastineau, Broadbent & Associates, Inc.
Christene Klimek, City of Henderson
Sean Robertson, City of Henderson
Stephanie Garcia-Vause, City of Henderson
Anthony Molloy, City of Henderson
Quincy Edwards, Pulte Group
Doug Adair, Pulte Group
Paul Kenner, on behalf of Pulte Group
Michael Ford, Snell & Wilmer
Brad Cahoon, Dentons
Bryan Douglass, Douglass, Inc.
Charles M. Damus, Laker Development, LLC
Darryn Padfield, River Mountain Bike Shop
David Grossheim, Laker Plaza, Inc.
Frank Sator, Laker Development, LLC
Laird Sanders, Lake Mead Boat Storage
Rhonda Sanders, Lake Mead Boat Storage
Tyler Cahoon, Dentons

Perimeter Air Monitoring Plan, Revision 1
Three Kids Mine
Henderson, Nevada

JURAT: I, Karen Gastineau, certify that I am responsible for the services in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, State, and local statutes, regulations, ordinances, and the requirements of the Mine Remediation and Reclamation Agreement and Administrative Order on Consent for the Three Kids Mine Site.

Karen Gastineau

April 23, 2024

Karen Gastineau
Senior Hydrogeologist
CEM #2468 (4/1/2025)

Date

ATTACHMENT A
Responses to NDEP Comments made on April 18, 2024
to the Perimeter Air Monitoring Plan, dated January 23, 2024

1. **General Comment #1** – What measures will be taken if sampling equipment fails or there are sustained logging/measurement errors? Will remediation work continue while a portion of the monitoring network is offline?

   The real-time data collected with the E-Samplers will be accessible to the CEM via an online dashboard with a real-time alert system, which informs staff the moment equipment diagnostics fall outside of specified parameters or if there are communication errors. Troubleshooting equipment and standard spare parts will be available locally for initial investigation into any network issues. If the onsite team is unable to quickly repair the equipment failure, additional replacement parts or rental equipment can be obtained quickly, sometimes within as little time as 72-96 hours. In the event that downwind equipment fails and replacements are not able to be quickly obtained (within two business days), equipment from upwind monitoring locations (i.e., AQ Site 1 or AQ Site 4) can be moved to downwind locations (i.e., AQ Site 2 or AQ Site 3). This approach was added to Section 10.

2. **General Comment #2** – Some sections of the PAMP identify 40 CFR 50 Appendix J (gravimetric) as the method that will be used to analyze PM10, while other sections (e.g., Table 2) indicate 40 CFR 50 Appendix L (gravimetric). If this is intentional, please explain the difference between the two methods and in what situations each will be used. Otherwise, please correct these discrepancies.

   References to 40 CFR 50 Appendix J in the text were changed to 40 CFR 50 Appendix L. Additionally, a note in Table 2 was added to clarify that Appendix L to Part 50 40 CFR 50 is the Reference Method for the Determination of Fine Particulate Matter as PM2.5 in the Atmosphere by low-volume method, and the low volume PM10 method being followed in the PAMP was formally accepted by the U.S. EPA in a 2016 memo "Clarification on Use of PM2.5 Field and Laboratory Requirements for Low Volume PM10 Monitoring to Support PM10 NAAQS."

3. **Section 1. Introduction** – The second paragraph states that "the document provides guidance on how the certified environmental manager (CEM) will implement the PAMP and comply with the applicable air quality standards and regulations." What are the applicable air quality standards and regulations? The PAMP should specify the applicable air quality standards and regulations and/or identify where they can be found. Please edit accordingly.

The Project Action Levels (PALs) for the PAMP are based on the following regulations:

- NAAQS for PM_{10}: 150 µg/m^3 for 24-hour average concentration, not to be exceeded more than once per year on average over three years.
- NAC 445B.22097 for PM_{10}: 150 µg/m^3 for 24-hour average concentration, not to be exceeded more than once per year.
- NAC 445B.22097 for Lead: 0.15 µg/m^3 rolling three-month average.

These references were added to Section 3 of the revised PAMP.

Additionally, the following US regulatory documents list were added to the footnotes of Table 2.

- 40 CFR 50 Appendix J - Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere
- 40 CFR 50 Appendix Q to Part 50 - Reference Method for the Determination of Lead in Particulate Matter as PM_{10} Collected from Ambient Air
- EPA Compendium Method IO-32.3 - Determination of Metals in Ambient Particulate Matter using E-Ray Fluorescence (XRF) Spectroscopy
- Compendium Method TO-13A - Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)

4. **Section 2. PAMP Overview** – The first bullet point indicates that the *Perimeter Air Monitoring Plan* (PAMP) covers asbestos during the asbestos abatement phase; however, it is not included in the PAMP. Consider referring to and including the Asbestos Abatement Plan (included in Appendix C of the *Corrective Action Plan, Revision 1*) as an appendix to the PAMP so that both air monitoring documents are together.

Relevant details on air monitoring for asbestos abatement were pulled from Appendix C of the *Corrective Action Plan, Revision 1* and included in Appendix A of the revised *Perimeter Air Monitoring Plan*.

Additionally, as noted in the revised Figure 1, the perimeter air monitor locations for asbestos fibers will be co-located with the locations identified in this plan instead of the locations identified in the *Corrective Action Plan, Revision 1*.

5. **Section 3. Monitoring Objectives** – One of the objectives identified in this section is to "comply with applicable state and federal emissions regulations for particulate matter (PM10)." What are the applicable state and federal emissions regulations? The PAMP should specify the applicable state and federal emissions regulations and/or identify where they can be found. Please edit accordingly.

See response to Comment #3.

6. **Section 4. Monitoring Schedule and Phases** – This section indicates that monitoring during final cover construction (Phase 4) will focus on opacity only. However, soils with high metals concentrations will be exposed and driven over providing a source for metals in dust until the cap is placed. It seems that metals monitoring should continue until these soils are no longer exposed.

The PAMP was edited to indicate that PM_{10} and metals air monitoring will continue until waste rock is no longer exposed or is otherwise stabilized with a minimum of four inches of native soil cover.

7. **Section 5. Monitoring Locations** – This section identifies prevailing wind direction as one of the considerations for selecting monitoring station locations. The PAMP should include a reference to supporting documentation regarding the prevailing wind direction at the site, either in Section 5 or in the list of Program Reference and Guidance Documents.

A wind rose with five years of data from the Western Regional Climate Center (WRCC) from station ID "Las Vegas," located off E Flamingo Road near S University Center Drive was added as Figure 2. A summary of the data was provided in the figure caption and the source was added to the references section.

8. **Figure 1. Monitoring Locations**
    a. Please update the monitoring locations in Figure 1 for consistency with the modified locations described and depicted in the April 12, 2024 air monitoring locations memorandum, and include the memorandum as an appendix to the PAMP.
    b. Consider including the prevailing wind direction in Figure 1.

Figure 1 was edited to reflect the locations in the April 12, 2024 memorandum, and the memorandum is included as Appendix B. Additionally, as stated in the response to Comment #7, a wind rose was added as Figure 2 for context.

9. **Table 2. Particulate, Metals, and PAH Methods and Equipment** – For consistency with Section 6.2, Table 2 should be revised as follows:

Target Analytes	Matrix	Method	Method of Analysis	Sample Media	Sampling Device	Frequency
PM10	Air	Real-time Particulate sampler	Light scattering spectrometry	N/A	Met One E-Sampler	Real-time with 60- minute average conc.
PM10		40 CFR 50 Appendix J	Gravimetric	Teflon Filter, 47mm		6-day integrated filter sample
PM10 Metals		IO-3.3	X-Ray Fluorescence (XRF)			6-day integrated filter sample

Table 2 in the revised PAMP was edited as suggested.

10. **Section 7. Action Levels and Response Procedures** –
    a. **Section 7.1 Project Action Levels (PALs)** – The fifth paragraph indicates that the MRL for manganese is 0.3 µg/m^3 and "the ATSDR MRL is below the industrial RSL." However, the fourth paragraph indicates that the industrial RSL for manganese is 0.22 µg/m^3. Please correct this discrepancy.
    b. **Table 4. Project Action Levels (PALs)** – For manganese, why is the highest concentration (ATSDR of 0.3 µg/m^3) being used as the PAL rather than the more conservative EPA RSL of 0.0521 µg/m^3? It is the only COC that uses the highest concentration. What drives this decision?
    c. **Table 4. Project Action Levels (PALs)** – Cancer risk of 10^{-6} is the typical value used when evaluating risk and has previously been used for this project. Why is a less conservative 10^{-4} cancer risk being used for PALs?

    a. The sentence in Section 7.1 stating that the ATSDR MRL is below the industrial level was removed.
    b. The rationale for using the ATSDR MRL is that it follows EPA's recent guidance on benchmark dose modeling, which is preferred over the low observed adverse effect level (LOAEL) approach used in the EPA RSLs. Additionally, the ATSDR is more transparent and peer-reviewed than the EPA RSLs. A reference to the EPA's benchmark dose guidance was added to the revised PAMP. There are not ATSDR MRLs for respirable arsenic or lead. Additional explanation was added to Section 7.
    c. Use of a cancer risk of 10^{-4} for the Three Kids Mine project was previously discussed during a meeting with NDEP on March 16, 2023. Additionally, there is precedent for use of a cancer risk range of 10^{-4} to 10^{-6}, which was used for air monitoring conducted at the Nevada Environmental Response Trust (NERT) site.

11. **Section 8. Decision Matrix** –
    a. Metals PALs are much lower than the PM10 RAL. If reliable correlation between PM10 and metals can be established, and the correlation indicates that metals are of concern at lower PM10 levels, how will the PM10 RAL be adjusted?
    b. What is the basis and determination of reliable correlation between PM10 and metals?
    c. What is the alternative if a reliable correlation cannot be appropriately established between PM10 and metals to ensure appropriate action is considered for metal-specific RALs?

    a. The real-time E-Sampler PM_{10} and E-FRM metals data will be reviewed after three months to evaluate the presence and strength of a correlation to refine the RAL. If a moderate to strong correlation is not present between real-time PM_{10} and metals, the data from the subsequent three months of E-Sampler and E-FRM data will be examined.
    b. Additional text was added to Section 7.2 explaining how the correlation will be established.
    c. The PAMP was edited to reflect these contingencies if a correlation cannot be established. Regardless of the correlation developed, metals will continue to be measured on 1:6 sampling schedule until waste rock reclamation is complete.

12. **Section 8. Decision Matrix** – How will PAH analysis be facilitated if RAL/PAL decision matrix (Table 6) is triggered and PAH samplers are not operational on given day outside of 1:6 sampling schedule?

    Because there are no six-day integrated PAH samples analogous to the six-day integrated metals samples, no immediate action is proposed for the PAH sampling program in the event of an RAL exceedance in the first three months of the air monitoring program. Although unlikely, if there is a correlation between PM_{10} and PAH results after analyzing the first three months of data, the RALs may be adjusted similar to the event in which there is a correlation between PM10 and metals. If the PAH sampling results in exceedances of the PALs, sampling frequency will be increased as described in Section 8.2. These concepts were added as Section 8.2 "Decision Matrix for Supplemental PAH Sampling" in the revised PAMP.

13. **Section 9. Reporting** The last sentence states that "annual reports will be submitted the 10th day of October of the following year." For consistency with the Remedial Design Report, Revision 1, please delete "of the following year."

    The text in Section 9 was revised to delete "of the following year."

14. **Section 10.1 Particulate Monitoring Quality Assurance** – The bullet point describing Sample Handling and Chain of Custody states that "the PM10 and PAH samples will be shipped…for analysis of PM10 and metals (Pb, As, and Mn) following 40 CFR 50 Appendix J (gravimetric analysis) and EPA Method IO-3.3 (metals analysis)." This sentence should be revised to state that "the PM10 and metals samples will be shipped…."

    The text in Section 10.1 was edited as suggested.

15. **Section 10.1 Particulate Monitoring Quality Assurance** – The bullet point describing Maintenance includes a list of maintenance activities for the samplers. The third bullet point within this list includes what appears to be an incomplete statement ("E-Sampler) and internal components according to the manufacturer's instructions"). Please correct.

    The statement was completed in Section 10.1 regarding E-Sampler quality assurance.

16. **Table 7. Summary of Instrument Calibrations** – The superscript in the column header for "Calibration Frequency" suggests the existence of a footnote, but Table 7 does not include a footnote. Please add the missing footnote or delete the superscript.

    There is no footnote associated with "Calibration Frequency" so the superscript was removed.

Intended for
Lakemoor Ventures, LLC and Broadbent & Associates, Inc.

Date
April 23, 2024

Project Number
1690030904

Perimeter Air Monitoring Plan Revision 1– PAMP

Three Kids Mine Remediation and Reclamation Project

RAMBOLL

Bright ideas.
Sustainable change.

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List of Acronyms	
ACM	Asbestos Containing Material
As	Arsenic
ATSDR	Agency for Toxic Substances and Disease Registry
CAP	Corrective Action Plan
CEM	Certified Environmental Manager
COC	Contaminants of Concern
CPU	Central Processing Unit
CSI	Campbell Scientific Inc.
E-FRM	Met One E-FRM Sampler
EPA	United States Environmental Protection Agency
E-Sampler	Met One E-Sampler Dual Particulate Sampler
FRM	Federal Reference Method
GC/MS	Gas Chromatography/Mass Spectrometry
hPa	Hectopascal
IAW	In accordance with
LOAEL	Low observed adverse effect level
Metals	Arsenic, Manganese, and Lead
mm	Millimeter
mV	Millivolts
MMRA-AOC	Mine Remediation and Reclamation Agreement and Administrative Order on Consent
Mn	Manganese
mph	Miles per hour
MRL	Minimal risk level
NAAQS	National Ambient Air Quality Standards
NAC	Navada Administrative Code
NDEP	Nevada Division of Environmental Protection
NIST	National Institute of Standards and Technology
PAHs	Polycyclic Aromatic Hydrocarbons
PALs	Project Action Levels
PAMP	Perimeter Air Monitoring Plan
Pb	Lead
PM_{10}	Particulate matter 10 microns or less
POD	Point of Departure
PUF	Polyurethane foam
RALs	Real-time Action Levels
RH	Relative humidity
RfC	Inhalation Reference Concentration
RSL	Regional Screening Level
VOC	Volatile organic compound
W/m^2	Watts per square meter
XRF	X-Ray Fluorescence
XAD	Naphthylisocyanate
°C	Degrees Celsius
$\mu g/m^3$	Micrograms per cubic meter

1. Introduction

The Three Kids Mine is a former open pit mine and mill site in Henderson, Nevada that produced manganese for the U.S. government between 1917 and 1961. The site covers approximately 1,165 acres and currently contains tailings impoundments, waste rock piles, open pits, and remnants of the original processing facilities. The mine was operated from 1917 to 1961 and has been inactive since that time. The site is currently being restored and redeveloped for residential use. The remediation and reclamation at the site is planned to take place over several years and will require excavating and handling millions of cubic yards of site materials and large amounts of fill material for the native soil cover. The fill material will be taken from areas surrounding the former mine site to the west, south, and east.

This document provides the Perimeter Air Monitoring Plan (PAMP) for the Three Kids Mine Remediation and Reclamation Project, prepared by Ramboll for Lakemoor Ventures, LLC and Broadbent & Associates, Inc. The PAMP outlines the objectives, contaminants of concern (COCs), equipment, methods, action levels, record keeping, and reporting for monitoring air quality along the perimeter of the construction site during remediation and reclamation. The document provides guidance on how the certified environmental manager (CEM) will implement the PAMP and comply with the applicable air quality standards and regulations listed in Section 3. The PAMP is in addition to a Dust Control Operating Plan, as required by Section 92 of Clark County Air Quality Regulations, which includes a full-time on-site Dust Control Monitor capable of performing opacity readings.

2. PAMP Overview

The PAMP for the Three Kids Mine Remediation and Reclamation Project is designed to monitor airborne COCs during various phases of remediation and reclamation at the site.

The PAMP covers the following contaminants of concern (COCs) for each construction phase:

- Asbestos (in accordance with the Corrective Action Plan, Revision 1 and summarized in Appendix A) during asbestos abatement
- Opacity (in accordance with the Dust Control Operating Plan) during all phases
- Particulate matter 10 microns or less (PM_{10}) during tailings remediation and waste rock reclamation
- Metals (arsenic, manganese, and lead) during tailings remediation and waste rock reclamation
- Polycyclic aromatic hydrocarbons (PAHs) during tailings remediation

The PAMP aims to monitor the air quality along the site boundary during various phases of construction. The PAMP defines Project Action Levels (PALs) and Real-time Action Levels (RALs) PM_{10} and other COCs.

