QUALITY ASSURANCE PROJECT PLAN

for the

IRON KING MINE HUMBOLDT SMELTER PM_{10} STUDY

Final

Prepared by:

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SECTION A. PROJECT MANAGEMENT

A.1 TITLE AND APPROVAL PAGE

Title: Quality Assurance Project Plan for the Humboldt Smelter PM_{10} Study Project

The Arizona Department of Environmental Quality has prepared this Quality Assurance Project Plan following the *EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)* dated March 2001, the *EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5)* dated December 2002, the *EPA Region 9 Requirements for Quality Assurance Program Plan (R9QA/03.2)* dated March 2012, and the ADEQ Quality Management Plan dated July 2016.

This QAPP is hereby recommended for approval and commits the Department to follow the elements described within.

Arizona Department of Environmental Quality

Paula Panzino, Quality Assurance Manager

Signature: Paula C Panzino Date: Dec 17, 2021

Bradley Busby, Manager, Air Monitoring and Assessment

Signature: Date: Dec 17, 2021

A.2 TABLE OF CONTENTS

A.2.A LIST OF FIGURES

A.2.B LIST OF TABLES

A.2.C MASTER LIST OF ACRONYMS

AMAS	(ADEQ) Air Monitoring and Assessment Section
AC	actual conditions (aka, local conditions)
ADEQ	Arizona Department of Environmental Quality
ADQ	audit of data quality
AMU	(ADEQ) Air Monitoring Unit
APTI	Air Pollution Training Institute
AQD	(ADEQ) Air Quality Division
CA	corrective action
CAP	corrective action process/program
CFR	*Code of Federal Regulations*
DM&QA	(ADEQ) Data Management & Quality Assurance (Unit)
DQA	data quality assessment
DQO	data quality objectives
EBAM	Environmental Beta-Attentuation Mass Monitor
EDO	environmental data operation
EPA	Environmental Protection Agency
FEM	federal equivalent method
FRM	federal reference method
IT	information technology
L/min	liters per minute
m^3	cubic meter
$\mu g/m^3$	micrograms per cubic meter
µm	micrometer
MO	monitoring organization
MQO	measurement quality objective
NAAQS	National Ambient Air Quality Standard
NIST	National Institute of Standards and Technology
PE	performance evaluation
PM	project manager, particulate matter, preventative maintenance (depends on context)
PM_{10}	particulate matter, aerometric diameter ≤ 10 micrometers
$PM_{2.5}$	particulate matter, aerometric diameter ≤ 2.5 micrometers
QA/QC	quality assurance/quality control
QAHBV2	*Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II: Ambient Air Quality Monitoring Program*
QAPP	Quality Assurance Program or Project Plan
QMP	Quality Management Plan
SLAMS	state and local air monitoring station
SOP	standard operating procedure
TSA	technical systems audit
ºC	degree Celsius or centigrade
ºF	degree Fahrenheit

A.3 DISTRIBUTION LIST

Arizona Department of Environmental Quality

Paula Panzino, Quality Assurance Manager, ADEQ

Brad Busby, Manager, Air Monitoring and Assessment

Karin Harkin, Manager, Federal Projects

Joey Pace, Project Manager, Humboldt Smelter Project

The Humboldt Smelter PM_{10} Study QAPP is distributed electronically to the ADEQ personnel mentioned in the distribution list. The QA personnel stores the QAPP electronically on the ADEQ's shared drive for use by all staff:

- *J:\COMMON\ADEQ QUALITY MANAGEMENT PROGRAM\QAPPs\Air Monitoring and Assessment*

A.4 PROJECT ORGANIZATION

The Arizona Department of Environmental Quality (ADEQ) is responsible for collecting measurements of airborne particulate matter (PM) for this Humboldt Smelter PM_{10} Study project. This Quality Assurance Project Plan (QAPP) communicates to all parties the specifications for implementing and operating the monitoring project in one clear, concise, and complete document. It details ADEQ's plan for operating the PM measurement instruments and the management of data generated.

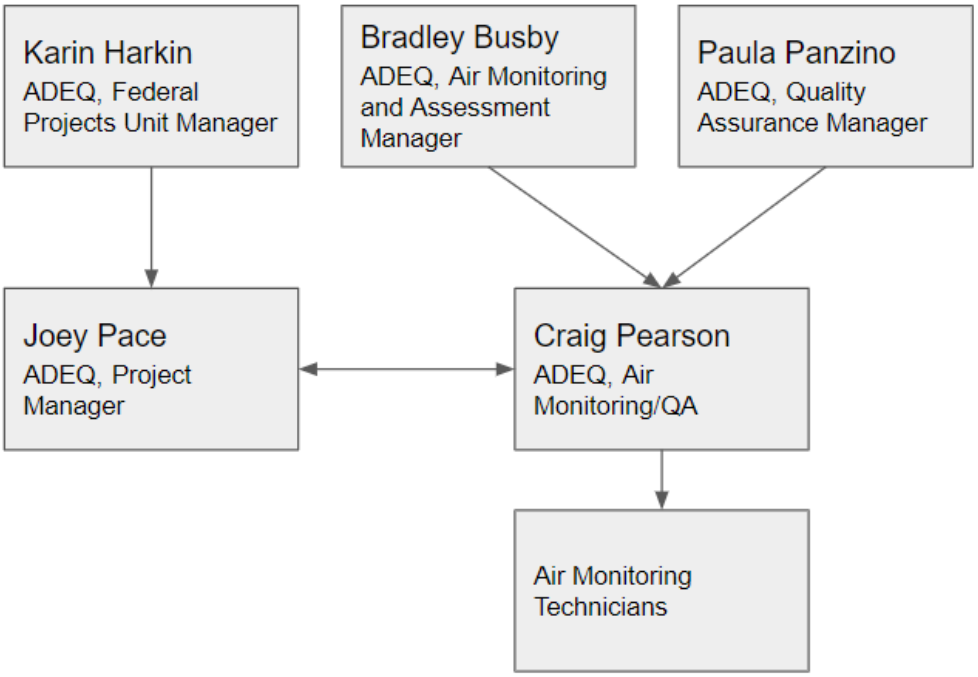
The effectiveness of a QA program and its specific quality control (QC) requirements depends on field and data collection, transmittal, and validation procedures being followed as specified. QA/QC principles and practices will be stringently applied throughout this environmental data operation (EDO). ADEQ's QAPP and associated standard operating procedures (SOP) have been developed to ensure they provide sound and practical processes. Contact information for key personnel is provided in the event questions arise or additional information is needed regarding elements of the Humboldt Smelter PM_{10} Study project.