The PALs are conservative action levels for concentrations of COCs at the site boundary. The air quality at the site boundary will be monitored at four locations and compared to the PALs and reported to the Nevada Division of Environmental Protection (NDEP). These PALs have been chosen based on EPA Regional Screening Levels (RSLs) for residential exposure scenarios and the Agency for Toxic Substances and Disease Registry (ATSDR) Screening Levels.

The RALs are designed to provide immediate feedback and trigger mitigation actions if the monitoring indicates exceedances of the thresholds. The RALs are based on hourly PM_{10} concentrations from the four perimeter monitoring stations and wind speed measurements from the on-site meteorological station. The RALs are initially set at 150 micrograms per cubic meter (µg/m^3) for PM_{10} and will be adjusted based on the correlation of PM_{10} and metals (As, Mn, and Pb) after the first three months of data collection. The RALs have four levels of response, ranging from email alerts to mitigation actions to enhance dust control practices to possible work pauses, depending on the duration and magnitude of the exceedances. The RALs are intended to complement the PALs, which are based on 24-hour integrated samples for PM_{10}, metals, and PAHs.

3. Monitoring Objectives

The objectives of the PAMP are to:

- Monitor air quality along the perimeter of the construction site during remediation and reclamation
- Maintain the levels of COCs at the site perimeter to levels that safeguard human health and help the region meet the air quality standards set by the Federal and State governments
  - National Ambient Air Quality Standards (NAAQS) for PM_{10}: 150 µg/m^3 for 24-hour average concentration, not to be exceeded more than once per year on average over three years
  - Nevada Administrative Code (NAC) 445B.22097 for PM10: 150 µg/m^3 for 24-hour average concentration, not to be exceeded more than once per year
  - NAC 445B.22097 for Lead: 0.15 µg/m^3 rolling three-month average
  - See also Section 11, number 14 for full reference
- Monitor emissions of COCs during various phases of construction
- Implement mitigation measures in response to exceedances of project action levels (PALs) and real-time action levels (RALs)
- Record and report air quality data and quality assurance activities

4. Monitoring Schedule and Phases

The PAMP will be implemented in accordance with the following schedule and phases:

- The monitoring program will commence prior to the start of the remediation and will continue until the completion of reclamation.

The monitoring program will be divided into four phases. The phases are as follows:

- **Phase 1:** Asbestos Abatement. This phase will involve the removal and disposal of asbestos-containing materials from the site. The monitoring will focus on asbestos fibers, PM_{10}, and metals.
- **Phase 2:** Tailings Remediation. This phase will involve the excavation and relocation of the tailings from the tailings ponds to the Hydro Pit as well as PAH-impacted soil from the mill site area. The monitoring will focus on PM_{10}, metals, and PAHs.
- **Phase 3:** Waste Rock Reclamation. This phase will involve the excavation of waste rock and placement in the pits. The monitoring will focus on PM_{10} and metals.
- **Phase 4:** Final Cover Construction. This phase will involve the installation of a native soil cover over the former mine site. The monitoring will focus on opacity only.

The monitoring frequency and analytes will vary depending on the phase and the potential sources of dust emissions. The table below summarizes the monitoring schedule and analytes for each phase.

Table 1. COCs by Project Phase

Activity	2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 1												
Asbestos Abatement[1]												
Phase 2												
Tailings Remediation												
Phase 3												
Waste Rock Reclamation[2]												
Phase 4												
Final Cover Construction												

NOTES:

Asbestos (IAW Corrective Action Plan, Revision 1) [1]

Opacity (IAW Dust Control Operating Plan)

PM_{10} = Particulate matter 10 microns or less [2]

Metals = Arsenic [As], Manganese [Mn], Lead [Pb] [2]

PAH = Polycyclic Aromatic Hydrocarbons

IAW = In accordance with

[1] Asbestos Monitoring will be conducted according to the Corrective Action Plan (CAP) Rev.1 - October 5, 2022, and the Asbestos Abatement Monitoring Plan (Appendix A) during abatement of Asbestos Containing Material (ACM).

[2] PM_{10} and metals air monitoring will continue until waste rock is no longer exposed or is otherwise stabilized with a minimum of four inches of native soil cover.

5. Monitoring Locations

The PAMP will include four monitoring locations on the perimeter of the site (Figure 1). The locations of the sampling sites have been chosen to provide a representative sample of the conditions at the perimeter of the mine site. Note that locations proposed in the PAMP submitted on January 23, 2024 were modified slightly, and additional details are provided in Appendix B.

Considerations included:

- Distance from sources of interference, such as buildings, trees, vehicles, and work areas
- Prevailing wind direction (see Figure 2) and terrain
- Proximity to the source areas
- Accessibility and security (to reduce vandalism and/or theft)

Details and rational for the selection of each site is provided below:

- **Air Quality Site 1:** Western part of the site. Directly upwind of the residential community close to Lake Mead Parkway. This site is situated in an area that will not be affected by the remediation and reclamation work, which will enable the monitors to be collocated with the meteorological monitoring station. This location is near the residential area along Lake Mead Parkway, which is one of the nearby receptors of possible dust impacts.
- **Air Quality Site 2:** Near the center of the northern perimeter boundary. Near residential areas along Lake Mead Parkway. This site is located downwind of the waste rock piles and tailings ponds which could be potential sources of dust emissions during the remediation and reclamation work.
- **Air Quality Site 3:** Northeast corner of site. Acts as the downwind site during typical higher wind events and can also act as the upwind site to assist in evaluation of upwind sources during alternate meteorological conditions.
- **Air Quality Site 4:** Southern boundary of site. This location is upwind of the site during typical high wind events and serves as a background reference of the dust concentrations during typical high wind events. This location may potentially be relocated further to the west during the project if earthwork is planned in the immediate vicinity and if road improvements are made in the southwest portion of the site.

A locked fence will surround the four sites. Access to the site will be controlled via on-site security guards, berms, and security cameras.

A meteorological monitoring station will be placed in the west corner of the site. The location was chosen based on the availability of undisturbed space, the distance from the dust sources, and the representativeness of the site conditions.

The location is as follows:

- **Meteorological Site 1:** Western part of the site. This site is located on relatively flat terrain and is free for obstructions. This site is located away from the work areas and the interference of the buildings and the vegetation to capture the average meteorological parameters of the site.

The map below shows the approximate locations of the air quality monitoring stations and the meteorological station.

Figure 1. Monitoring Locations

Google Earth V10.52.0.0 (5/9/2023). Henderson, Nevada. 36.073864°N 114.850742°W Eye Alt 523 meters. Google. http://www.earth.google.com [4/20/2024].
Blue pins depict perimeter air monitoring locations, including perimeter air monitoring for asbestos abatement activities. Additional details are provided in Appendix A.
White pins depict an example of air monitoring locations for a regulated area during asbestos abatement. Air monitoring for regulated areas will move based on the location of asbestos abatement activities. White polygon depicts an illegal dump area.

Las Vegas Nevada

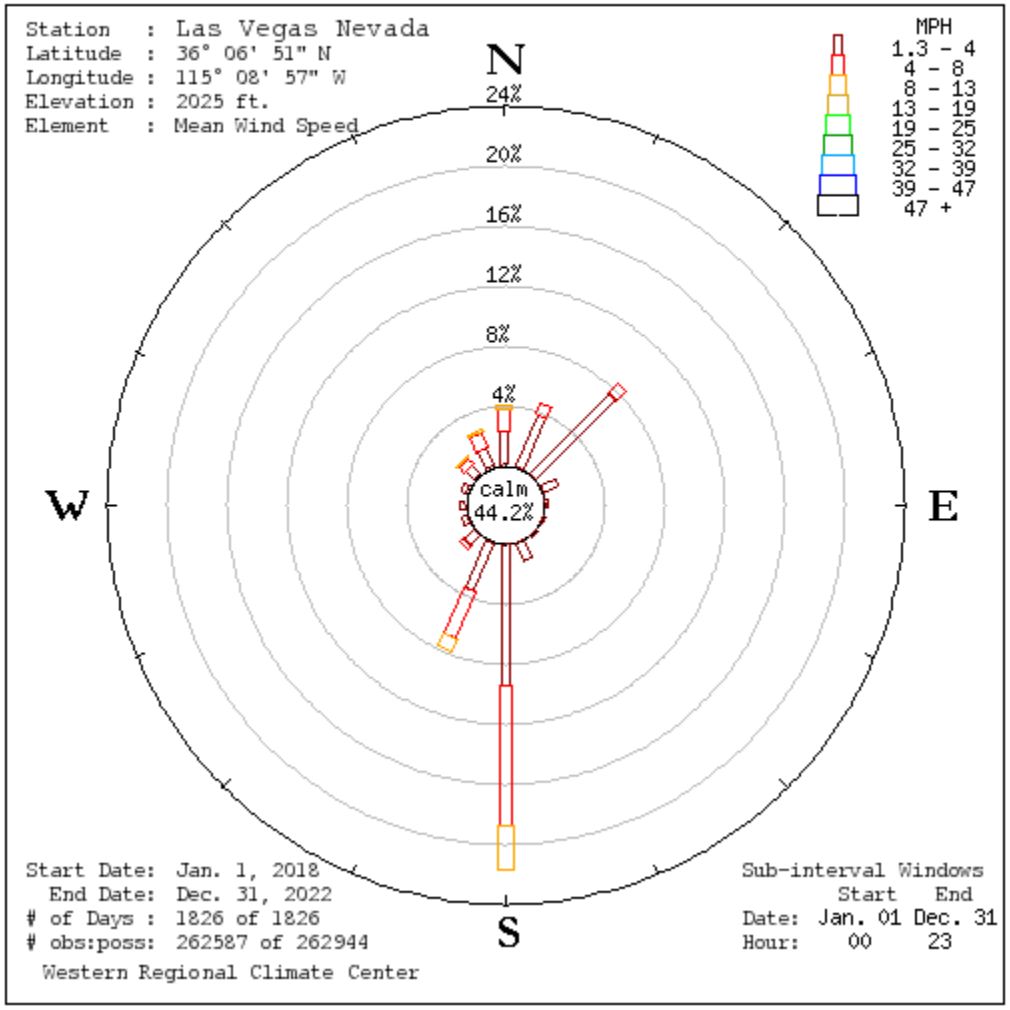

Figure 2. Wind Rose

Wind rose obtained from the Western Regional Climate Center (WRCC), a climate center administered by the National Oceanic and Atmospheric Administration (NOAA) and in partnership with Desert Research Institute. Wind rose was generated at the WRCC website from the WRCC database. Wind data was collected from station ID "Las Vegas," located off E Flamingo Road near S University Center Drive. Though this station is not in the immediate vicinity of the Three Kids Mine, data available provides significant years of scientifically reviewed wind data for the Las Vegas region. The WRCC wind rose shows a predominate wind direction from the south and speeds of 19 miles per hour or less.

Reference: Western Regional Climate Center (WRCC). Recent Climate in the West. https://wrcc.dri.edu/. Accessed July 2023.

6. Monitoring Methodology

The primary concern during remediation and reclamation is the transport of dust (potentially containing metals) offsite. Most of the dust generated on site will be redeposited very close to the source within the site boundary. Some of the finer dust may travel longer distances and has the potential to travel outside the site boundary in higher wind events. For this reason, the monitoring program will focus on dust particles with aerodynamic diameter less than or equal to PM_{10} which can be transported longer distances.

The particulate monitoring portion of the program will incorporate two methods: filter-based gravimetric sampling and real-time monitoring. The gravimetric methods will involve collecting air samples on filters weighed before and after sampling to determine the mass of PM and analyzing the particles captured on the filters to determine the concentration of metals. Gravimetric methods provide accurate and reliable measurements of PM mass but are integrated over 24-hours and require laboratory analysis which provide only a single data point per sample day and the results can be delayed by days to weeks. Real-time methods involve using instruments that measure PM concentrations continuously and provide instant readings. Real-time methods provide timely and continuous measurements of PM concentration but have lower accuracy and generally do not provide compositional information (i.e., metals concentrations).

Combining real-time PM measurements with integrated filter-based sampling provides both accurate (but intermittent) samples of the dust concentration and composition at the fenceline as well real-time concentration data that can assist the CEM with onsite actions to reduce fugitive dust.

A detailed discussion of the various monitoring equipment and methods is provided below. A table summarizing the details for PM_{10}, metals, and PAH sampling is provided in Table 2 and meteorological monitoring parameters in Table 3. Equipment specification sheets are provided in Appendix C.

6.1 Met One E-FRM (PM_{10} Filter-based sampler)

Integrated filter-based sampling of PM_{10} and metals will be conducted at the four perimeter monitoring stations using the Met One E-FRM-DC sampler (E-FRM). The E-FRM is a portable device that measures the concentration of particulate matter in the ambient air through low-volume (16.67 Liters per minute [L/min]) filter-based sampling based on approved EPA Methods. The E-FRM is a federal reference method (FRM) sampler that uses a cyclone inlet to collect only the PM_{10} size fraction on a 47-millimeter (mm) Teflon filter. US EPA FRM Designation(s): RFPS-0315-221; RFPS-0216-231; RFPS-0316-232.

The E-FRM uses a filter cassette to collect the particles and a flow meter to measure the sampled air volume. The sampler can be programmed to run for a specified duration and interval, and the runtime data can be downloaded to a computer to aid in data validation and analysis.

Flow is highly dependent on actual temperature and actual pressure, and therefore are intended to be calibrated or calibration checked at site conditions. Upon set up at the field monitoring location, the E-FRMs will be field calibrated using a BGI Delta-Cal or similar National Institute of Standards and Technology (NIST) traceable standards. Temperature, barometric pressure, and air flow for each E-FRM will be calibrated, and the target flow rate of 16.67 L/min verified. Calibrations will also be

checked once per month, and at the conclusion of the monitoring program or exchange of the sampler.

The samplers will be powered by a solar array with battery storage to eliminate the need to run AC power to the monitoring sites. The sampler will be programmed using the keypad and the LCD display on the front panel of the sampler. The sampling duration and interval will be set according to the EPA run-day calendar on the 1:6 (every 6 days) sampling schedule (Figure 3). The filter cassette will be removed from the sampler after the sampling event and placed in a sealed plastic bag. The filter cassette number, site ID, sampler ID, start time, and stop time will be written on the bag.

The run data can be downloaded to a computer after removing the filter cassette. The data can be downloaded remotely using a cellular modem or locally by using a USB cable, which can be connected to the USB port on the side of the sampler. The data is transferred using the Met One COMET E-FRM software. The software allows the user to view, save, and export the data in various formats, such as Excel, CSV, or PDF. The software also allows the user to generate reports and graphs, and to perform quality assurance and quality control checks on the data.

The PM_{10} samples will be shipped overnight under Chain of Custody documentation to Chester LabNet of Tigard, Oregon or other accredited laboratory for analysis of PM_{10} and metals (Pb, As, and Mn) following 40 CFR 50 Appendix L (see note in Table 2) and EPA Method IO-3.3 (metals analysis). PM_{10} and metals concentrations will be reported in $\mu g/m^3$.

6.2 Met One E-Samplers (PM_{10} Real-time sampler)

Real-time monitoring of particulate matter at the four perimeter sampling locations will be achieved using the Met One E-Sampler. The E-Sampler is a rugged and highly portable particulate matter monitor that can be configured to collect various size fractions of particulate by installing different cyclone heads. The E-Sampler provides real-time particulate measurement utilizing near-forward light scattering measurements. An internal rotary vane pump draws air at approximately 2 L/min into the sensing chamber, where it passes through visible laser light. Aerosols in the air scatter light in proportion to the particulate load in the air. The scattered light is collected by precise glass optics and focused on a PIN diode. Electronics measure the intensity of the focused light and output a signal to the central processing unit (CPU), where the results are logged and displayed as concentration values. Ambient temperature and pressure are measured, and actual flow is calculated and controlled by the E-Sampler. The E-Sampler is further equipped with a sample chamber allowing for collection of air samples on the same type and size of filter (47-mm Teflon) as the E-FRM and can be submitted for laboratory analysis. The collection time and resulting sample volume can be determined by the user. The E-Samplers will be configured to collect continuous PM_{10} averaged over 60-minute interval and gravimetric concentration data with a sample duration of six days.

Flow is highly dependent on actual temperature and actual pressure, and therefore are intended to be calibrated or calibration checked at site conditions. Upon set up at the field monitoring location, the E-Samplers will be field calibrated using a BGI Delta-Cal or similar NIST traceable standards. Temperature, barometric pressure, and air flow for each E-sampler will be calibrated, and the target flow rate of 2 L/min verified. Calibrations will also be checked once per month, and at the conclusion of the monitoring program or exchange of the sampler.