Table A.1 shows ADEQ personnel involved with the Humboldt Smelter PM_{10} Study project and their responsibilities. Figure A.1 provides the organizational chart for the project.

Table A.1 ADEQ Air Quality Division (AQD) Humboldt Smelter PM_{10} Project Personnel

Name	Role	Responsibilities
Bradley Busby	Air Monitoring and Assessment Manager	Responsible for securing project funding and staffing for the PM_{10} air monitoring study, and providing leadership and guidance to all air quality personnel involved with the project.
Joey Pace	Project Manager	Responsible for project oversight and the key decision maker.
Paula Panzino	ADEQ Quality Assurance Manager	Ensures that this project aligns with the Agency Quality Management Plan and resolves data quality issues.
Air Monitoring Technicians	Field services	Operation/performance of air monitors at assigned sites and QA data review.
Craig Pearson	Air Manager/QA/QC Specialist	Data Management & QA Unit program operations and deliverables.
Karin Harkin	Federal Projects Unit Manager	Ensures that the project manager has sufficient resources to make decisions.

Figure A.1 ADEQ Humboldt Smelter Project Organizational Chart



A.5 PROBLEM DEFINITION/BACKGROUND

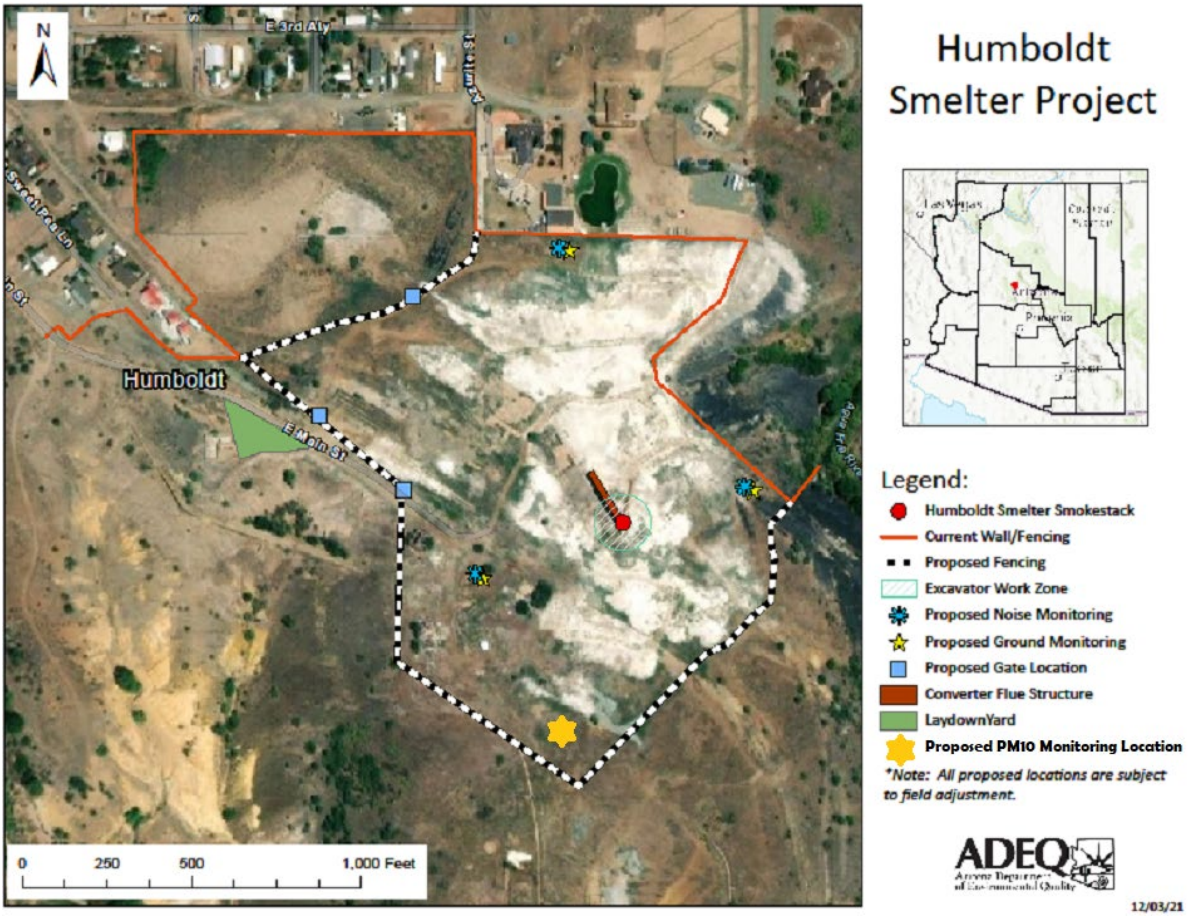
The Arizona Department of Environmental Quality's (ADEQ) Quality Management System (QMS) requires that all environmental monitoring and measurement efforts mandated or supported by EPA have a centrally managed Quality Assurance Program/Project Plan in place. ADEQ's QMS has been implemented to satisfy the policy and program requirements of the United States Environmental Protection Agency (EPA) Order CIO 2105.0 as a non-EPA organization performing work in behalf of EPA through extramural agreements. ADEQ provides this QA Project Plan for guidance on how quality assurance and quality control procedures are applied to produce data that are scientifically valid, of documented quality, and legally defensible.