Filter-based samples will be collected within the PM_{10} configured E-Samplers over a 6-day duration and will result in collection of a large volume of sample air. Filter samples will be installed and the start time and sampler parameters recorded, and then left to accumulate sample deposits on the filter over the course of six days. Following the 6-day sample collection period, the sample will be retrieved, and the sample parameters recorded. Instrument flows and sample filter installation and retrieval times will be referenced to determine accurate sample volumes and durations.

The PM_{10} samples will be shipped under Chain of Custody documentation to Chester LabNet or other accredited laboratory for analysis of PM_{10} mass and metals (Pb, As, and Mn) following 40 CFR 50 Appendix L (see note Table 2) and EPA Method IO-3.3 (metals analysis) if indicated through the factors outlined in the decision matrix (see Section 8. Decision Matrix). PM_{10} and metals concentrations will be reported in $\mu g/m^3$.

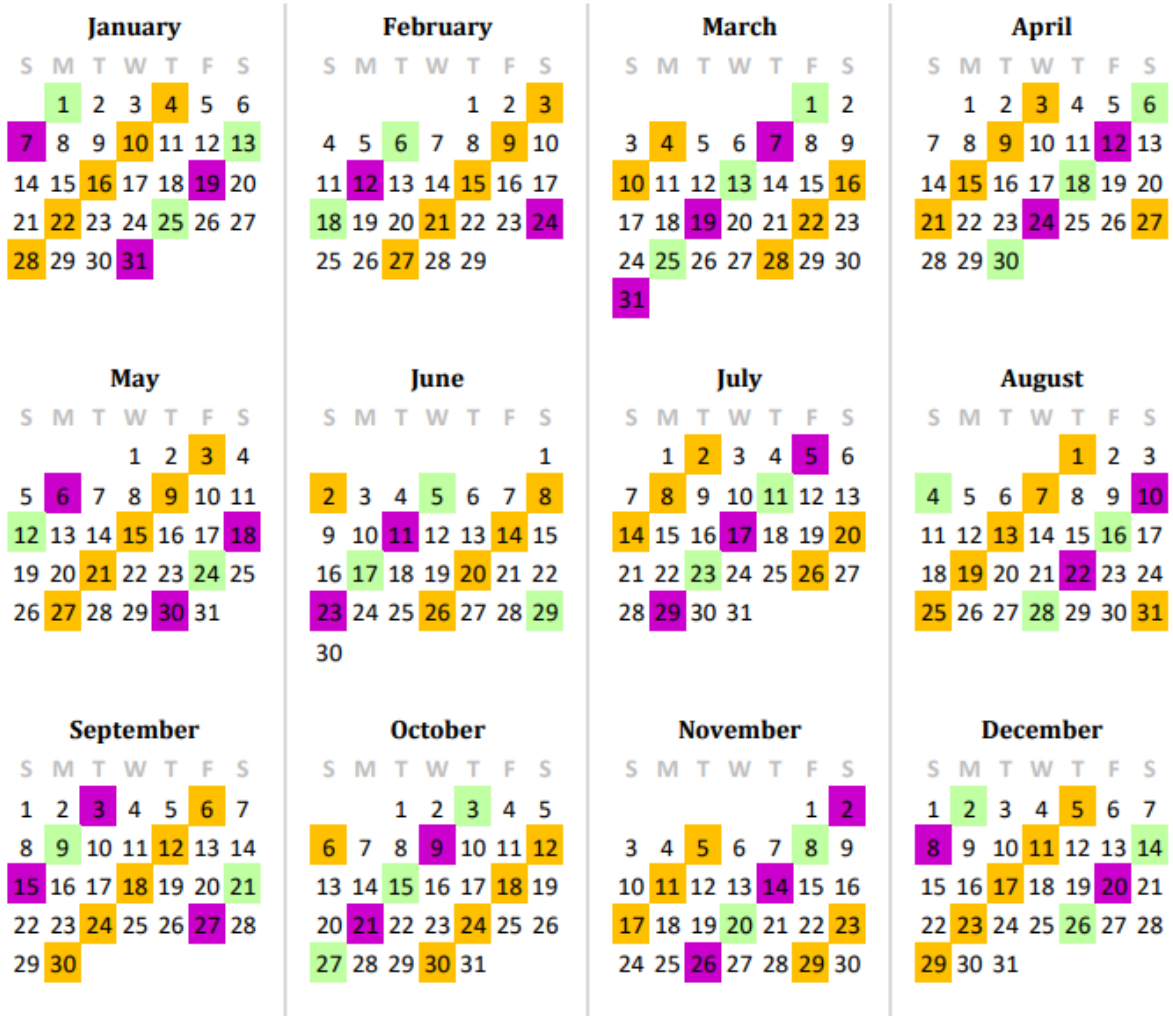

Figure 3. 2024 U.S. EPA National Sampling Schedule

NOTE: 3-Day schedule is shown in orange, green, and purple; 6-Day schedule is shown in green and purple; and 12-Day schedule is shown only in purple.

6.3 PAH Sampling Methods

Each of the four monitoring locations will also be equipped with an SKC AirChek 20 (or equivalent) for collection of PAH samples on the EPA 1:6 sample schedule (Figure 2). The SKC AirChek 20 system will be housed in a weatherproof and rugged case with external tubing connections that allows the pump to remain in the closed case while operating. The external tubing will be routed to the appropriate sample height (approximately 2 meters) and secured with a mounting bracket. The SKC pump can be adjusted to a set flow rate up to 10 L/min and will be powered by the solar/battery power system used for the E-Samplers. The SKC AirChek 20, sample line, and inlet head will be capped and left in place at the monitoring location between sampling days. Sampling media will be transported to each site for a sample event and removed at the same time as the PM_{10}/metals samples are recovered.

The SKC AirChek 20s will be configured to operate at a flow rate of approximately 5 L/min in accordance with the laboratory's Standard Operating Procedure for low volume polyurethane foam (PUF) sampling, modified method TO-13A (TO-13 Low flow), which recommends a sampling flow rate of 1-5 L/min for 4 to (up to) 24 hours with the sample media in-line. The SKC AirChek 20s will be initially calibrated using a NIST-certified gas flow calibrator and the sample rate will be set to 5 L/min at actual conditions with PUF sample in-line. The flow rate will be field checked and recorded for each 24-hour sample event at the beginning and end of sample collection. The sample duration and the average of beginning and ending flow values will be used to determine total volume of air sampled. All flow measurements will be verified with PUF sample media inline.

Samples will be collected over the course of 24 hours using lab-provided PUF/naphthylisocyanate (XAD) media filters. PAH filter samples will be shipped overnight on ice (below 4 degrees Celsius) to Eurofins Air Toxics in Folsom, California or other accredited laboratory for TO-13 A analysis[1]. The analytical laboratory will also provide all PUF sample media.

6.4 Meteorological Monitoring Methodology

The PAMP includes the installation of a 10-meter meteorological monitoring tower to measure continuous Wind Speed, Wind Direction, Temperature, Relative Humidity, Barometric Pressure, Precipitation, and Solar Radiation. The data will be collected and stored at 15-minute intervals. The monitoring will start and end at the same time as the dust monitoring activities. The continuous operation will provide comprehensive and consistent data for the meteorological parameters. The 15-minute interval will provide the high-resolution and representative data of the measured parameters. The tower will be installed adjacent to the E-FRM / E-Sampler at AQ Site 1. The tower will be designed to collect data utilizing a Campbell Scientific Inc. (CSI) CR300/350 (or equivalent) datalogger and cellular data modem to allow for remote communications to enable and real-time data reporting. The tower will be configured as follows:

- Universal Tower UT30 3-sides aluminum lattice tower with concrete base, guy wire supports, and wind sensor crossarm at 10-m level
- RM Young Inc. 05305 AQ Wind Monitor: wind speed and direction, wind direction standard deviation, and maximum wind speed gust
- CSI HygroVUE10: ambient temperature and relative humidity (with gill naturally aspirated radiation shield)
- CSI CS100: barometric pressure

[1] https://www.epa.gov/sites/default/files/2019-11/documents/to-13arr.pdf

- Texas Electronics TE525WS: precipitation (mounted on open ground at 1-m above ground level)
- Hukseflux SR-05: solar radiation
- Campbell Scientific datalogger programmed for 15-minute, 60-minute, and daily data tables to record data from all sensors specified above

In addition, a web-based dashboard will be developed to allow for near real-time interpretation and reporting of PM_{10} concentrations and meteorological monitoring data and provide email and text notifications to the CEM if a condition is exceeded (e.g., elevated PM_{10} or high wind event) to allow for prompt response and limit emissions. The Dust Control Monitor implementing the Dust Control Operating Plan will also have access to the web-based dashboard.

Table 2. Particulate, Metals, and PAH Methods and Equipment

Target Analytes	Matrix	Method	Method of Analysis	Sample Media	Sampling Device	Frequency
PM_{10}	Air	40 CFR Part 50 Appendix L[1, 2]	Gravimetric	Teflon Filter, 47mm	Met One E-FRM-DC US EPA FRM Designation(s): RFPS-0315-221 RFPS-0216-231 RFPS-0316-232	1:6 Day Sampling (24-hour)
PM_{10} Metals		40 CFR Part 50 Appendix Q [3] IO-3.3 [5]	X-Ray Fluorescence (XRF)			
PM_{10}	Air	Real-time Particulate sampler	Light scattering spectrometry	N/A	Met One E-Sampler	Real-time with 60-minute average conc.
PM_{10}		40 CFR Part 50 Appendix L [1, 2]	Gravimetric	Teflon Filter, 47mm		6-day integrated filter sample
PM_{10} Metals		IO-3.3 [4]	X-Ray Fluorescence (XRF)			6-day integrated filter sample
PAH	Air	TO-13A (low volume method) [5]	GC/MS	41.3-mm PUF with 47-mm quartz filter	Cartridge Sampler System for PAHs	1:6 Day Sampling (24-hour)
NOTES:						
PM_{10} = Particulate matter 10 microns or less						
Metals = As, Mn, and Pb						
PAH = Polycyclic aromatic hydrocarbons						

[1] 40 CFR Part 50 Appendix L is approved for PM_{10} Low-Vol monitoring by EPA Clarification Memorandum, Clarification on the Use of $PM_{2.5}$ Field and Laboratory Requirements for Low Volume PM_{10} Monitoring to Support PM_{10} NAAQS, dated 3/3/2016

[2] 40 CFR 50 Appendix L - Reference Method for the Determination of Fine Particulate Matter as PM2.5 in the Atmosphere

[3] 40 CFR Part 50 Appendix Q - Reference Method for the Determination of Lead in Particulate Matter as PM10 Collected from Ambient Air

[4] EPA Compendium Method IO-3.3 - Determination of Metals in Ambient Particulate Matter using E-Ray Fluorescence (XRF) Spectroscopy

[5] EPA Compendium Method TO-13A - Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)

Table 3. Meteorological Monitoring Equipment Specifications

Parameter	Equipment Model	Units and Range	Accuracy/ Resolution	Sample/Measurement Frequency
Measurement and Control Datalogger	CSI CR350 Datalogger	-100 to +2500 mV	±(0.1% of measurement + offset) at -40° to +70°C	1-second scan rate with 15, 60 and daily data tables
Wind Speed and Direction	RM Young 05305AQ Wind Monitor	m/s and degrees true 0° to 360°	Wind speed: ±0.2 m/s (0.4 mph) or 1% of reading Wind direction: ±3 degrees	1-sec. scan rate; hourly average with 15-minute subintervals (Yamartino Method)
Ambient Temperature	CSI HygroVue10 Hygrometer (with radiation shield)	-40°C to +70°C	±0.1°C (over the range 20 to 60°C) ±0.2°C (over the range -40 to +70°C)	1-second scan rate; with 15-min, 60-min, and daily data tables
Relative Humidity	CSI HygroVue10 Hygrometer (with radiation shield)	0% to 100%	±1.5% (at 25°C, over range 0 - 80% RH) ±2% (at 25°C, over range 80-100% RH)	1-second scan rate; with 15-min, 60-min, and daily data tables
Barometric Pressure	CSI CS100 Sensor	600 to 1100 hPa	±0.5 hPa (@ +20°C) ±1.0 hPa (@ 0° to 40°C) ±1.5 hPa (@ -20° to +50°C) ±2.0 hPa (@ -40° to +60°C)	1-second scan rate; with 15-min, 60-min, and daily data tables
Precipitation	TE525WS Rain Gauge	.01-inch increments per tip	±1.0% up to 2 inch/hour)	Hourly total accumulation
Solar Radiation	Hukseflux SR-05	W/m^2	Spectral range 285 to 3000 x 10-9 m Rated operating temperature -40 to +80 °C	1-second scan rate; with 15-min, 60-min, and daily data tables

7. Action Levels and Response Procedures

This PAMP defines both Project Action Levels (PALs) and Real-time Action Levels (RALs) for PM_{10} and other COCs based on federal and state standards and risk-based screening levels. The PAMP will use the following action levels and response procedures to help ensure compliance with applicable requirements and minimize dust emissions.

The PALs are the thresholds for the concentrations of PM_{10} and other COCs in the ambient air along the perimeter of the construction site during the remediation and reclamation. The PALs are based on the NAAQS, NAC, EPA RSLs for residential and composite worker exposure scenarios, and ATSDR Screening Levels.

The RALs are based on hourly PM_{10} concentrations measured at the same four perimeter monitoring locations as the 24-hour integrated samples collected to determine compliance with the PALs. The RALs are designed to provide immediate feedback to project staff and can trigger mitigation actions if the hourly air quality exceeds the thresholds. The RALs have four levels of response, ranging from email alerts to mitigation actions to enhance dust control practices to possible work pauses, depending on the duration and magnitude of the exceedances.

7.1 Project Action Levels (PALs)

The PALs are intended to maintain the levels of COCs at the site perimeter to levels that safeguard human health, help the region meet the air quality standards set by the Federal and State governments, and minimize emissions from the project. The PALs may be adjusted based on the review of the sampling data in consultation with the CEM and the NDEP.

The PALs for the COCs are listed in Table 4 below. The COCs include PM_{10}, metals (arsenic, lead, and manganese), and PAHs. The COCs vary depending on the construction (The monitoring frequency and analytes will vary depending on the phase and the potential sources of dust emissions. The table below summarizes the monitoring schedule and analytes for each phase.
Table 1). The PALs for PM_{10} are the same for all phases and scenarios and are based on the 24-hour NAAQS of 150 µg/m^3.

The PALs for lead and arsenic are based on the 24-hour RSLs for cancer or non-cancer effects, whichever is lower. The PAL for manganese is based on the ATSDR Screening Levels.

The ATSDR Screening Level was selected as the PAL for manganese after a consideration of how each of three screening levels was calculated: the ATSDR Minimal Risk Level (MRL), the EPA residential RSL, and the EPA industrial RSL. Both the residential EPA RSLs and the ATSDR assume similar default exposure scenarios (i.e., number of days per year and hours per day of exposure). Where they differ is the inhalation reference concentration (RfC). The ATSDR uses the EPA's preferred approach of benchmark dose modeling, while the EPA RSLs are based on a low observed adverse effect level (LOAEL), which has limitations. Additional details are provided below.

The RfC used in calculating the EPA RSLs for manganese is based on a study by Roels et al. (1992) and uses a LOAEL of 50 µg/m3 and a conservative uncertainty factor of 1,000 (EPA 2023). The uncertainty factor of 1,000 includes a factor of 10 to protect sensitive individuals, a factor of 10 for

the use of a LOAEL, and a factor of 10 for database limitations (EPA 2023). The residential and industrial RSLs are 0.052 µg/m3 and 0.22 µg/m3, respectively.

The ATSDR MRL for manganese is based on the same study as the EPA RSLs (Roels et al. 1992) but instead uses a benchmark dose approach to determine a point of departure (POD) of 34 µg/m3 and an uncertainty factor of 100, which includes a factor of 10 to protect sensitive individuals and a factor of 10 for database limitations. The ATSDR MRL is 0.3 µg/m3. ATSDR additionally performed analysis and review of other epidemiological studies of similar endpoints to confirm the inhalation toxicity value (ATSDR 2012). The ATSDR MRL follows the EPA's recent guidance on benchmark dose modeling, which is preferred over the LOAEL approach used in the EPA RSLs (EPA 2012). The ATSDR MRL is also more transparent and peer-reviewed than the EPA RSLs. Based upon a review of the supporting toxicity information, the use of the ATSDR MRL of 0.3 µg/m3 is the more appropriate value for use at the Three Kids Mine for the perimeter air monitoring screening criteria.