The purpose of this Quality Assurance Project Plan (QAPP) is to document the Quality Assurance, Quality Control, and other technical activities to be implemented to ensure that the results of ADEQ Air Monitoring and Assessment (AM&A) Value Stream operations are of the type and quality required by the ADEQ Quality Management System. This QAPP was prepared in accordance with ADEQ's most current Quality Management Plan.

Particulate Matter (PM), also known as dust, is a regional and local issue in Arizona. Arizona's arid climate and fine-grained soils can lead to air-borne dust. Dust presents a human health issue when it is less than 10 microns in diameter, which is small enough to penetrate into the lungs and damage lung tissue. ADEQ plans to collect PM_{10} measurements around the Humboldt Smelter where there may be dust impacts to determine pollutant levels. Deconstruction of the old smelter building and tower may produce particulate matter, therefore the monitoring will be in place to capture any particulates released during this deconstruction process.

Figure A.2 shows the Humboldt Smelter study area.

Figure A.2 The ADEQ Humboldt Smelter PM_{10} Study Area



A.6 PROJECT DESCRIPTION

Air monitors must meet project data quality objectives (DQOs) and measurement quality objectives (MQOs). PM measurements for this project are to be collected on a continuous schedule. Detailed information regarding the monitoring methods is provided in Section B of this document.

The Humboldt Smelter PM_{10} Study project will use EPA quality control criteria for PM monitors as found in *40 CFR Part 58* as a guide to conduct ambient air monitoring.

ADEQ plans to collect PM_{10} measurements around the Humboldt Smelter. The location of the monitoring equipment is located to the south of the stack which is anticipated to capture maximum concentrations of particulate matter. This will be located within the mine property fence line. Additionally, ADEQ plans to collect PM_{10} measurements at a second location in the town of Dewey-Humboldt to capture population exposure.

Resource constraints include availability of personnel and instrumentation, as these resources are also used for wildfire and prescribed burn smoke management.

A.7 QUALITY OBJECTIVES AND CRITERIA

Quality objectives and associated criteria establish the foundation upon which air monitoring data collection operations are conducted. Many decisions regarding data collection and evaluation must be made before an air monitoring organization can consistently and confidently evaluate representative data. Quality objectives must be well defined for an air monitoring organization to produce data of a known quality. These decisions are continually evaluated and adjusted over time, based on the network's performance and objectives. Statistical goals and a host of quality criteria are established for field, laboratory, and data validation operations.

What:	PM_{10} Monitoring
Where:	South of the Humboldt Smelter, Dewey-Humboldt, AZ and in the town of Dewey-Humboldt, AZ.
Purpose:	Air Quality Impact from Deconstruction Project
Objective:	Understand PM_{10} concentrations around the Humboldt Smelter

<u>Data Quality Indicators</u>:

- Completeness - Daily requirement: 75% of the hourly concentrations in the 24hr period. Study period requirement: 100% completeness for the study period.
- Precision: One-point flow verification less than 5% Difference from Reference standard before and following the study period.
- Representativeness: Siting Criteria:
    - The inlet must be located between 2 and 15 meters above ground level
    - The inlet must have unrestricted airflow and be located away from buildings and other obstacles. The distance from the obstacle to the inlet must be at least twice the height that the obstacle protrudes above the inlet.
    - The distance from roadways should be 10 meters.
- Representativeness: Located at the maximum concentration area at the smokestack or within the town to capture population exposure.
- Instrument sensitivity: Minimally 1 µg/m3
- Instrument accuracy: ±10% of indicated value for hourly measurements.
- Instrument lower detection level: Less than 6.0 µg/m3

Decision Rule: If data quality indicators are met, then the data collected during the study period is sufficient to answer the below study questions.

Principle Study Question:

Principle Study Question	Possible Alternative Actions
Does a 24hr average in the study period exceed the daily PM_{10} NAAQS level of 150 µg/m^3?	Increase dust controls during the project
	Conduct further investigation into public impact
	Take No Action

Alternative Study Question:

Alternative Study Question	Possible Alternative Actions
Does a 1hr average in the study period exceed the project PM_{10} alert level of 800 µg/m^3?	Increase dust controls during the project
	Conduct further investigation into public impact
	Take No Action

Section B of this QAPP provides detailed information concerning ADEQ's quality control activities.

Measurement Quality Objectives

MQOs are designed to evaluate and control various phases of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the Humboldt Smelter PM_{10} Study project are found below in Table A.2.

Table A.2 Humboldt Smelter PM_{10} Study Project Validation Template

PM Research Project Validation Template		
Requirement	Frequency	Acceptance Criteria
Monitor	NA	Range: 0-5,000µg/m3 Resolution: 1µg/m3 Dectability: <2µg/m3 for a 24hr average
Measurement Cycle	Continous	Hourly averages
Average Flow Rate	Every 24 hours of operation	Average within 10% of 16.67 lpm
Digital Flow Rate Meter	Certified annually to a NIST-traceable	± 2% reproducibility
Digital Temperature Probe	"	2 ºC resolution
Digital Pressure Probe	"	± 5 mm Hg resolution
One-point (QC) Flow Rate Verification	Once per Quarter	at 16.7 lpm 4% diff from std
Final Flow Check	Once per month	Within 2% of Set Flow
Date and Time	Once per Quarter	5 min
Ambient Temperature Verification	"	± 2.0 ºC
Barometric Pressure Verification	"	± 10mmHg
Leak Check (Main Flow)	"	±<1.6 L/min
Pump Check	Once per Year	<0.6 lpmin
Flow Calibration	"	@16.7 l/m 2% diff from std
Temperature Calibration	"	± 2.0 ºC
Pressure Calibration	"	± 10mmHg
Span Membrane Check	"	Pass/Fail
Bias	Once per Year	<10%
Completeness	Daily and Quarterly	>75%
Siting	Once per Project	Meets siting criteria found in 40 CFR Part 58 App E
Reporting Units	NA	µg/m3
Rounding convension	NA	Per rounding convensions for PM10 and PM2.5 found in 40 CFR Part 50 App K & N

A.8 SPECIAL TRAINING/CERTIFICATIONS

ADEQ conducts on-the-job training as the primary means of training personnel. No specific certifications are required for operating instruments and validating data for this project. Project managers plan for new personnel to train with experienced personnel for a period of one to three months as required, with refresher trainings thereafter. New personnel must exhibit to a senior technician, the knowledge, skill, and ability needed to successfully operate the air

monitoring instrument(s) before working independently. Personnel have adequate time to review instrument manuals, monitoring literature, and EPA regulations. Technical personnel have access to the ADEQ QMP, QAPPs, and SOPs as well as other guidance such as the manufacturer's operating manuals. Management will provide sufficient time for personnel to read and understand these documents. ADEQ strives to provide professional development to employees whenever possible. Training includes EPA courses, workshops, conferences, or trade shows. In addition, employees participate in webinars provided by EPA and complete self-instructional courses available through EPA's Air Pollution Training Institute (APTI).

Technicians are proficient with the current fleet of PM instrumentation, as ADEQ has been successfully monitoring for PM for many years. We do not anticipate needing any additional specialized training for personnel. If operating challenges arise with a monitor, technicians consult with the manufacturer's representatives. It is the responsibility of the DM&QA unit manger to ensure that personnel are trained in the operation of the Humboldt Smelter PM_{10} Study, and to maintain training records.

ADEQ technicians shall follow the project health and safety plan provided by the project manager.

A.9 DOCUMENTATION AND RECORDS

Personnel within the AMAS use a shared computer network for storing documents electronically. ADEQ Information Technology (IT) backs the network drive up daily. Documents are stored for a minimum of five years.

Service documents and forms, otherwise known as "field sheets", related to the operation of air monitoring sites and instruments are generated and stored in electronic files in the cloud and on ADEQ's servers. Field sheets include: site logs, instrument logs, communication logs, instrument verification and calibration sheets, site and instrument change forms, and field service reports. The reports are used for data verification and validation.

In addition, the QA Team will perform audits of data quality and TSAs and submit reports to the AMAS Manager. Section C contains more detailed information regarding reports.

Section D contains more detailed information regarding how data will be managed from ADEQ's Humboldt Smelter PM_{10} Study Project. The concentration data and its associated QC data will be archived in ADEQ's database for future reference by the agency and other interested parties. Table A.3 shows a summary of documents stored by ADEQ and their locations.

Table A.3 Summary of ADEQ Documents and Records

Type of Record	Medium	Data Storage Location(s)	Responsibility
Calibration and Verification Records	Electronic	ADEQ Survey123 website, DM&QA Site Files, and/or J:\AQD\AQD\ASSESS\	Air Manager
Certificates for all instruments and standards	Hardcopy and/or Electronic	DM&QA instrument Files, AMU instrument files and/or J:\AQD\AQD\ASSESS\MONITORING UNIT\SITE_LOG\ADEQ Active Sites	Air Manager
Corrective Action Reports	Electronic	DM&QA Site Files and J:\AQD\AQD\ASSESS\QUALITY ASSURANCE DOCUMENTS\Corrective_Action_Process	QA Team
Maintenance and Service Records	Electronic	DM&QA Site Files and J:\AQD\AQD\ASSESS\MONITORING UNIT\SITE_LOG\ADEQ Active Sites	Air Manager
Quality Assurance Audit Records	Electronic	For TSA & ADQ reports, see J:\AQD\AQD\ASSESS\DATA MANAGEMENT AND QA UNIT\AUDITS	Air Manager
Site and Instrument Logbooks	Hardcopy and Electronic	Site e-logbooks are stored as part of the onsite verification records in ADEQ Survey123 Instrument logbook travels with monitor until retired.	Air Manager
Site Information	Electronic	Network Plan found at: J:\AQD\AQD\ASSESS\DATA MANAGEMENT AND QA UNIT\DM\Docs\AQD\Reports and other site information at J:\AQD\AQD\ASSESS\MONITORING UNIT\SITE_LOG	Air Manager
Process Steps	Electronic	J:\AQD\AQD\ASSESS\STANDARD WORK DOCUMENTS	Air Manager
Training Records	Electronic	Unit Manager's Staff Training Files	Air Manager
Data Review and Validation Documents and Notes	Electronic	J:\AQD\AQD\ASSESS\DATA MANAGEMENT AND QA UNIT\Data Review\	Air Manager

SECTION B. DATA GENERATION AND ACQUISITION

B.1 SAMPLING PROCESS (NETWORK) DESIGN

Airborne PM measurements, or "samples", are collected with continuous analyzers using beta ray attenuation. Although, these continuous monitors do not actually produce physical samples that can be referenced again in the future for further analysis, the process is commonly referred to as "sample collection" or "sampling the air".