The PALs for PAHs are based on the 24-hour RSLs for cancer effects only since the non-cancer effects are negligible.

If PALs are exceeded, NDEP will be notified within via e-mail or telephone within one week of receiving results. PAL exceedances will also be noted in the daily reports compiled and submitted to NDEP on a monthly basis.

Table 4. Project Action Levels (PALs)

Pollutant	Nevada Ambient Air Quality Standard (µg/m³)	Residential[4] (µg/m³)		Composite Worker[4] (µg/m³)		ATSDR[5]	Project Action Level[1,2] (µg/m³)
		Cancer[2]	Non-Cancer[3]	Cancer[2]	Non-Cancer[3]	Screening Level	
PM_{10}[1]	150						1.50E+02
Arsenic		6.53E-02	1.56E-02	2.85E-01	6.57E-02		1.56E-02
Lead[3]	0.15		1.50E-01		1.50E-01		1.50E-01
Manganese			5.21E-02		2.19E-01	3.00E-01	3.00E-01
Naphthalene		8.26E+00	3.13E+00	3.61E+01	1.31E+01		3.13E+00
Benzo(a)pyrene		1.69E-01	2.09E-03	2.04E+00	8.76E-03		2.09E-03
Benz(a)anthracene		1.69E+00		2.04E+01			1.69E+00
Benzo(b)fluoranthene		1.69E+00		2.04E+01			1.69E+00
Chrysene		1.69E+02		2.04E+03			1.69E+02
Dibenz(a,h)anthracene		1.69E-01		2.04E+00			1.69E-01
Indeno(1,2,3-cd)pyrene		1.69E+00		2.04E+01			1.69E+00

[1] PM_{10} 24-hour Standard (Not to be exceeded more than once per year on average over 3 years)

[2] Based on 10-4 cancer risk and Hazard Index of 1

[3] Rolling 3-month Average (Not to be Exceeded)

[4] United States Environmental Protection Agency. Regional Screening Levels for Chemical Contaminants at Superfund Sites. (12/4/2023)

[5] Agency for Toxic Substances and Disease Registry Screening Levels. See section 3.2.1 of Draft Technical Memorandum Baseline Air Monitoring 12/15/23.

7.2 Real-time Action Levels (RALs)

The PAMP also establishes the following Real-time Action Levels (RALs) for PM_{10} based on the hourly average concentrations and the wind speed and gusts (Table 5). The RALs are designed to provide immediate feedback to the CEM and trigger mitigation actions if monitoring results exceed a threshold. Mitigation actions may include increased applications of water in areas creating dust, adjusting work activities to reduce work in the dust source area, increasing dust monitor staffing levels, or pausing work activities. The CEM will work with the Dust Control Monitor to evaluate which mitigation activities are appropriate to implement. Note that the Dust Control Monitor also has ability to pause work based on Clark County Air Quality Regulations and the Dust Control Operating Plan.

The RALs are based on hourly PM_{10} concentrations from the four perimeter monitoring stations and wind speed measurements from the on-site meteorological station. The RALs have four levels of response, ranging from email alerts to work pauses, depending on the duration and magnitude of the exceedances. The lowest RAL PM_{10} concentration is set at 150 $\mu g/m^3$, corresponding to the NAAQS 24-hour value, for a single hour, which is intended to alert the CEM of short wind events. The next action level uses the same PM_{10} concentration but increases the time to four consecutive hours, which is intended to capture regional wind events that last over four hours. Action levels 3 and 4 are based on a concentration of 300 $\mu g/m^3$, which is twice the NAAQS 24-hour value. The RALs are intended to complement the PALs, which are based on 24-hour integrated samples for PM_{10}, metals, and PAHs.

The RALs are initially set as indicated in Table 5 for PM_{10} and will be adjusted based on the review of the E-sampler and E-FRM PM_{10} and metals (As, Mn, and Pb) data collected over the first three months of the project. A linear regression will be performed, and correlation coefficients will be computed to assess whether any correlations exist (and how strong they are). If a moderate to strong PM_{10} / metals correlation is detected, the RALs may be modified in consultation with the CEM and NDEP. If the correlation of PM_{10} and E-FRM Metals data is not adequate to calculate an updated RAL, the initial RALs will be maintained. In this case, an additional three months of real-time E-Sampler PM_{10} data and E-FRM metals data will be examined. If a sufficient correlation is still not observed, the initial RALs will be used for the duration of the project.

The PAH data collected on a 1:6 sampling schedule at the four perimeter monitoring stations will also be reviewed to evaluate the correlation of PM_{10} and PAHs. If a moderate to strong PM_{10} / metals correlation is observed, adjustments to the RALs may also be proposed if the PM_{10} / PAH correlation and the related PAL levels are found to be more protective of human health.

Table 5. Real-time Action Levels (RALs)

Action Level[1]	PM_{10} RAL ($\mu g/m^3$)	Wind Speed (mph)	Wind Gusts (mph)	Actions
1	150 (1 hour)	15	25	Notify CEM via email alert
2	150 (4 consecutive hours)	20	30	Notify CEM via email alert and phone call. Mitigation efforts, work adjustments and additional notifications implemented by CEM
3	300 (1 Hour)	25	35	Notify CEM via email alert and phone call. Examine delta values between upwind and downwind sites. Check monitors for errors. Mitigation efforts, work adjustments and additional notifications implemented by CEM
4	300 (4 consecutive hours)	30	40	Notify CEM via email alert and phone call. Mitigation efforts, work adjustments (including possible work pause), and additional notifications implemented by CEM

[1] The RAL has been triggered if either the PM_{10} RAL limit has been exceeded for the time indicated or if the wind speed or wind gust levels are above the thresholds set for that action level.

8. Decision Matrix

8.1 Decision Matrix for Six-day Integrated Filter Analysis

The decision matrix Table 6 is based on wind speed, visible dust, RALs for PM_{10}, and PALs for metals. The decision matrix outlines the steps to be taken if wind speed, visible dust, or real-time levels of PM_{10} exceed set thresholds. The evaluation steps outlined in the decision matrix are designed to provide thresholds to trigger the additional analysis of the 6-day integrated PM_{10} filters from the E-Samplers if the event occurs on a day that is not a current 1:6 E-FRM filter sampling day. The intent of this procedure is to provide filter-based metals data if an event occurs when the 24-hour regulatory monitors are not scheduled to be operating. Additionally, steps are included that will trigger notifications to the CEM.

It should be noted that the E-Sampler PM_{10} filters will be analyzed for PM_{10} and metals for each 6-day run for the first 3 months of sampling in order to assist with the development of a site-specific calibration factor for the real-time PM_{10} E-Samplers and to provide data to help evaluate the level for the RALs. The metals data will be evaluated for correlations of PM_{10} and metals to allow a real-time

PM based surrogate (RAL) to be set for metals (As, Mn, and Pb). If a robust correlation is not present between the real-time PM_{10}, and metals data collected during the first 3 months of the program, the initial RALs will continue to be used. After six-months, the real-time data from the E-Sampler and the metals data from the E-FRM will be evaluated again for a correlation. As indicated in section 7, in the event that no clear correlation is found after six-months of E-Sampler filter analysis, the initial project RALs will be retained for the remainder of the project. Any additions to or adjustments of the existing RALs will be made consultation with the CEM and NDEP.

8.2 Decision Matrix for Supplemental PAH Sampling

Based on the lack of a six-day integrated PAH sample, no immediate action is proposed for the PAH sampling program in the event of an RAL exceedance in the first three months of the program. If after examination of the first three months of 1:6 PAH data, a correlation of PM_{10} and PAHs is present, the corresponding RALs may be updated based on the results. The adjusted RALs would trigger the reporting requirements as outlined in Table 5.

If the PAH sampling results for the regularly scheduled 1:6 run days include detections exceeding the PALs, then additional PAH sampling will be conducted as specified in Table 7. Upon receipt of a valid PAH sample result above the PAL, the PAH sampling schedule will be increased to a 1:3 day schedule until two valid consecutive samples are reported below the PALs at all locations.

Table 6. RAL / PAL Decision Matrix for Six-day Integrated PM_{10} Filter Analysis

Step	Condition	Action
1-A	Is the wind speed above 25 mph for 1 hour?	**YES** - Move to Step 2
		NO - Continue to monitor the data
1-B	Is there visible dust on the fenceline?	**YES** - Move to Step 2
		NO - Continue to monitor the data
1-C	Is the Real-time PM data above RAL level 3?	**YES** - Move to Step 2
		NO - Continue to monitor the data
2	Is the current day a 1:6 filter run day?	**YES** - Process the filters normally and go to Step 3
		NO - Send the E-Sampler filters to the lab for analysis and go to Step 3
3	Does the lab analysis exceed the PAL?	**YES** - Notify the CEM and highlight data in the monthly data report
		NO - Note the event in the monthly data report

Note: For the first three months of construction all E-Sampler 6-day integrated filters will be collected and analyzed for PM_{10} and metals

Table 7. RAL / PAL Decision Matrix for PAHs

Step	Condition	Action
1	Does the most recently received lab analysis for PAHs exceed the PAL?	**YES** – Increase PAH sampling frequency to 1:3 until two consecutive samples for all sites are below the PAL. Notify the CEM and highlight data in the monthly data report
		NO - Move to Steps 2-A
2-A	Is the wind speed above 25 mph for 1 hour?	**YES** - Move to Step 3
		NO - Move to Step 2-B
2-B	Is there visible dust on the fenceline?	**YES** - Move to Step 3
		NO - Move to Step 2-C
2-C	Is the Real-time PM data above RAL level 3?	**YES** - Move to Step 3
		NO - Continue to monitor the data
3	Is the current day a 1:6 filter run day?	**YES** - Process the filters normally and go to Step 4
		NO – No immediate action required
4	Does the lab analysis exceed the PAL?	**YES** – Increase PAH sampling frequency to 1:3 until two consecutive samples for all sites are below the PAL. Notify the CEM and highlight data in the monthly data report
		NO - Note the event in the monthly data report

9. Reporting

The PAMP requires daily, quarterly, and annual reporting of monitoring results, including general weather description, summary of meteorological data, synopsis of site construction activities, summary of continuous monitoring results, equipment maintenance and calibration notes, samples collected and submitted for laboratory analysis, mitigation actions taken in response to RAL/PAL exceedances, and signature from the CEM. Quarterly progress reports and annual reports will be consistent with requirements outlined in the Mine Remediation and Reclamation Agreement and Administrative Order on Consent for the Three Kids Mine (MMRA-AOC) dated November 17, 2023. The continuous data (meteorological station and PM_{10}) will be available in real-time on an internal web-based dashboard for use by the CEM and project staff and will also be uploaded to an online file system (e.g., SharePoint) for use in report generation.

Daily reports will be prepared as described in this PAMP and in the CAP. Daily reports will contain the following information and will be submitted to NDEP on a monthly basis:

- Date and time of report
- General weather description
- Summary of meteorological conditions
- Brief synopsis of site construction activities for the day
- Summary of continuous monitoring results including exceedances of PALs and RALs
- Equipment maintenance and calibration activities
- Samples collected and submitted for laboratory analysis
- Analytical results received that day and synopsis of results
- Mitigation actions taken in response to RAL or PAL exceedance
- Verifying signature from a CEM

Quarterly progress reports will contain the following items pertaining to perimeter air monitoring:

- Summary of construction activities completed that quarter
- Exceedances of PALs that quarter
- Implementation of control measures and work stoppages related to air monitoring exceedances
- Progress reports will be submitted on the 10th day of January, April, and July.

Annual reports will contain the following items pertaining to perimeter air monitoring:

- Summary of construction activities completed that year
- Summary of real-time monitoring results
- Summary of laboratory analytical data from filter-based samples
- Other items in accordance with the AOC not pertaining to air monitoring
- Annual reports will be submitted the 10th day of October.

10. Quality Control and Quality Assurance

The PAMP also includes quality control and quality assurance measures, such as PM sampler flow checks and calibrations, routine maintenance, data review, field blanks, trip blanks, and annual calibrations / audits of meteorological sensors.

10.1 Particulate Monitoring Quality Assurance

The PAMP will follow the quality assurance procedures outlined in the EPA Quality Assurance Handbook for Air Pollution Measurement Systems.

The procedures include the following items:

- **Field Blanks:** The particulate and PAH sample filters will be analyzed in a commercial laboratory following the EPA QA Handbook and Methods. Field blanks will be tested at a rate of about 10% (total) of the sampled filters. A field blank for air samples is a clean sample media that is exposed to the sampling environment but not actually used to collect air. It is taken to the field and returned to the lab without being used to check for contamination that may have occurred during the sampling process. For PAH sampling, each sampling episode will include one cartridge and filter that serves as a field blank.

- **Field logs:** The field personnel will record the relevant information during the sampling and monitoring event, such as the start and end time, the location, the weather conditions, the equipment settings, and any deviations or problems. The field log will provide the essential data and the documentation for the sampling and monitoring activities. The field log will be done using a standard form and a pen, or an electronic device.

- **Data validation:** The data collected from the samplers, the monitors, and the data loggers will be validated using the EPA criteria for completeness and accuracy. The data validation will help ensure the quality and the usability of the data. The data validation will be documented and recorded.

- **Data reporting:** The data will be reported in a format that includes the tables, graphs, maps, and narratives that summarize the results and the findings of the PAMP. The data reporting will provide the communication and the dissemination of the data. The data reporting will be documented and recorded.

- **Calibration:** The flow meters, real-time monitors, filter-based particulate samplers, and the data system will undergo routine calibrations and checks using standard methods and equipment. The calibration will help ensure the accuracy and the reliability of the measurements and the data. The calibration will be done using a primary standard or a certified reference material, or by comparison with a calibrated instrument. The calibrations will be documented and recorded.

- **Sample Handling and Chain of Custody:** The PM_{10} and metals samples will be shipped under Chain of Custody documentation to Chester or other accredited laboratory for analysis of PM_{10} and metals (Pb, As, and Mn) following 40 CFR 50 Appendix L (see note in Table 2) and EPA Method IO-3.3 (metals analysis). The PAH samples will be shipped under Chain of Custody documentation to Eurofins Air Toxics of Folsom, California or other accredited laboratory for analysis for analysis of

PAH. PAH filter samples will be kept below 4 degrees Celsius once removed and shipped. The analytical laboratories will provide the prepared sample media. All filters will be returned to the laboratories within the specified holing times and transport temperatures as required in their respective EPA method.

- **Maintenance:** All sampling equipment will be maintained according to the manufacturers recommendations and based on the experience of the project staff. Staff will be familiar with the operation, maintenance, and troubleshooting of the E-FRM, E-Samplers, PAH Samplers, and meteorological monitoring station. Knowledge and experience with this equipment will be a key part of the successful execution of this plan. For instance, the Met One E-Sampler is a robust real-time instrument will a proven track record of performance, but ongoing maintenance steps need to be taken to help ensure their proper operation. In addition to routine maintenance, the operations staff will need to be fully trained on troubleshooting the equipment if errors or suspected faulty readings are observed.

- **Corrective actions:** The real-time data collected with the E-Samplers will be accessible to the CEM via an online dashboard with a real-time alert system, which informs staff the moment equipment diagnostics fall outside of specified parameters or if there are communication errors. Troubleshooting equipment and standard spare parts will be available locally for initial investigation into any network issues. If the onsite team is unable to quickly repair the equipment failure, additional replacement parts or rental equipment can be obtained quickly, sometimes within as little time as 72-96 hours. If downwind equipment fails and replacements are not available within two business days, equipment from the upwind monitoring locations (i.e., AQ Site 1 or AQ Site 4) can be moved to downwind locations (i.e., AQ Site 2 or AQ Site 3). Electrical and mechanical failures and their associated corrective actions will be documented and regularly reviewed to improve overall program performance and data capture rates.

The list of maintenance activities for the Met One E-FRM and E-Samplers are provided below:

- Regularly inspect and clean the sampler's PM_{10} cyclone head and inlet screen to ensure they are free of debris that may cause faulty readings.
- Inspect and clean the instrument down-tube, optics (E-Sampler), and internal components according to the manufacturer's instructions.
- Regularly check and replace the internal pump and sheath air filters (E-Sampler) as required.
- Calibrate the instrument regularly to ensure accurate readings.
- Check the flow rate and adjust if necessary.
- Keep the instrument's firmware up to date.
- Perform routine functional checks to help ensure the instrument is functioning properly.
- Follow the manufacturer's instructions for additional maintenance or troubleshooting.

The operations team will always trust that an E-Sampler real-time reading is correct unless there is significant evidence to suggest that the sampler is malfunctioning due to cell contamination or other obvious failures.