Station Classification

Special Purpose Monitor (SPM) Stations

As defined by *40 CFR Part 58*, an "SPM station" means a monitor included in an agency's network that the agency has designated as a special purpose monitor station in its monitoring network plan and in the AQS. The agency does not count SPM monitors toward showing compliance with the minimum requirements for QA, siting, and for the quantity of monitors needed for a particular criteria pollutant. SPMs are not required to meet the rigorous QA/QC requirements applied to SLAMS monitors. Often SPMs are used to quickly gather and report preliminary information regarding air quality in a local area.

It is important to note that if an SPM station uses an FRM, FEM, or ARM method and meets the siting requirements in *40 CFR Part 58 Appendix E*, then the agency can be limited to its removal without EPA approval. Removal depends upon the particular criteria pollutant concentrations derived and the monitor's operating duration.

The monitor for the Humboldt Smelter PM_{10} Study is classified as an SPM.

Site Selection and Information

Site selection is a key factor to assuring measurements are representative of the area of concern. The locations identified in the 2015 5-Year Network Assessment only identified the general areas for monitoring. It did not identify the specific locations within those areas. The sites will be chosen to comply with the siting requirements found in 40 CFR Part 58 Appendix E. They will be careful to take into consideration local impacts and will represent the neighborhood or larger scale. The locations will be chosen for easy accessibility, safety and security. Sites are chosen that are easily accessible during normal business hours and near roadways or public spaces.

Site visits will be scheduled during times and under conditions that will allow for easy accessibility. This includes scheduling for road works, weather conditions, and during normal business hours. If, at any time, a site is not accessible to perform necessary maintenance or operation, a visit will be rescheduled to perform the needed tasks. If, at any time, a site becomes

unsafe to perform the necessary tasks, the operator has the direction to not perform the tasks until the safety hazards are removed.

B.2 SAMPLING METHODS

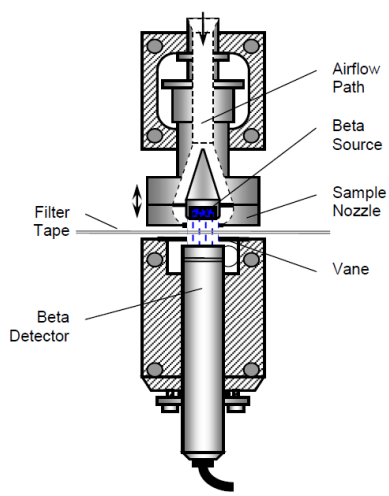
To ascertain the levels of airborne PM, continuous analyzers are used to collect hourly and daily measurements, unless a monitor is out-of-service.

PM Instrument

The instrument used in the Humboldt Smelter PM_{10} Study project is the MetOne EBAM. The EBAM is a small and easily deployable instrument which utilizes beta ray attenuation to measure PM concentrations in ambient air. A beta particle sources emits electrons to be measured by a detector. A pump pulls ambient air through particle selective inlets and onto a filter tape. The difference in beta counts between a clean filter tape and one laden with particulates is used to determine volumetric concentration. Refer to the following SOP for EBAM processes to be followed by ADEQ to avoid contamination and ensure maintenance of the instrument:

- *SOP_SM_001_3.0_Operation and Maintenance of the MetOne EBAM Monitor*

The sample flow path begins with a PM_{10} separating inlet and will add a $PM_{2.5}$ separating cyclone for $PM_{2.5}$ measurements. The particulates then travel through the downtube and onto the filter tape to be measured using the beta source and detector. See below figure.



The acceptable operating criteria for analyzers and transfer standards is provided in Section A.7 of the QAPP. See Section D for more information on the management and review of these data.

B.3 SAMPLE HANDLING AND CUSTODY

No sample is collected as the analysis is done in-situ.

B.4 ANALYTICAL METHODS

No laboratory analysis occurs. Analysis is done in-situ. No sample disposure is required.

B.5 QUALITY CONTROL

Quality control (QC) is the overall system of technical activities that measure the attributes and performance of a process against established standards to verify that performance meets the stated requirements established by the decision maker or data user. Information on data validation and verification can be found in Sections D and A.7 of this QAPP.

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. The first function is the control of the measurement process through broad QA activities such as establishing policies and procedures, developing DQOs and MQOs, assigning roles and responsibilities, conducting QA oversight and technical system reviews, and implementing corrective actions.

The second function is the control of measurement error by implementing specific quality control checks at established frequencies to ensure the monitors operate within specified criteria. QC procedures include, but are not limited to: periodic (typically annual) NIST-traceable certification of calibration standards/references (aka, calibrators) used for testing monitors and supporting meteorological instruments; regularly scheduled calibrations, and verifications.

B.6 INSTRUMENT TESTING, INSPECTION, AND MAINTENANCE

Prior to being deployed to a site, the instrument will be tested in the shop to verify that it is working properly and that it meets operating criteria. Ultimately, it is the responsibility of the DM&QA Unit manager to ensure that instruments are tested, inspected and maintained.

Refer to *SOP_SM_001_3.0_Operation and Maintenance of the MetOne EBAM Monitor* for more details on the operation and maintenance of the instrument.

Inspection and acceptance of the sample train is also performed. To prevent an interruption in the collection of measurements and to ensure DQIs are met, ADEQ strives to keep critical supplies and consumables in stock such as, NIST-certified calibrators, spare parts for instrumentation, and backup analyzers. The standards used to check the sampling system are shown in Table B.2.