10.2 Meteorological Monitoring Quality Assurance

Meteorological monitoring is an essential component of the PAMP. To ensure the accuracy and reliability of the meteorological data, the following quality assurance measures will be implemented:

- **Calibration:** The meteorological sensors will be calibrated annually using standard methods and NIST traceable equipment. The calibration will be documented and recorded.

- **Maintenance:** The meteorological monitoring equipment will be maintained according to the manufacturer's recommendations to ensure optimal performance.

- **Data validation:** The meteorological data will be validated using established criteria for completeness and accuracy. The data validation activities will be documented and recorded.

- **Data reporting:** The meteorological data will be reported in a clear and concise format, including tables, graphs, and narratives that summarize the results and findings. The data reporting will be documented and recorded.

Table 8. Summary of Instrument Calibrations

Pollutant / Measurement	Parameter Calibrated	Calibration Frequency	Calibration Range	Acceptance Criteria
Particulate Matter (PM_{10})	Flow Rate	Monthly	15.0 – 18.4 Lpm	±4% of transfer standard ±5% of design flow rate
	Temperature		-25 °C – 25 °C	<2 °C Mean Error
	Barometric Pressure		Ambient Pressure	± 10 mmHg
Polycyclic Aromatic Hydrocarbons (PAH)	Flow Rate		0 – 10 Lpm	±4% of transfer standard
Wind Speed	Anemometer speed accuracy	Annually	0 to 50 m/s	≤ 5%
Wind Direction	Anemometer alignment accuracy		0 – 360° (3 – 5 points)	≤ 5°
	Linearity		0 – 360°	≤ 3°
Ambient Temperature	Probe accuracy		-35 °C – 25 °C	≤0.5°C (accuracy)
Solar Radiation	Sensor Accuracy		Ambient Light Intensity	±10 W/m^2 (< 200 W/m^2) ±5% mean (≥200 W/m^2)
Precipitation	Sensor Accuracy		Volume equivalent to a minimum of 10 cycles	≤ ± 10% of measured H2O input, or ≤ ± 5mm H2O
Barometric Pressure	Sensor Accuracy		Ambient Pressure	≤3 mb (0.3kPa)
Relative Humidity	Sensor Accuracy		Ambient Humidity	RH ≤7%; Dew Point ≤1.5°C
Precipitation	Sensor Accuracy		Volume equivalent to a minimum of 10 cycles	≤ ± 10%

11. Program Reference and Guidance Documents

The following sources have informed this plan for monitoring the air quality around the perimeter of the Three Kids Mine:

1. Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological profile for Manganese. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.
2. Agency for Toxic Substances and Disease Registry. (2024). Screening Levels Used by ATSDR.
3. Broadbent & Associates, Inc. (October 5, 2022). Corrective Action Plan – Soil and Mine Wastes, Revision 1, Three Kids Mine, Prepared for Lakemoor Ventures LLC.
4. Code of Federal Regulations. (Nov. 12, 2008). 40 CFR Part 50 - Appendix Q to Part 50 - Reference Method for Measuring Lead in Particulate Matter as PM10 Collected from Ambient Air.
5. Code of Federal Regulations. (Oct. 17, 2006). 40 CFR Part 50 Appendix L - Reference Method for the Determination of Fine Particulate Matter as PM2.5 in the Atmosphere.
6. Code of Federal Regulations. (July 18, 1997). 40 CFR Part 58 Appendix E - Criteria for Siting Probes and Monitoring Paths for Ambient Air Quality Monitoring.
7. Environmental Protection Agency. (February 7, 2024). National Ambient Air Quality Standards (NAAQS) for Particulate Matter (PM10).
8. Environmental Protection Agency. (11/01/1995). Integrated Risk Information System (IRIS), Chemical Assessment Summary, Manganese.
9. Environmental Protection Agency. (June 1999). Compendium Method IO-3.3 - Measurement of Metals in Ambient Particulate Matter using X-Ray Fluorescence (XRF) Spectroscopy.
10. Environmental Protection Agency. (January 1999). Compendium Method TO-13A - Measurement of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS).
11. Environmental Protection Agency. (February 2000). Meteorological Monitoring Guidance for Regulatory Modeling Applications.
12. Environmental Protection Agency. (January 2017). Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II - Ambient Air Quality Monitoring Program.
13. Nevada State Environmental Commission. (July 2022). Standards of quality for ambient air (NAC 445B.22097). Retrieved from NAC 445B.22097.
14. Roels, H.A., Ghyselen, P., Buchet, J.P., Ceulemans, E., & Lauwerys, R.R. (1992). Assessment of the permissible exposure level to manganese in workers exposed to manganese dioxide dust. British Journal of Industrial Medicine, 49, 25-34.
15. Western Regional Climate Center. (Accessed July 2023). Recent Climate in the West. https://wrcc.dri.edu.

Appendix A

Asbestos Abatement Perimeter Monitoring Plan

ASBESTOS ABATEMENT PERIMETER MONITORING PLAN
THREE KIDS MINE
HENDERSON, NEVADA
(Prepared by Broadbent & Associates, Inc.)

Details are provided to follow as they relate to the asbestos abatement perimeter monitoring plan at the Three Kids Mine (Site).

Project Personnel and OSHA Classes of Work

Abatement of Regulated Asbestos Containing Material (RACM) at the Site will be performed by an asbestos abatement contractor licensed in the State of Nevada. The abatement activities will be performed in accordance with applicable Occupational Safety and Health Administration (OSHA) regulations by properly trained workers that have been licensed in Nevada through the Asbestos Control Program. Applicable OSHA regulations can be found in 29 Code of Federal Regulations (CFR) 1926.1101 and Nevada Administrative Code (NAC) 618.850 through 618.986. The following OSHA Classes of Work apply to the abatement of RACM at the Site.

1) Class I Asbestos Work – Defined as activities involving the removal of thermal system insulation (TSI) and surfacing ACM. This definition applies to the surfacing ACM remaining in place on structures located within the boundaries of the Flotation Cell Area.

2) Class II Asbestos Work – Defined as activities involving the removal of ACM which is not thermal insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing, siding shingles, and construction mastics. This definition applies to the abatement of penetration mastic, expansion joint, and gaskets located within the boundaries of the Flotation Cell Area.

3) Class IV Asbestos Work – Defined as maintenance and custodial activities during which employees contact but do not disturb ACM and activities to clean up dust, waste, and debris resulting from Class I and II activities. This definition applies to the abatement of sporadic debris on the surface of the ground as well as in the various debris piles located throughout the Site.

During the abatement of RACM, the asbestos abatement contractor will provide a licensed Asbestos Competent Person (ACP). An ACP is defined as a person who is capable of identifying existing asbestos hazards, selecting the appropriate control strategy for asbestos exposure, and who has the authority to take prompt corrective measures to eliminate the hazards. In addition to the ACP provided by the licensed asbestos abatement contractor, an Asbestos Abatement Consultant (AAC) licensed through the Asbestos Control Program will provide oversight during the performance of the abatement activities. At a minimum, the AAC will be accredited as an Inspector and a Project Monitor. The AAC will assist in evaluating and mitigating hazards resulting from the work at the Site, guide abatement activities at the Site, perform air sampling, perform post abatement inspections, and collect additional material samples in the event additional suspect ACM is identified.

Site Control for Asbestos Abatement

Within the boundaries of the secured Site as described above, support areas, contaminant reduction areas, and asbestos regulated areas will be constructed. These Site control areas will be established first and not dismantled until the location passes a visual inspection for remnant RACM as performed

by an AAC in accordance with NAC 618.956(2)(a). As the RACM is present in multiple locations at the Site, multiple support areas, contamination reductions areas, and asbestos regulated areas will be constructed. These Site control areas will be constructed at the discretion of the ACP and in coordination with the AAC.

Regulated areas will be established for Class I and Class II work. In addition, with the exception of small-scale work (i.e., picking up sporadic RACM debris), Class IV work will be performed within regulated areas. Class IV work that will be performed within a regulated area includes abatement and segregation of isolated waste piles throughout the Site. Loading and securement of RACM into containers for disposal will be performed within a regulated area.

Perimeter Air Monitoring

Although wet methods and dust control measures will be implemented during the abatement of the RACM during the project, asbestos has the potential to become airborne and migrate beyond the boundaries of a regulated area. As a result, a perimeter threshold for airborne asbestos will be established for the project and perimeter air sampling will be performed to evaluate asbestos concentrations to the established threshold. For the purposes of the project, a perimeter threshold of 0.01 fibers per cubic centimeter (f/cc) will be utilized. The threshold is based on the final clearance concentration standard for re-occupancy of a building subsequent to the completion of asbestos abatement activities as set for in NAC 618.956. The perimeter air monitoring will be performed by the AAC.

Upon initiating asbestos abatement activities at the Site, construction perimeter air monitoring will be initiated. Operation of the air monitoring stations will commence daily and will coincide with the start and stop of the asbestos abatement activities. The construction perimeter air monitoring performed will include operating four monitoring stations around each regulated area (one on each side of the regulated area). The use of four air monitoring stations in this manner will allow representative data to be collected in the event wind directions shift during the workday. Monitors will not be moved to reflect changes in wind directions that may occur during daily operations. However, significant changes in wind direction or speed will be recorded during the collection of the construction air monitoring samples. Wind direction will be determined at the Site using a handheld anemometer (BTMETER Model #BT-100-APP). The monitors will be placed within five feet of the regulated area and at locations that attempt to accurately evaluate airborne asbestos concentrations potentially generated by abatement activities at the Site. Figure 1 depicts the locations of the perimeter air monitoring stations set up in response to a regulated area established around Illegal Dump #5. Perimeter air monitoring stations will be set up as work moves to other areas of the Site, and new regulated areas are established.

In addition to the air monitoring stations setup in the immediate vicinity of the regulated area, four additional air monitoring stations will be set up near the perimeter of the Site. These air monitoring stations will be co-located with the other perimeter air monitoring locations described in this Perimeter Air Monitoring Plan (PAMP). The air monitoring stations will be operated to further evaluate potential airborne asbestos concentrations at sensitive receptors (i.e., commercial businesses and housing) located outside the Site boundaries. Figure 1 depicts the perimeter monitoring locations.

It should be noted that the air monitoring stations located on the perimeter of the Site, as depicted in Figure C-2 of the Corrective Action Plan (CAP), were modified to be co-located with the perimeter air monitoring locations described in this PAMP for three reasons. First, co-locating with sensors measuring PM10 can provide context to the PCM results. Next, these locations will be secured with

fencing to avoid theft or vandalism, which could result in interruptions in monitoring data. Finally, the locations will be outside of the grading area to the extent possible, which results in samples that are more representative of the perimeter and safer access to the stations.

The following procedures will be implemented during the collection of the perimeter air samples.

1) Low flow air pumps (Gilian BDX II or similar) will be utilized to collect perimeter air samples. The perimeter air samples will be collected at an anticipated flow rate of 2 to 3 liter per minute (LPM). The flow utilized will vary daily to accommodate changing work hours but allow a minimum total sample volume of 1,200 liters to be collected.

2) Each low flow air pump will be calibrated prior to use with a Swift 6.0 Air Flow Meter or a primary gas flow calibrator (Drycal). As an alternative and in the event of equipment malfunction, a rotometer may be used for low flow air pump calibration. In the event a rotameter is used, it will be calibrated with a primary standard in the last six months. Each low flow air pump will be calibrated at the Site to minimize environmental influences on flow rates. A filter cassette from the same cassette lot used for calibration will be used for sampling. In the event the flow rate changes by more than 5 percent during the sampling period, the average of the pre and post calibration rates will be used to calculate the total sample volume.

3) The air will be drawn through a factory preassembled 0.8-micron mixed cellulose ester filter (MCEF) 25-millimeter (mm) open face cassette equipped with a 50 mm long electrically conductive extension cowl. Filter cassettes will not be reused. One cassette will be used to collect the daily perimeter air sample at each monitoring location.

4) Prior to connecting each sample cassette to the air pump, the air sample will be assigned a unique identification name.

5) The sample cassette will be connected to the air pump using 0.25-inch flexible tubing. Each cassette will be secured and positioned open face downward, perpendicular to the wind, and approximately 5 feet above ground surface.

6) Upon completion of the air sampling, the cassettes will be closed and sealed with the factory provided base and plastic plugs.

7) The flow rate of the low flow air pump will be verified at the completion of the daily sampling activities. In the event that the flow rate changed by more than 5 percent during the sampling period, the average of the pre and post calibration rates will be used to calculate the total sample volume.

8) It is unlikely that factory-provided sample cassettes would be contaminated prior to receipt. However, as part of the quality assurance (QA) procedures, upon receiving and initially opening a shipment of cassettes, one sample cassette will be collected for each lot identification number and submitted without opening for laboratory analysis. In accordance with National Institute for Occupational Safety and Health (NIOSH) Test Method 7400, if a lot blank sample has a fiber count in excess of five fibers observed in 100 graticule fields, the remaining cassettes associated with the lot will be returned to the manufacturer for replacement.

9) To evaluate if contamination occurred during sample handling, two field blank samples will be collected daily prior to the start of operations. The field blank samples will be collected by opening an unused filter cassette for approximately 30 seconds at the sampling location with no air being drawn through it. Upon closing the cassette, the field blank sample will be handled and transported with the remaining samples collected during the workday. In accordance with Appendix A Item 11 of OSHA 1910.1101, sample sets represented by a field blank having a fiber count in excess of seven fibers observed in 100 graticule fields are to be rejected.

10) The perimeter air samples will be delivered under chain-of-custody procedures to an accredited laboratory in the National Voluntary Laboratory Accreditation Program for the sample analysis outlined to follow. The samples will be analyzed by Phase Contrast Microscopy (PCM) per National Institute for Occupational Safety and Health (NIOSH) Test Method 7400. If PCM data suggests the perimeter air threshold has been exceeded, the asbestos content of the sample(s) will be confirmed using Transmission Electron Microscopy (TEM) in accordance with NIOSH Test Method 7402. This confirmation will be done since other fibrous substances, if present, may interfere with PCM analysis and result in an inaccurate evaluation of actual asbestos fibers. Samples will be submitted with a turn-around time that will not exceed 24 hours (weekends excluded).

Construction activities will be planned, managed, scheduled, and executed in a manner that attempts to ensure the perimeter monitoring threshold is not exceeded. Although not anticipated, in the event the perimeter monitoring threshold is exceeded, engineering, work practice, and administrative controls will be adjusted to further minimize the offsite migration of asbestos. These adjustments will be made by the ACP and AAC. Adjustments to these controls will be documented.

Appendix B

Memorandum – Air Monitoring Locations

MEMORANDUM

To: Alan Pineda, Bureau of Industrial Site Cleanup, Nevada Division of Environmental Protection

From: Karen Gastineau, Broadbent & Associates, Inc.

Subject: Air Monitoring Locations, Three Kids Mine, Henderson, Nevada

Date: April 12, 2024

The proposed locations described below and in the attached PDF and KMZ were modified slightly from the *Perimeter Air Monitoring Plan* (PAMP) dated January 23, 2024 to account for contractor grading plans. Placing the air monitoring stations outside of the grading zones will result in samples more representative of the perimeter, allow for safer access to the stations, and avoid the need to move the stations to accommodate grading work. The description for each site includes the distance and direction to which the modified location was moved relative to the original location, the text from the PAMP identifying the purpose of the location, an explanation for how the modified location meets the same intent, information on access, and a summary of how the location fits in with the contractor grading plans.

AQ Site 1 / Meteorological Station

Moved approximately 1,000 ft south-southwest from location in 1/23/2024 PAMP.

Text from PAMP: "Western part of the site. Directly upwind of the residential community close to Lake Mead Parkway. This site is situated in an area that will not be affected by the remediation and reclamation work, which will enable the monitors to be collocated with the meteorological monitoring station. This location is near the residential area along Lake Mead Parkway, which is one of the nearby receptors of possible dust impacts."

Meets original intent of location: The modified location is on the western part of the site and is upwind of the former mine site. The moved location is slightly farther away from potential receptors (residences on the north side of Lake Las Vegas Parkway), but AQ Site 2 has been moved closer to those residences.

Access: The staked location can be easily accessed with a vehicle and is sufficiently far away from the power line. The location is owned by Southern Nevada Water Authority (SNWA), and Lakemoor is working with them on formal approval.

Relative to Grading Area: The modified location is on SNWA property and therefore not within Pulte's grading area. It is critical that the meteorological station is outside of the grading area as it cannot easily be moved.

AQ Site 2

Moved approximately 1,000 ft to the southwest from location in 1/23/2024 PAMP.