Table B.1 Standard Materials and/or Apparatus used for Verifying and Calibrating PM Instruments

Parameter M=Material A=Apparatus	**Std. Material**	**Mfr. Name**	**Model#**	**Acceptance Criteria**

Flow Rate Temperature, Pressure A	NA	Digital Standard	Alicat	Annually-NIST-Traceable Certification

Inspection of Field Items

Supplies and consumables are inspected for defects prior to use and their availability in-house is monitored by the project personnel. There are several items that are routinely inspected in the field during service visits to prevent the loss of data. This includes, but is not limited to: overall site condition/recent changes, cleanliness of down tubes and sample pump integrity.

Preventative Maintenance of Field Items

There are many preventative maintenance tasks associated with the operation of a successful "field" program. For preventative maintenance information, see Section B.7 and *SOP_SM_001_3.0_Operation and Maintenance of the MetOne EBAM Monitor*. In addition, ADEQ references the manufacturer's operating manuals for additional, supporting information when needed. As needed, ADEQ personnel contact the manufacturer's representatives for additional support.

Spare Parts

ADEQ maintains a control system to ensure that there are adequate spare parts for the equipment used in the program. This system consists of keeping parts in separate boxes. The oldest parts are used first, and at least one items is kept on hand at all times. When inventory is low, more spare parts are ordered. These spare parts are maintained by project technicians and are stored in the ADEQ air monitoring lab.

B.7 INSTRUMENT CALIBRATION AND FREQUENCY

"Calibration" is defined as the comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustment. Use of the term "calibration" indicates that an adjustment either in the instrument or the software occurred. Verifications or "checks without correction", are used to confirm whether an instrument is operating within its acceptance range.

The purpose of calibration is to minimize bias. Calibration activities follow a two-step process.

1. Certifying the calibration standards against an authoritative standard, usually the NIST.
2. Comparing the routine sampling or analytical instrument against the calibration standard.

Figure B.1 Example of Certification for a Temperature, Pressure, and Flow Rate Standard

ALICAT SCIENTIFIC

7641 N. Business Park Dr., Tucson, AZ 85743 U.S.A., 1.888.290.6060

Certificate of Calibration

Serial No. 145900 - 14-Nov-2017

Device Under Test

Customer:	Arizona Department of Environmental Quality	**Calibration Procedure/Rev. #:**	DOC-AUTOCAL-GASFLOW/Rev. 93
Return Number:	R27485	**Calibrated By:**	Ashley Dunwell
Serial Number:	145900	**Calibration Date:**	14-Nov-2017
Model Number:	MWB-20SLPM-D-FP-8T	**Certification Number:**	178140
Customer Part Number:	FP-25	**Full Scale Pressure (internal):**	30.000 PSIA
Software Version:	7v09.0-N02	**Pressure Accuracy (internal):**	+/-0.5% of Full Scale
Process Gas:	RHAir	**Temperature Accuracy (internal):**	+/-1.5°C
Calibration Gas:	Air	**Relative Humidity Accuracy:**	+/-3.5% RH
Range:	25.000 SLPM	**Standard Temp. & Pressure:**	25.00°C, 14.69595 PSIA
Gas Temperature:	26°C	**Normal Temp. & Pressure:**	0.00°C, 14.69595 PSIA
Ambient Humidity:	34.33%	**Calibration due 1 yr. after receipt:**	

Equipment Used

Flow:	TOOL-FLOW22	**Temperature:**	TOOL-TEMP18	**Pressure:**	TOOL-BAROM4
Tool Due Date:	11-Feb-2018	Tool Due Date:	09-Jun-2018	Tool Due Date:	29-Aug-2018
Manufacturer/Model:	Alicat / MCM-25SLPM-D	Manufacturer/Model:	SELCO	Manufacturer/Model:	Bosch Sensortec / BME280
Device Uncertainty:	0.4% of Reading + 0.2% of FS	Device Uncertainty:	+/- 0.75°C	Device Uncertainty:	+/-0.02% of Full Scale
Pressure:	TOOL-PRESSUREB	**Temperature:**	TOOL-TEMP15		
Tool Due Date:	09-Mar-2018	Tool Due Date:	08-Nov-2018		
Manufacturer/Model:	Alicat / P-100PSIG-D	Manufacturer/Model:	ASL / F200-A-2+Probe		
Device Uncertainty:	+/- 0.2% of full scale	Device Uncertainty:	+/- 0.02°C		

All test equipment used for calibration is NIST traceable.

Calibration

Uncertainty: +/- (1% of Reading + 0% of Full Scale)
Units of measure: SLPM

Calibration Pressure: N/A

Flow Calibration

D.U.T.	Actual	In Tolerance
0.000	0.000	Yes
1.671	1.674	Yes
6.253	6.261	Yes
6.676	6.682	Yes
12.519	12.534	Yes
16.696	16.704	Yes
18.779	18.794	Yes
22.062	22.061	Yes
25.033	25.051	Yes

Temperature Probe
Uncertainty: +/- 0.2°C

D.U.T.	Actual
23.46	23.44

Barometer
Uncertainty: +/- 1 mmHg

D.U.T.	Actual
706.20	706.40

Tech Signature:

QC Signature:

Alicat Scientific, Inc. is an ISO 9001 certified company.

CS1 Rev 17 Last Modified 15-May-2017

Table B.2 shows the acceptance criteria for PM instruments used by ADEQ, and corrective actions taken when deficiencies are found.

Table B.2 Acceptance Criteria for PM Instrument and Standards Operating in Actual Conditions

Criteria	Frequency	Acceptance Range	Corrective Action
Monitoring Instrument Average Flow Rate	Every 24 hours of operation	Average within 10% of 16.67 L/min	If sampler fails to maintain FR troubleshoot/repair/ calibrate
Standards (References) Digital Flow Rate Meter Digital Temperature Probe Digital Pressure Probe	Certified annually to a NIST-traceable	± 2% reproducibility 2 ºC resolution ± 5 mm Hg resolution	Ensure annual certification is completed and repair or replace references as needed
Verification/Calibration One-point (QC) Flow Rate Verification Date and Time Ambient Temperature Verification Barometric Pressure Verification Leak Check (Main Flow) Pump Check Flow Calibration Temperature Calibration Pressure Calibration Span Membrane Check	Once per Quarter Once per Quarter " " " Once per Year " " " "	@16.7 l/m <4% diff from std 5 min ± 2.1 ºC ± 10.1mmHg <±1.6 lpm Able to achieve 17.0lpm @16.7 lpm 2% diff from std ± 2.0 ºC ± 10mmHg Pass/Fail	If failure occurs, adjust, repair, or replace unit.

B.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the Humboldt Smelter PM_{10} Study project network. The network relies on various supplies and consumables that are critical to its operation. Table B.3 shows the critical, consumable field supplies for the Humboldt Smelter PM_{10} Study project.

The DM&QA Unit Manager is responsible for ordering supplies and consumables in the field, workshop, and office environments.

Table B.3 Critical Field Supplies and Consumables

Area	Item	Description	Vendor
General Supplies	Canned Air	Used for cleaning - debris removal and/or drying apparatus/material	Lowes, Manufacturer, etc.
	Iso-propanol or Ethanol		
	Paper Towels		
General Field Equipment	Air compressor	Used during calibration/verification/ troubleshooting process	Lowes, Manufacturer, etc.
	Funnels and Tubing		

NOTE: Listing of specific suppliers or trade names does not constitute endorsement by ADEQ.

B.9 NON-DIRECT MEASUREMENTS (DATA FROM OTHER SOURCES)

This element addresses data to be used in the Humboldt Smelter PM_{10} Study project that is not obtained by direct measurement. Such data may be obtained from other MOs, the EPA, ADEQ networks, and historical data from scientific studies.

Monitor Operation and Manufacturers' Literature

Important information is found in the manufacturers' literature and operating manuals. Operating manuals for the PM instruments and standards is made available to personnel.

Geographic Location

The location of sampling sites, conventional longitude and latitude coordinates, or universal transverse mercators (UTMs) are found by local GPS or by public mapping software.

Historical Monitoring Information

Historical monitoring data and summary information derived from previous ADEQ data may be used in conjunction with current monitoring results to report trends in pollutant concentrations.

Internal Monitoring Databases

Data from ADEQ's SLAMS PM_{10} and $PM_{2.5}$ monitoring networks may be used in reports.

Meteorological Data from Other Sources

Meteorological data from sources such as the National Weather Service, National Climate Data Center, and other regional climate centers may be used to provide information required when developing monitoring sites, computing corrections needed to convert form standard conditions to actual conditions, and to support analysis and monitoring efforts.

B.10 DATA MANAGEMENT

Data management (DM) describes how the data are handled through the collection, analysis, validation, and reporting processes; and, it identifies responsibilities and requirements during each process. The handling of data is covered in *SOP_DR_027_EBAM Data Review.* This SOP includes checklists for data management records.

Data Flow and Management

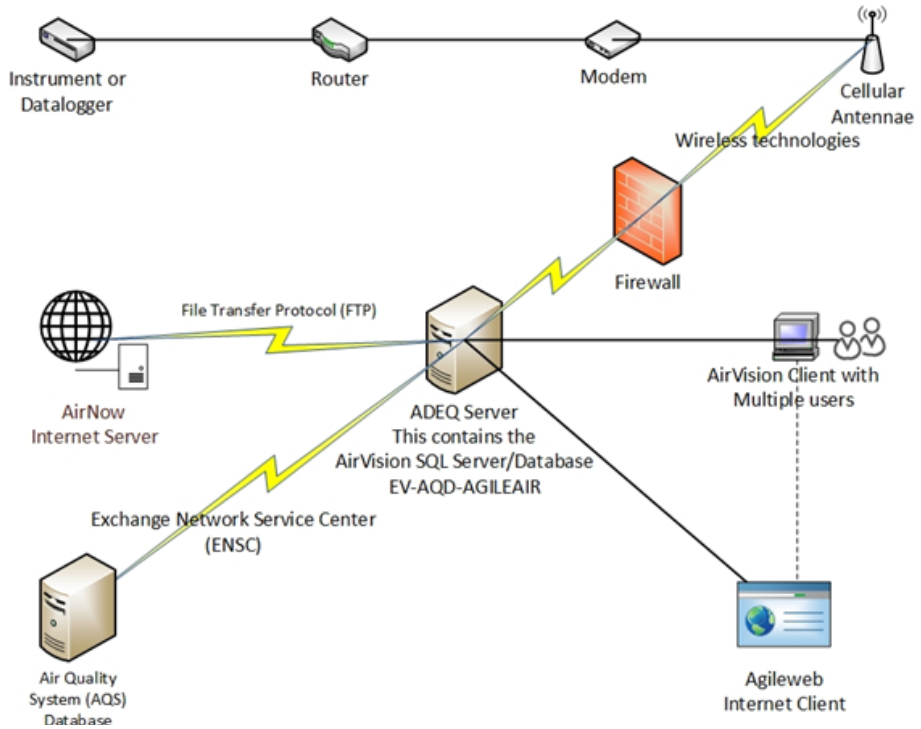
Data collected from ADEQ-operated instruments will consist of measurements from continuous analyzers operating daily.