Text from PAMP: "Midpoint of northern perimeter boundary. Near residential and commercial areas along Lake Mead Parkway. This site is located downwind of the waste rock piles and tailings ponds which could be potential sources of dust emissions during the remediation and reclamation work."

Meets original intent of location: The modified location is located downwind of tailings and waste rock, which is the primary purpose of AQ Site 2. It remains close to residential areas, but it is father away from potential commercial receptors (workers at Lake Mead Boat Storage). However, this location is less likely to be impacted by dust from off-site sources, such as Lake Mead Boat Storage.

Access: The modified location can be accessed via the bike path. Because of the berms along the path, other locations off the bike path are not accessible, including and notably, the original location.

Relative to Grading Area: The modified location is within the grading area, but there is not a point outside of the grading area that is also downwind of the tailings based on predominant wind direction. This location will likely need to be moved slightly to the south during the power line work scheduled for January 2025, then returned to its original location after that work is complete.

AQ Site 3

Moved approximately 750 feet to the northeast from location in 1/23/2024 PAMP.

Text from PAMP: "Northeast corner of site. Acts as the downwind site during typical higher wind events and can also act as the upwind site to assist in evaluation of upwind sources during alternate meteorological conditions."

Meets original intent of location: The modified location remains in the northeast corner of the site and can act as a downwind site during wind events from the southwest.

Access: Modified location can be accessed via Lake Mead Parkway.

Relative to Grading Area: Modified location is within grading area, but it is Development Area 7 so may not be graded until after environmental work is complete.

AQ Site 4

Moved approximately 500 ft south-southwest from location in 1/23/2024 PAMP, at which time the location of the construction water pond was unknown.

Text from PAMP: "Southern boundary of site. This location is upwind of the site during typical high wind events and serves as a background reference of the dust concentrations during typical high wind events. This location may potentially be relocated further to the west during the project if earthwork is planned in the immediate vicinity and if road improvements are made in the southwest portion of the site."

Meets original intent of location: Moving the modified location approximately 500 ft to the south-southwest allows it to meet the original intent of this location, which is to be upwind of site activities and serve as a background reference. This is consistent with text from the PAMP, which indicates that the location might be moved somewhat outside the grading area.

Access: Modified location is along the existing dirt road which is passable with four-wheel drive.

Relative to Grading Area: The modified location is just outside of the grading area.


Air Monitoring Locations
4/9/2024 Site Visit
Legend
AQ Site
Future pond
AQ Site 3
Lake Las Vegas Pkwy
564
AQ Site 2
E Lake Mead Pkwy
AQ Site 1/met station
AQ Site 4
Google Earth
Image Landsat / Copernicus
N
3000 ft

Appendix C

Equipment Specification Sheets

Met One Instruments, Inc.

E-FRM-DC Sampler

The New and Improved Met One Instruments E-FRM-DC sampler is a single-event filter sampler for the determination of daily $PM_{2.5}$ or PM_{10} particulate concentrations in ambient air.

The E-FRM-DC has an innovative design and unique features provide a versatile, reliable, and simple platform for your ambient air sampling needs. This versatile instrument is used for fixed or portable ambient particulate sampling applications. The E-FRM-DC sampler is also designed for easy setup and deployment. This allows it to be used for either permanent long-term sampling at a fixed site or as an audit sampler for frequent relocation.

The E-FRM-DC can be configured for $PM_{2.5}$ and PM_{10} as well as TSP and PM_1 with optional accessories. Featuring modern components paired with innovative design and state of the art manufacturing practices, the E-FRM-DC is the premier single event sampler in the industry of particulate collection. The E-FRM-DC is ideal for Environmental Monitoring, Perimeter Sampling, and Industrial Monitoring. E-FRM-DC user interface is a full-color 4.3" graphical touchscreen which utilizes intuitive control. The touchscreen was developed specifically to satisfy the recommendations of instrumentation operators. Data can be retrieved through any MODBUS compatible data acquisition system or can be easily downloaded and transported with your filter on a USB drive.

Applications:

- Criteria PM Sampling
- Audit Sampling
- Remote Sampling Applications
- Health Studies
- Perimeter Sampling
- Regulatory Enforcement

Measurement Principle:	Programmable-event filter sampler for determination of particulate matter concentrations
Resulting Data Units:	Micrograms per actual or standard cubic meter µg/m^3. Calculated from lab filter weights and actual or standard sampled volumes.
Design Specifications:	Title 40 CFR, Part 50 Appendix L
U.S. EPA Designations:	RFPS-0315-221, RFPS-0216-231, RFPS-0316-232
Main Inlet Type:	EPA-pattern PM_{10} size-selective louvered inlet standard (MOI part no. BX-802)
$PM_{2.5}$ Separator Type:	Options: BX-808 Very Sharp Cut Cyclone or BX-804 WINS Impactor
PM_{10} Sampling Config:	Pass-through tube (used in place of cyclone) included for PM_{10} sampling.
Other Configurations:	Compatible with $PM_{2.5}$ or PM_1 SCC cyclones. TSP inlet available.
Filter Type:	47mm PTFE disc filters standard. Other filter material types available.
Filter Holder:	Accommodates standard EPA-pattern white Delrin filter cassettes.
Filter Temp Control:	Filter Temp within 5°C of ambient during sampling and standby. Logged in data.
Operating Temperature:	-30 to +50°C Ambient
Operating Pressure:	400 to 800 mmHg, Ambient
Sample Events:	24 hour samples standard. Programmable start date/time and duration.
Flow Rate:	16.67 L/min (1 m^3/hr.). With flow sensor and real-time actual flow control.
Flow Accuracy:	±2% (±.33 L/min)
Flow Records:	Flow rate, temperature, pressure logged in 5 minute intervals.
Vacuum Pump:	Single-head diaphragm 12 VDC pump
Data Collection:	RS-232 port (9-pin). USB data port. USB flash drive port. Software supplied.
Memory Capacity:	24 sample events
Compatible Software:	FSCommAQ
User Interface:	4.3" graphical touch screen
Enclosure Type:	Active fan ventilation
Deployed Dimensions:	2.0 meters (78.75") high, 65.5 cm (25.75") wide, 64.1 cm (25.25") deep
Footprint Dimensions	65.5 cm (25.75") wide, 64.1 cm (25.25") deep
Weight:	Sampler 33 lb (except PM_{10} inlet head); Stand 10.5 lb
Power:	100 to 240VAC, 33W nominal (2.75A)

Features

- Designed and tested to meet all current EPA $PM_{2.5}$ Federal Reference Method specifications.
- Accommodates one EPA $PM_{2.5}$ reference method 47mm sample filter cassette.
- Compatible with the VSCCTM cyclone or the classic WINS Impactor for $PM_{2.5}$ sampling.
- Manufactured and supported in the United States at out ISO-9001 certified facilities.

Accessories

BX-802 EPA PM_{10} Inlet
BX-808 $PM_{2.5}$ VSCC™ Cyclone (standard unless specified)
BX-804 $PM_{2.5}$ WINS Impactor (optional)
BX-811 PM_1 Cyclone (optional)
BX-803 TSP Inlet (optional)
BX-307 Flow Calibrator (optional)
BX-305 Leak Test Valve
81210 PM_{10} Adapter
460128 FRM Filter Cassette (1 included with sampler)
460122 FRM 47mm PTFE Filters
80866-1 Ambient Temperature Sensor
Aluminum Stand (Optional)
CCS Modem (Optional)

Met One Instruments, Inc.

1600 Washington Blvd. Grants Pass, Oregon 97526 **Phone:** 541.471.7111
Sales: sales@metone.com | **Service:** service@metone.com | **Website:** www.metone.com

August 2019

Met One Instruments, Inc.

E-Sampler Dual Ambient Monitor/Sampler

The E-SAMPLER is the most feature-packed light-scatter Aerosol Monitor available. Whatever your monitoring needs, the E-sampler will provide accurate, dependable and relevant data.

The E-SAMPLER is a dual technology instrument that combines the unequaled realtime measurement of light scatter with the accuracy standard of filter methods. The simple filter loading process testifies to the seamless blending of both technologies. Filters can be extracted and replaced in less than one minute. Filter medium can be selected based on laboratory analysis requirements.

Particulate loading on the filter does not reduce performance due to the Met One actual flow control protocol. Ambient temperature and pressure are measured and actual flow is calculated and controlled by the E-SAMPLER microprocessor, independent of filter loading change.

The E-SAMPLER provides real-time particulate measurement through near-forward light scattering. An internal rotary vane pump draws air at 2 LPM into the sensing chamber where it passes through visible laser light. Aerosols in the air scatter light in proportion to the particulate load in the air. Scattered light is collected by precise glass optics and focused on a PIN diode.

Rugged state of the art electronics measure the intensity of the focused light and output a signal to the CPU. The output is linear to concentrations greater than 65,000 ug/m^3. Every E-SAMPLER is factory calibrated using polystyrene latex spheres of known index of refraction and diameter at multiple points to validate linearity.

Features:

- Programmable Auto-Zero
- Programmable Auto-Span
- Auto-ranging (1 to 65000 µm/m^3)
- Automatic Flow Control
- Protocol
- Internal Battery (30 Hours Operation without heater & 10 Hours with heater.)
- Laser-Diode Precise Optical Engine
- Integral 47mm Analysis Filter
- Ambient Pressure and Temperature
- Internal Data-logger
- PM_{10}, $PM_{2.5}$, PM_1, TSP Monitoring
- Aluminum Weatherproof Enclosure
- Purge-Air protected Optics
- Completely Self-Contained
- No Tools Filter Replacement

Applications:

- Ambient Air Monitoring
- Remediation Site Perimeter Monitoring
- Indoor Air Quality Monitoring
- Source Monitoring
- Visibility Monitoring
- Mobile Monitoring

Measurement Principles:	Light Scatter and 47mm low flow gravimetric filter sampler.
Available Cut Points:	TSP Inlet Standard. PM_{10}, $PM_{2.5}$, and PM_1 sharp-cut cyclone inlets available.
Measurement Range:	0 to 65 mg/m^3 (0 to 65,530 µg/m^3) dynamic range. 16 bit digital range.
Nephelometer Accuracy:	± 10% to gravimetric method typical when K-factored to local particulate type.
Gravimetric Accuracy:	± 8% of NIOSH 0600.
Precision:	Greater of 3 µg/m^3 or 2%.
Data Storage Resolution:	1 µg/m^3
Data Storage Intervals:	User-Selectable 1, 5, 10, 15, 30, or 60 minute averages.
Nephelometer Interval:	1-second measurements, available on analog output and display.
Sample Cycles:	Continuous operation or programmable scheduled sample runs.
Particle Size Sensitivity:	0.1 to 100 micron. Optimal sensitivity 0.5 to 10 micron particles.
Laser Type:	Diode Laser, 5 mW, 670nm. Visible red.
Long Term Stability:	5% with clean optics.
Flow Rate:	2.0 liters/minute ± 0.1 lpm. Actual volumetric flow.
Pump Type:	10,000 hour brushless diaphragm sample pump and secondary purge pump.
Gravimetric Filter Type:	47mm disc filters (not included). Accepts standard FRM filter holder cartridges.
Automatic Zero and Span:	User-selectable 15 min, 1 hour, 2 hour, 12 hour, or 24 hour intervals. 2.8 min cycle.
Internal Battery:	12V, 12 Amp-Hour. Yuasa NP12-12 or equivalent, Optional lead acid battery.
Internal Battery Run Time:	Up to 30 hours with inlet heater off. Up to 10 hours with inlet heater on.
Power Supply:	Universal 100-240 VAC input, 15 VDC output power supply included. Compatible with solar power kits or external batteries using optional DC power cable.
Power Consumption:	1.1 amps @ 12 VDC (15 Watts) max continuous draw, running with inlet heater on. 0.35 amps (4.2 Watts) running with inlet heater off.
Operating Temperature:	0 to +50°C . (Ambient Temperature Sensor Range -30 to +50°C).
Barometric Pressure:	60,000 to 104,000 Pascal pressure sensor range.
Ambient Humidity Range:	0 to 90% RH, non-condensing.
Humidity Control:	Automatic 10 Watt inlet heater module controlled to sample RH setpoint. Sample RH sensor standard. Optional EX-593 ambient RH sensor available.
Approvals:	CE, ISO-9001. Designed to agree with EPA Class I and Class III FRM/FEM particulate samplers and monitors. Not an EPA-designated equivalent method.
User Interface:	Menu-driven interface with 4x20 character LCD display and dynamic keypad.
Analog Voltage Output:	0-1, 0-2.5, or 0-5 volt DC output. User-set range with 1-second real-time output.
Serial Interface:	RS-232 duplex serial port for PC, datalogger, or modem communications.
Alarm Contact Closure:	Normally closed contact closure relay output. Contact rating 0.5A @ 100V DC max.
Compatible Software:	Comet™ (included), Air Plus™, terminal programs such as HyperTerminal®
Alarm Reporting:	Available through serial port data files, display, and relay output.
Memory:	4369 data logger records (182 days @ 1 record/hr, 3 days @ 1 record/min).
Factory Service Interval:	24 Months typical, under continuous use in normal ambient air.
Mounting Options:	Pole or wall mount bracket standard. Optional EX-905 tripod recommended.
Unit Weight:	6.4 kg (14 lbs) without tripod, battery, or optional accessories.
Unit Dimensions:	65cm high, 27cm wide, 16.5cm deep. (25.5" x 10.5" x 6.5"). With inlet assembly

Specifications are subject to change at any time.

Met One Instruments, Inc.

1600 Washington Blvd. Grants Pass, Oregon 97526 **Phone:** 541.471.7111

Sales: sales@metone.com | **Service:** service@metone.com | **Website:** www.metone.com

August 2019

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AirChek 20 Area Sample Pump

Part Number: 920-2000

AirChek 20 Area Sample Pump Overview

AirChek 20 Area Sample Pump only, includes exhaust port and screwdriver, requires battery and charger available separately
Flow range: 4 to 20 L/min
Purchase Lead-acid Battery Cat. No. P920201 and Battery Charger Cat. No. 920-210 or Line Operation Adapter Cat. No. 920-211 separately

Specifications

Performance Profile

Flow Range	Constant flow from 4 to 20 L/min
Compensation Range *(back pressure capability)*	4 L/min at 225 inches water back pressure 8 L/min at 170 inches water back pressure 10 L/min at 145 inches water back pressure 12 L/min at 120 inches water back pressure 16 L/min at 70 inches water back pressure 20 L/min at 25 inches water back pressure
Flow Control System	Patented flow control system holds constant flow to ± 5% of set-point
Power	Lead-acid 12 V, 7-Ah capacity Economical, disposable AA alkaline batteries are ready to go anytime for over 10 hours
Accuracy	**Flow control:** holds constant flow to ± 5% of set-point
Temperature Ranges	**Operating:** 23 to 122 F (-5 to 50 C)
Display/parameters	Backlit LCD
Dimensions	4.4 x 6.4 x 8 in (11.2 x 16.3 x 20.3 cm)
Weight	4.5 lbs (2.06 kg)
Certifications	• CE, UKCA, EMC compliant with IEC 61000-6-1 and 61000-6-3 • ***Not*** intrinsically safe

Product Document

AirChek 20 Operating Instructions (PDF)

AirChek 20 Quick Guide (PDF)

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

CR350

Measurement and Control Datalogger

Compact Data Logger with RS-485

Ideal for small applications

Overview

The CR350 is a multi-purpose, extremely low power, compact measurement and control data logger. This entry-level data logger, with its rich instruction set, can measure most hydrological, meteorological, environmental, and industrial sensors. The CR350 concentrates data, makes it available over varied networks, and delivers it using your preferred protocol. The CR350 also performs automated on-site or remote decision-making for control and M2M communications. This data logger is ideal for small applications requiring long-term, remote monitoring and control.

The following outlines the primary differences between the CR300, CR310, and CR350 dataloggers:

- The CR310 and CR350 offer removable connectors.
- The CR310 includes a 10/100 Ethernet connection.
- The CR350 has two independent RS-232/RS-485 ports and USB-C.

The CR350 includes Wi-Fi, cellular, or the following radio options for different regions:

- CR350-RF407: US and Canada
- CR350-RF412: Australia and New Zealand
- CR350-RF422: Europe
- CR350-RF427: Brazil

Note: Campbell Scientific does not recommend the CR350 for use as a PakBus router in networks with more than 50 devices. Large arrays or string variables may also reach memory limits. For such applications, a CR1000X Measurement and Control Datalogger is recommended.

Benefits and Features

- Two dedicated SDI-12 terminals to expand SDI-12 sensor use
- Extremely low current requirements
- Two dedicated RS-232/RS-485 terminals to support smart sensors or modems
- Easy setup with PC software and USB-C connectivity
- Ability to measure analog and digital sensors with confidence
- Trusted Campbell Scientific quality, including integral surge and ESD protection
- Integrated radio option to network wirelessly to another node or Internet gateway
- CR350-WIFI ideal for short-range, wireless IP communication
- Removable terminal block for easy wiring
- Ability to communicate anywhere using built-in cellular or satellite peripherals
- Integrated 12 V battery solar charge regulator to charge batteries

- Flexibility to connect with PakBus, Modbus, DNP3, GOES, and other standard communication protocols
- Multiple general-purpose I/O and programmability to analyze and control measurement acquisition
- Event-driven communications and physical outputs for notifications

Detailed Description

The CR350 is a low-powered data logger designed to measure sensors, analyze data, and store data and programs. A battery-backed clock assures accurate timekeeping. The on-board, BASIC-like programming language—common to all Campbell Scientific data loggers—supports data processing and analysis routines.

Terminal Descriptions

- Two switched 12 V terminals (SW12V) for powering sensors or communication devices, 2100 mA
- Two sensor excitation or continuous 0.15 to 5 V terminals (VX1, VX2) for sensor excitation or output control
- Four multipurpose analog input terminals (SE1–SE4)
  - Analog functions (SE1–SE4)
    - Analog inputs: 4 single-ended or 2 differential inputs with -100 to +2500 mV and ±34 mV ranges 24 bit ADC
    - 4 to 20 mA or 0 to 20 mA inputs (SE1, SE2 only)
  - Digital I/O functions (SE1–SE4) consist of 3.3 V logic levels for:
    - High frequency counter (35 kHz)
    - Pulse width modulation
    - Interrupts and timer input
    - Period average (200 kHz, amplitude dependent)
- Two Pulse Counting Terminals (P_SW, P_LL)
  - P_SW
    - Switch closure (150 Hz)
    - High frequency counter (35 kHz)
  - P_LL
    - Low level ac (20 kHz)
    - High frequency counter (20 kHz)
- Two Control Terminals (C1, C2): C terminals are software configurable for digital functions
  - Digital I/O functions consist of 5 V output and 3.3 V input logic levels for:
    - SDI-12
    - High frequency counter (3 kHz)
    - Switch closure (150 Hz)
    - General status/control voltage source 5 V; 10 mA @ 3.5 V
    - Interrupts
    - Serial asynchronous communication Tx/Rx pair

Specifications

Operating Temperature Range	*Non-condensing environment* -40° to +70°C
Maximum Scan Rate	10 Hz
Case Material	High-impact-resistant polycarbonate, recycle code 7
Analog Inputs	4 single-ended or 2 differential (individually configured)
Pulse Counters	8 (P_SW, P_LL, C1, C2, and SE1 to SE4)
Voltage Excitation Terminals	2 (VX1, VX2)
Communications Ports	USB Type C 2.0 RS-232 RS-485
Switched 12 Volt	2 terminals
Digital I/O	7 terminals (C1, C2, P_SW, and SE1 to SE4) configurable for digital input and output. Includes status high/low, pulse width modulation, external interrupt, and communication functions. Exception: C2 and P_SW don't do pulse-width modulation.
Analog Input Limits	-100 to +2500 mV
Analog Voltage Accuracy	Accuracy specifications do not include sensor or measurement noise. ±(0.04% of measurement + offset) at 0° to 40°C ±(0.1% of measurement + offset) at -40° to +70°C
ADC	24-bit

For comprehensive details, visit: www.campbellsci.com/cr350

Power Requirements	16 to 32 Vdc for charger input (CHG) (Current limited to 1.1 A maximum for power converter or solar panel input.)
Real-Time Clock Accuracy	±3 min. per year
Internet Protocols	Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP(APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, NTP, Telnet, HTTP(S), FTP(S), SMTP/TLS, POP3/TLS, MQTT(S)
Communication Protocols	PakBus, PakBus Encryption, Modbus RTU/ASCII/TCP, DNP3, SDI-12, and others
CPU Drive/Programs	50 MB serial flash
Data Storage	50 MB serial flash
Idle Current Drain, Average	0.5 mA (@ 12 Vdc)
Active Current Drain, Average	❱ < 1.5 mA (@ 12 Vdc for 1 Hz scan with 1 analog measurement) ❱ 8 mA (@ 12 Vdc with processor always on)
Dimensions	16.3 x 8.4 x 5.6 cm (6.4 x 3.3 x 2.2 in.) Additional clearance required for cables and leads.
Weight	288 to 306 g (0.64 to 0.68 lb) depending on communication option selected

CR350-RF407 Option

Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 928 MHz (US, Canada)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required; see www.campbellsci.com/order/rf407 for Campbell Scientific antennas.)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)

CR350-RF412 Option

Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	915 to 928 MHz (Australia, New Zealand)
RF Data Rate	200 kbps
Receive Sensitivity	-101 dBm
Antenna Connector	RPSMA (External antenna required; see www.campbellsci.com/order/rf412 for Campbell Scientific antennas.)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)

CR350-RF422 Option

Radio Type	868 MHz SRD 860 with Listen Before Talk (LBT) and Automatic Frequency Agility (AFA)
Output Power	2 to 25 mW (user-selectable)
Frequency	863 to 870 MHz (European Union)
RF Data Rate	10 kbps
Receive Sensitivity	-106 dBm
Antenna Connector	RPSMA (External antenna required; see www.campbellsci.com/order/rf422 for Campbell Scientific antennas.)
Idle Current Drain, Average	9.5 mA
Active Current Drain, Average	20 mA

CR350-RF427 Option

Radio Type	Frequency Hopping Spread Spectrum (FHSS)
Output Power	5 to 250 mW (user-selectable)
Frequency	902 to 907.5 MHz/915 to 928 MHz (Brazil)
RF Data Rate	200 kbps
Receive Sensitivity	–101 dBm
Antenna Connector	RPSMA (External antenna required.)
Idle Current Drain, Average	12 mA (@ 12 Vdc)
Active Current Drain, Average	< 80 mA (@ 12 Vdc)

CR350-WIFI Option

Operational Modes	Client or Access Point
Operating Frequency	2.4 GHz, 20 MHz bandwidth
Antenna Connector	Reverse Polarity SMA (RPSMA)
Antenna	pn 16005 unity gain (0 dBd), 1/2 wave whip, omnidirectional with articulating knuckle joint for vertical or horizontal orientation

Transmit Power	7 to 18 dBm (5 to 63 mW)

CR350-CELL205 Option

-NOTE-	*The CR350-CELL205 option is not compatible with a Verizon cellular network.*
Certifications	IC (Industry Canada) 10224A-201611EC21A
Cell Technologies	4G (LTE CAT-1) 3G (UMTS/HSPA+)
3G Frequency Bands	850, 1700/2100 (AWS), and 1900
4G Frequency Bands	700, 850, 1700/2100 (AWS-1), 1900
Antenna Connector	SMA (External antenna required; see www.campbellsci.com/order/cr350 for Campbell Scientific antennas.)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V.
Radio Output Power	27 dBm on EDGE 23 dBm on LTE 33 dBm on GSM 24 dBm on UMTS
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR350-CELL210 Option

-NOTE-	*The CR350-CELL210 option is only compatible with a Verizon cellular network.*
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	700, 850, 1700, 1900, 2100
Antenna Connector	SMA (External antenna required; see www.campbellsci.com/order/cr350 for Campbell Scientific antennas.)
Power Consumption - Low Power Mode	5 mA
Power Consumption - Idle	35 mA
Power Consumption - Active	70 mA
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V.
Radio Output Power	23 dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR350-CELL215 Option

-NOTE-	*The CR350-CELL215 option is intended for use in EMEA countries.*
Cell Technologies	3G (UMTS/HSPA+) 4G (LTE CAT-1) 2G (GSM/GPRS/EDGE)
2G Frequency Bands	900 and 1800 MHz
3G Frequency Bands	850, 900, and 2100 MHz
4G Frequency Bands	800, 850, 900, 1800, 2100, and 2600 MHz
Antenna Connector	SMA (External antenna required; see www.campbellsci.com/order/cr350 for Campbell Scientific antennas.)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V.
Radio Output Power	23 dBm on LTE 27 dBm on EDGE 24 dBm on UMTS 33 dBm on GSM
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR350-CELL220 Option

-NOTE-	*The CR350-CELL220 option is intended for use in Australia and New Zealand.*
Cell Technologies	3G (UMTS/HSPA+) 4G (LTE CAT-1)
3G Frequency Bands	850 and 2100 MHz (EC-21AUT) 850, 900, 1900, and 2100 MHz (EC-21AU)
4G Frequency Bands	700, 850, 1800, 2100, and 2600 MHz (EC-21AUT) 700, 900, 1700, 1800, 1900, 2100, and 2600 MHz (EC-21AU)
Antenna Connector	SMA (External antenna required; see www.campbellsci.com/order/cr350 for Campbell Scientific antennas.)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V.
Radio Output Power	24 dBm on UMTS 23 dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

CR350-CELL225 Option

-NOTE-	*The CR350-CELL225 option is intended for use in Japan.*
Cell Technologies	4G (LTE CAT-1)
4G Frequency Bands	800 (lower), 800 (upper), 850+, 900, 1800, and 2100 MHz

Antenna Connector	SMA (External antenna required; see www.campbellsci.com/order/cr350 for Campbell Scientific antennas.)
SIM Interface	3FF (6 position/contacts) Supports SIMs that require 1.8 or 3 V.
Radio Output Power	23 dBm on LTE
Radio Sensitivity Range	-99.5 to 110.5 dBm (10 M)

For comprehensive details, visit: www.campbellsci.com/cr350

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The Wind Monitor-AQ is a high resolution wind sensor designed specifically for air quality applications. It combines simple, corrosion-resistant construction with low threshhold, fast response and excellent fidelity.

The Wind Monitor-AQ meets the requirements of the following regulatory agencies:

U.S. Environmental Protection Agency – Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD).

U.S. Nuclear Regulatory Agency – NRC Regulatory Guide 1.23 Meteorological Programs in Support of Nuclear Power Plants.

American Nuclear Society – Standard for Determining Meteorological Information at Power Plants.

Wind speed is sensed by a lightweight, carbon fiber thermoplastic (CFT), helicoid propeller. Propeller rotation produces an AC sine wave voltage signal with frequency directly proportional to wind speed. Slip rings and brushes are not used.

The wind direction sensor is a lightweight vane with performance characteristics that assure excellent fidelity in fluctuating wind conditions. Vane position is sensed by a precision potentiometer. Output is a DC voltage directly proportional to vane angle.

The instrument body is UV stabilized plastic with stainless steel and anodized aluminum fittings. Precision grade, stainless steel ball bearings are used throughout. Transient protection and cable terminations are located in a convenient junction box. The instrument mounts on standard 1 inch pipe.

The Wind Monitor-AQ is available with two additional output signal options. **Model 05305V** offers calibrated voltage outputs, convenient for use with many dataloggers. **Model 05305L** provides a calibrated 4-20 mA current signal for each channel, useful in high noise areas or for long cables (up to several kilometers). Signal conditioning electronics are integrated into the sensor junction box.

Ordering Information — MODEL

WIND MONITOR-AQ	**05305**
WIND MONITOR-AQ VOLTAGE OUTPUTS	**05305V**
WIND MONITOR-AQ 4-20mA OUTPUTS	**05305L**

Specifications

Range:
Wind speed: 0-50 m/s (112 mph)
Azimuth: 360° mechanical, 355° electrical (5° open)

Accuracy:
Wind speed: ±0.2 m/s (0.4 mph) or 1% of reading
Wind direction: ±3 degrees

Threshold:*
Propeller: 0.4 m/s (.9 mph)
Vane: 0.5 m/s (1.0 mph) at 10° displacement

Dynamic Response:*
Propeller distance constant (63% recovery) 2.1 m (6.9 ft)
Vane delay distance (50% recovery) 1.2 m (3.9 ft)
Damping ratio: 0.45
Damped natural wavelength: 4.9 m (16.1 ft)
Undamped natural wavelength: 4.4 m (14.4 ft)

Signal Output:
Wind speed: magnetically induced AC voltage, 3 pulses per revolution. 1800 rpm (90 Hz) = 9.2 m/s (20.6 mph)
Azimuth: analog DC voltage from conductive plastic potentiometer – resistance 10K Ω, linearity 0.25%, life expectancy – 50 million revolutions

Power Requirement:
Potentiometer excitation: 15 VDC maximum

Dimensions:
Overall height: 38 cm (15.0 in)
Overall length: 65 cm (25.6 in)
Propeller: 20 cm (7.9 in) diameter
Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)

Weight:
Sensor weight: 0.7 kg (1.5 lbs)
Shipping weight: 2.3 kg (5 lbs)

**Nominal values, determined in accordance with ASTM standard procedures. Shielded bearings lubricated with Type LO-1 light General Purpose Instrument Oil.*

MODEL 05305V **Voltage outputs**

Power Requirement:
8-24 VDC (5 mA @ 12 VDC)

Operating Temperature:
-50 to 50° C

Output Signals:
WS: 0-2.5 VDC (0-50 m/s)
WD: 0-5 VDC (0-360°)

MODEL 05305L **4-20 mA outputs**

Power Requirement:
8-30 VDC (40 mA max.)

Operating Temperature:
-50 to 50° C

Output Signals:
4-20 mA full scale

CE *Complies with applicable CE directives.*
Specifications subject to change without notice.

R.M. YOUNG COMPANY
2801 Aero Park Drive
Traverse City, Michigan 49686 USA
TEL: (231) 946-3980 FAX: (231) 946-4772
E-mail: met.sales@youngusa.com
Web Site: www.youngusa.com

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

TE525WS-L

Rain Gage with 8 in. Orifice

Conforms to National Weather Service Recommendation

Overview

The TE525WS, manufactured by Texas Electronics, is a tipping bucket rain gage that conforms to the National Weather Service recommendation for an 8 in. funnel orifice. It measures rainfall in 0.01 in. increments. This tipping bucket is compatible with all Campbell Scientific data loggers, and it is widely used in environmental monitoring applications.

Benefits and Features

- Compatible with most Campbell Scientific data loggers
- Accuracy is ±1 percent at rates up to 1 in./hr
- High precision—tips at 0.01-in. increments
- Directly compatible with the CS705 Snowfall Adapter allowing the TE525WS to measure the measure the water content of snow
- Conforms to the National Weather Service recommendation for an 8-inch funnel orifice
- Compatible with the CWS900-series interfaces, allowing it to be used in a wireless sensor network

Detailed Description

The TE525WS funnels precipitation into a bucket mechanism that tips when filled to its calibrated level. A magnet attached to the tipping mechanism actuates a switch as the bucket tips. The momentary switch closure is counted by the pulse-counting circuitry of our data loggers.

Specifications

Sensor Type	Tipping bucket with magnetic reed switch
Material	Anodized aluminum
Operating Temperature Range	0° to 50°C
Resolution	1 tip
Volume per Tip	8.24 ml/tip (0.28 fl. oz/tip)

Rainfall per Tip	0.254 mm (0.01 in.)
Measurement Uncertainty	1.0% up to 50 mm/h (2 in./h)
Cable Type	2-conductor shielded
Orifice Diameter	20.3 cm (8 in.)

Dimensions	21 x 21 x 26.7 cm) (8.25 x 8.25 x 10.5 in.)
Cable Weight	0.1 kg (0.2 lb) per 3.05 m (10 ft) length
Tipping Bucket Weight	1.0 kg (2.2 lb)

For comprehensive details, visit: www.campbellsci.com/te525ws-l

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CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

HygroVUE10

Digital Temperature and Relative Humidity Sensor with M12 Connector

Rugged, Reliable, and Flexible

Simple to use and easy to maintain

Overview

The HygroVUE™10 offers a combined temperature and relative humidity element in an advanced digital sensor that is ideal for weather networks. The electronics within the sensor provide accurate measurements, and the sensor is easy to use. The digital SDI-12 output allows a simple connection and measurement by many data logging systems. Another benefit is that this digital output avoids the extra errors associated with measuring analog sensors.

A hydrophobic sintered filter prevents dirt and water from entering the cap. The filter is designed to be resistant to wind-driven rain. A secondary PTFE membrane filter is bonded to the surface of the sensor element to prevent finer dust and mold from directly influencing the measurements.

Because the sensor housing is designed to withstand permanent exposure to various weather conditions and to fit inside a range of radiation shields (including compact shields), the HygroVUE™10 is truly suitable for a wide range of monitoring applications.

The HygroVUE™10 utilizes a latest-generation, Swiss-made, combined relative humidity and temperature element based on CMOSens® technology that offers good measurements, accuracy, and stability. Each element of the HygroVUE™10 is individually calibrated with the calibration corrections stored on the chip. You can easily change the sensor element in the field, which reduces your downtime and calibration costs.

Benefits and Features

- Uses a combined, pre-calibrated digital humidity and temperature element
- Field-changeable element for fast, on-site recalibration
- Digital SDI-12 output, allowing long cables with no added errors
- Simple data logger programming
- Low power consumption
- Wide operating voltage
- Rugged design with potted electronics
- Standard M12 connector with IP67 sealing rating

Detailed Description

Mounting

When you use the HygroVUE 10 outdoors, it is standard practice to install the sensor within a housing, known as a

shield. The shield prevents solar radiation from heating the sensor and creating measurement errors. The radiation shield also provides a degree of protection from adverse weather, such as hail or driving rain. The most common type of shield is a relatively small, naturally ventilated screen that is low maintenance and requires no power.

The HygroVUE 10 is specifically designed for field use with dimensions to suit common radiation shields. (Campbell Scientific recommends the RAD10E 10-Plate Solar Radiation Shield.) You can mount the RAD10E on vertical or horizontal poles.

Field Calibration

Calibration is easy to carry out by simply changing the sensor element. As each sensor element is individually calibrated, no further adjustments of the sensor are required. This means that when you change the element, it returns the sensor to the factory calibration state for both temperature and humidity—without interrupting your measurement collection for long periods.

Specifications

Sensing Element	SHT35 modified by Campbell Scientific
Communication Standard	SDI-12 V1.4 (responds to a subset of commands)
Supply Voltage	7 to 28 Vdc
EMC Compliance	Tested and conforms to IEC61326:2013.
Standard Operating Temperature Range	-40° to +70°C
Main Housing Material	UV stable, white PET-P
Electronics Sealing Classification	IP67
Sensor Protection	Outer glass-filled polypropylene cap fitted with a stainless-steel mesh dust filter with nominal pore size of < 30 µm. The sensor element has a PTFE protective film with a filtration efficiency of > 99.99% for particles of 200 nm or larger size.
Sensor Connector	M12, male, 4-pole, A-coded
Cable	Polyurethane sheathed, screened cable, nominal diameter 4.8 mm (0.19 in.)
Field-Replaceable Chip or Recalibrate	Field-replaceable chip
Sensor Cap Diameter	12.5 mm (0.5 in.)
Body Diameter at Connector	18 mm (0.7 in.)
Length	180 mm (7.1 in.) without cable fitted
Sensor Body Weight	50 g (1.8 oz)
Weight	250 g (8.8 oz) with 5 m (16.4 ft) cable

Relative Humidity	
Measurement Range	0 to 100% RH
Accuracy	❱ ±2% (at 25°C, over the range 80 to 100% RH) ❱ *-NOTE- The accuracy figures quoted are the 95% confidence limits relative to factory standards.* ❱ ±1.5% (at 25°C, over the range 0 to 80% RH)
Short-Term Hysteresis	< ±1% RH
Additional Errors at Other Temperatures	< ±1% RH (over -40° to +60°C)
Long-Term Stability	±0.5% per year (maximum drift in clean air conditions)
Reported Resolution	0.001% RH
Repeatability	0.05% RH (3σ noise level)
Response Time with Filter	< 20 s (63% response time in still air)

Air Temperature	
Measurement Range	-40°C to +70°C
-NOTE-	*The accuracy figures quoted are the 95% confidence limits relative to factory standards.*
Accuracy	❱ ±0.1°C (over the range 20 to 60°C) ❱ ±0.2°C (over the range -40 to +70°C)
Long-Term Drift	< 0.03°C per year
Reported Resolution	0.001°C
Repeatability	0.04°C (3σ noise level)
Response Time with Filter	< 130 s (63% response time in air moving at 1 m/s)
Calibration Traceability	NIST and NPL standards

Maximum Current Drain

Quiescent	50 µA
During Measurement	0.6 mA (takes 0.5 s)

YOUNG

Model 41003 Multi-Plate Radiation Shield

The Multi-Plate Radiation Shield protects temperature and relative humidity sensors from error-producing solar radiation and precipitation. Compact size and light weight make this shield useful for many applications.

The multiple plates have a unique profile that blocks direct and reflected solar radiation, yet permits easy passage of air. Enlarged top plate and steep edge profile minimize moisture accumulation from precipitation and dew. The plate material is specially formulated for high reflectivity, low thermal conductivity, and maximum weather resistance. The rugged U-bolt mounting clamp attaches easily to any vertical pipe up to 2 inches diameter.

Model 41003 employs a universal clamp-type adapter to securely hold sensors up to 12.5 mm diameter. **Model 41003P** features a special mounting adapter that is custom sized to fit a sensor from 12.5 mm to 26 mm diameter; please specify the sensor diameter when ordering.

The Temperature Probe is a precision Platinum RTD encased in a stainless steel protective sheath. The sensor assembly is securely mounted in a convenient junction box that fits YOUNG radiation shields. For special applications, the temperature probe is available with various output options. The 4-20 mA current output is useful in high noise, industrial settings or for long cable lengths. The 0-1 VDC option provides a calibrated voltage output signal. Low power circuitry makes it ideal for field studies and remote data-logging applications.

The Relative Humidity/Temperature Probe combines a high-accuracy humidity sensor and temperature sensor into one compact unit. The probe is available with 0-1 VDC or 4-20 mA outputs to satisfy a wide variety of applications.

Ordering Information — MODEL

MULTI-PLATE RADIATION SHIELD *Includes universal adapter for sensors to 15 mm diameter.*	**41003**
MULTI-PLATE RADIATION SHIELD *With custom sensor adapter. Specify diameter from 12.5 mm to 26 mm.*	**41003P**
TEMPERATURE PROBE - RTD OUTPUT	**41342**
4-20 mA OUTPUT*	**41342L***
0-1 VDC OUTPUT*	**41342V***
RELATIVE HUMIDITY/TEMPERATURE PROBE:	
4-20 mA OUTPUT*	**41382L***
0-1 VDC OUTPUT*	**41382V***
ACCESSORY JUNCTION BOX *Specify sensor diameter (10 mm max.)*	**41390**

Specifications

Sensor Types:
Accommodates temperature and humidity sensors up to 26 mm (1 in) diameter

Radiation Error:
@ 1080 W/m² intensity- Dependent on wind speed
0.4° C (0.7°F) RMS @ 3 m/s (6.7 mph)
0.7° C (1.3°F) RMS @ 2 m/s (4.5 mph)
1.5° C (2.7°F) RMS @ 1 m/s (2.2 mph)

Construction:
UV stabilized white thermoplastic plates
Aluminum mounting bracket, white powder coated
Stainless steel U-bolt clamp

Dimensions:
13 cm (5.1 in) diameter x 26 cm (10.2 in) high
Mounting fits vertical pipe 25-50 mm (1-2 in) diameter

Weight:
Net weight: 0.7 kg (1.5 lb)
Shipping weight: 1.4 kg (3 lb)

MODEL 41342 Platinum Temp. Probe

Sensor Type:
1000 Ω Platinum RTD

Range:
Temperature: ..... -50° C to +50° C (-50° to +150° F)

Accuracy:
±0.3° C at 0° C ..... (standard)
±0.1° C at 0° C ..... (optional)

Available Outputs: (Power Requirement)
4 wire RTD 41342
4-20 mA (12-30 VDC, 20 mA) 41342L
0-1 VDC (8-24 VDC, 5 mA) 41342V

MODEL 41382 Rel. Humidity/Temp. Probe

Sensor Type:
Temperature: ..... 100 Ω Platinum RTD
Humidity: ..... Capacitive Polymer

Range:
Temperature: ..... -50° C to +50° C (-50° to +150° F)
Humidity: ..... 0 to 100% RH

Accuracy:
Temperature: ..... ±0.3° C
Humidity: ..... ±2% RH

Available Outputs: (Power Requirement)
4-20 mA (10-28 VDC, 20 mA) 41382L
0-1 VDC (10-28 VDC, 8 mA) 41382V

SPECIFY TEMPERATURE SCALING:
-50 to +50° C ..... add suffix C
-50 to +150° F ..... add suffix F

YOUNG
R.M. YOUNG COMPANY
2801 Aero Park Drive
Traverse City, Michigan 49686 USA
TEL: (231) 946-3980 FAX: (231) 946-4772
E-mail: met.sales@youngusa.com
Web Site: www.youngusa.com

SR05 SERIES

Second class pyranometers with various outputs

SR05 series is the most affordable range of pyranometers meeting ISO 9060 requirements. They are ideal for general solar radiation measurements in (agro-)meteorological networks and PV monitoring systems. SR05's are easy to mount and install. Various outputs are available, both digital and analogue, for ease of integration.

Figure 1 *SR05 with ball levelling and tube mount*

Figure 2 *Easy levelling of SR05 on its tube mount with ball levelling. SR05 series offers various industry standard digital and analogue outputs.*

Introduction

SR05 series is an economical range of ISO 9060 second class pyranometers for measurement of solar radiation received by a plane surface, in W/m^2, from a 180 ° field of view angle. Different configurations are available, depending on its mounting and the output needed. The combination of easy installation and its cost makes SR05 ideal for installation in (agro-) meteorology networks and PV power plant monitoring.

Benefits

- Industry standard digital and analogue outputs: easy implementation and servicing
- Easy mounting and levelling
- Pricing: second class pyranometers finally affordable for large networks

Suggested use

- general solar radiation measurements
- (agro-)meteorological networks
- PV power plant monitoring

SR05 series design

SR05 pyranometers employ a thermopile sensor with black coated surface, one dome and an anodised aluminium body with visible bubble level. Optionally the sensor has a unique ball levelling mechanism and tube mount, for easy installation. SR05 has a variety of industry standard outputs, both digital and analogue: SR05-D1A3 offers Modbus over RS-485 and 0-1 V output, SR05-D2A2 offers Modbus over TTL and 4-20 mA current loop output. Version SR05-A1 offers a conventional analogue millivolt output.

Figure 3 *'Exploded view' of SR05. The optional ball levelling and tube mount allow for easy installation. The cable (standard 3 m) has an M12-A connector.*

Standards

Applicable instrument classification standards are ISO 9060 and WMO-No. 8.

SR05 series specifications

Measurand	hemispherical solar radiation
ISO classification	second class pyranometer
Calibration uncertainty	< 1.8 % (k = 2)
Calibration traceability	to WRR
Spectral range	285 to 3000 x 10^{-9} m
Rated operating temperature range	-40 to +80 °C
Standard cable length	3 m
Rated operating voltage range	
-versions -D1A3 and -D2A2	5 to 30 VDC
-version -A1	passive sensor
Levelling	ball levelling, optional with / without tube mount

Output

Version SR05-D1A3

Communication protocol	Modbus over RS-485
Digital output	-irradiance in W/m² -instrument body temperature in °C
Analogue output	0-1 V

Version SR05-D2A2

Communication protocol	Modbus over TTL
Digital output	-irradiance in W/m² -instrument body temperature in °C
Analogue output	4-20 mA current loop

Version SR05-A1

Analogue output	millivolt
Sensitivity (nominal)	10 x 10^{-6} V/(W/m²)

Versions

SR05 series offers various versions with industry standard outputs, both digital and analogue, each with several options:

- SR05-D1A3 digital second class pyranometer, with Modbus over RS-485 and 0-1 V output
- SR05-D2A2 digital second class pyranometer, with Modbus over TTL and 4-20 mA output
- SR05-A1 analogue second class pyranometer with millivolt output

In addition, version SR05-D1A3-PV is available as a perfect alternative for PV reference cells. Please see SR05-D1A3-PV's separate brochure.

Options

- cable lengths: 10, 20 m
- extension cable with connector pair: 10, 20 m
- with ball levelling
- with ball levelling and tube mount (for tube diameters 25 – 40 mm)
- OEM versions

Table 1 *Ordering codes for SR05*

VERSIONS OF SR05 (part numbers), without cable	
SR05-D1A3	digital second class pyranometer, with Modbus over RS-485 and 0-1 V output
SR05-D2A2	digital second class pyranometer, with Modbus over TTL and 4-20 mA output
SR05-A1	analogue second class pyranometer, with millivolt output
SR05-D1A3-PV	digital second class pyranometer, alternative for PV reference cell (see seperate product brochure)
CABLE FOR SR05, with female M12-A connector at sensor end, non-stripped on other end	
'-03' after SR05 part number	standard cable length: 3 m
'-10' after SR05 part number	cable length: 10 m
'-20' after SR05 part number	cable length: 20 m
CABLE EXTENSION FOR SR05, with male and female M12-A connectors	
C06E-10	cable length: 10 m
C06E-20	cable length: 20 m
LEVELLING OPTIONS FOR SR05	
BL01	ball levelling, for levelling of SR05
TMBL01	tube mount with ball levelling, for mounting SR05 on a tube

SR05

SR05 with BL01

SR05 with TMBL01

See also

- PMF01 pyranometer mounting fixture, compatible with SR05 ball levelling
- view our complete range of pyranometers

About Hukseflux

Hukseflux Thermal Sensors offers measurement solutions for the most challenging applications. We design and supply sensors as well as test & measuring systems, and offer related services such as engineering and consultancy. Our main area of expe rtise is measurement of heat transfer and thermal quantities such as solar radiation, heat flux and thermal conductivity. Hukseflux is ISO 9001 certified. Hukseflux sensors, systems and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

Are you interested in this product?
E-mail us at: info@hukseflux usa.com

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

CS100
Barometric Pressure Sensor

Standard Barometer

Resides inside a weather-proof enclosure

Overview

The CS100 measures barometric pressure for the range of 600 to 1100 hPa (mBar). This range equates to from below sea level (as in a mine) up to 12,000 feet above sea level. Designed for use in environmental applications, the CS100 is compatible with all Campbell Scientific data loggers.

Benefits and Features

- Optimized to mount in Campbell Scientific enclosures
- Low power consumption
- Three-year warranty
- 500 to 1100 hPa (mBar) and 800 to 1100 hPa (mBar) versions also available by special order—contact Campbell Scientific
- Integral switching circuit limits power consumption to measurement cycle

Detailed Description

The CS100 is a Campbell Scientific version of Setra's model 278 barometer. It uses Setra's Setraceram capacitive sensor and IC analog circuit to measure barometric pressure. The CS100 iincludes a 0.76 m (2.5 ft) cable and a terminal strip for data logger power and signal connections.

The CS100 is encased in a stainless-steel and polyester case fitted with an 1/8 in. barbed fitting for pressure connection. It includes an internal switching circuit that allows the data logger to power the barometer only during measurement, which reduces power usage.

Specifications

Measurement Description	Barometric pressure
Signal Type/Output	Analog voltage
-NOTE-	*1 hPa = 1 mBar*
Pressure Range	600 to 1100 hPa
Long-Term Stability	±0.1 hPa per year
Response Time	< 100 ms
Resolution	±0.01 hPa
Excitation	9.5 to 28 Vdc

Elevation	~609.6 m (2,000 ft) below sea level (as in a mine) to 3,657.6 m (12,000 ft) above sea level
Accuracy	⟩ ±1.5 hPa (@ -20° to +50°C) ⟩ ±2.0 hPa (@ -40° to +60°C) ⟩ Accuracy refers to the root sum squared (RSS) of end point non-linearity, hysteresis, repeatability, and calibration uncertainty. ⟩ ±0.5 hPa (@ +20°C) ⟩ ±1.0 hPa (@ 0° to 40°C)
Linearity	±0.4 hPa
Hysteresis	±0.05 hPa
Repeatability	±0.03 hPa

Signal Output	0 to 2.5 Vdc
Warm-up Time	< 1 s
External Trigger Voltage	⟩ 3 to 28 Vdc (operating mode) ⟩ 0 Vdc (sleep mode)
Current Consumption	⟩ < 3 mA (active) ⟩ < 1 µA (sleep mode)
Temperature Range	-40° to +60°C
Cable Diameter	0.8 cm (0.3 in.)
Cable Length	0.8 m (2.5 ft)
Dimensions	9.1 x 6.1 x 2.5 cm (3.6 x 2.4 x 1.0 in.)
Weight	135 g (4.8 oz)

For comprehensive details, visit: www.campbellsci.com/cs100

CAMPBELL SCIENTIFIC®
Campbell Scientific, Inc. | 815 W 1800 N | Logan, UT 84321-1784 | (435) 227-9120 | www.campbellsci.com
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