For continuous PM analyzers:

For PM data from the low-volume continuous analyzers, interval and sample summary data are collected and reported to the AirVision database. Prior to leaving the monitoring site, the technician ensures that data collection is occurring by either confirming through MetOne's COMET software or by contacting an AirVision Data Collection Specialist to ensure that software and logging configurations are correct. The following day, the initial daily check verifies that the analyzer operated within acceptance criteria. The analyzers provide real-time measurements of PM; however, the measurements are preliminary until the final check is completed.

Each week, the data reviewer is scheduled to perform verification and validation on the concentration data called Level 2 data verification. The Level 2 data reviewer assigns the appropriate validation flag to data as needed. The data are then reviewed by utilizing quality control checks and summary statistics called Level 3 validation. Figure B.2 shows the data collection system hardware architecture for retrieving continuous data.

Figure B.2 Continuous Data Collection System Hardware Architecture



Data Management Practices

This section describes the data handling practices that will be followed by ADEQ. Field records are reviewed for completeness and accuracy and initialed by the lead service report reviewer and the data reviewers.

Manual Data

In general, whenever data are recorded by hand, manually copied or entered into an electronic medium, the personnel member performing the operation and, if possible, the personnel member receiving the data, must verify that the operation was performed correctly as written in the instrument SOPs. Manual data checks include:

- verifying that the information was recorded or copied correctly
- verifying that handwriting is legible and handwritten numbers are clearly identifiable
- verifying that documents have been dated and signed or initialed as required

Electronic Data

All electronic files must be visually inspected by opening the files and viewing the records. This includes files downloaded from monitors and dataloggers. The purpose of this inspection is to:

- verify that the file can be opened and is readable
- verify that the dataloggers have been correctly programmed
- identify the format of the data prior to loading into a database or software application

In general, when electronic data are copied or saved to another file format or loaded from one software application to another, the person performing the operation must verify that the data have transferred correctly. Checks on electronic data operations include:

Sample and Data Tracking and Documentation

The following information and documents are used by ADEQ to track and control the movement and handling of samples and data, to ensure proper procedures are followed, and to support the data review and validation processes.

Site and Metadata Information

The representativeness of a site or monitor can be the most important factor when making decisions about the data collected from that site or monitor. The metadata associated with the site or monitor serves as the documentation of this representativeness. All necessary site and instrument information, e.g., site location, sampler siting information, date(s) of sampler installation and/or removal, etc., is recorded in a Site Information and Metadata File, which is maintained by the

DM&QA Unit. Site and instrument change forms are used to document changes. In addition, instrument logbooks are kept at the site for use by the field technicians to record all activities during each site visit and note any problems.

Chain-of-Custody & Field Data Forms

No chain-of-custody (COC) will be used with the Humboldt Smelter PM_{10} Study project sampling.

Shipping and Handling Records

ADEQ will maintain their respective shipment records for instruments and standards.

Data Corrections

Following good data management practices helps to ensure that mistakes will either be avoided or found and corrected early in the process. Occasionally, however, errors will be made and overlooked, or problems discovered at a later date. In such cases, it may be necessary to change data after it has been validated in ADEQ's AirVision database. The changes will be recorded.

Data Storage and Retrieval

Data management includes storing and archiving all data, data files and any related documents needed to ensure data quality. Table A.3 summarizes the specific ADEQ records and documents and the Unit responsible for storing them. The analyzed data will be kept in AirVision™.

ADEQ Database

The AirVision™ database contains instrument information and has graphics capability to assist users in data review. AirVision™ also contains place information for the monitoring sites. Access to AirVision™ is controlled by a valid User ID and password. There are user roles, which control user privileges including table access, screen access, and the ability to insert, update, and delete data and metadata. User roles are assigned by the data collection specialists and/or their designee. Both the AMU and DM&QA Managers are designees and retain the ability to assign roles.

The AirVision™ database is housed on the ADEQ server kept in the information technology services (ITS) server room. The ITS has daily, weekly, and monthly back up procedures as well as back-up power support to the server room. The server is inside the ADEQ firewall and protected with antivirus and other security software. The ITS has a database administrator with 24-hour / 7-day access to identify any server issues. ITS back-up and security procedures are described in the ADEQ QMP.

SECTION C. ASSESSMENT AND OVERSIGHT

C.1 ASSESSMENTS AND RESPONSE ACTIONS

This section describes the audits and reports planned for the Humboldt Smelter PM_{10} Study Project to ensure that:

- elements of the QAPP are correctly implemented as prescribed,
- the data generated are of high quality and meet the needs of users, and
- response/corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed.

An assessment, for this QAPP, is defined as an evaluation process used to measure the performance or effectiveness of the quality system for a monitoring site, and various measurement phases of the Environmental Data Operation (EDO). The results of assessments indicate whether the network is operating as required, and whether QC efforts are adequate or need improvement. To ensure the adequate performance of the quality system, ADEQ plans to periodically perform assessments.

Assessments of ADEQ Program Activities

Surveillance

Surveillance is the continual monitoring and analysis of records to ensure that specified requirements are being fulfilled. On a routine basis, project personnel review log books and instrument service reports (calibrations, verifications, PE audits, instrument change forms, and corrective action reports, etc.) generated from the operation and maintenance of the PM instruments to verify that the acceptance criteria are being met. In addition, ADEQ plans to review the electronic data files regularly to ensure that the monitors are operated correctly.

Technical Systems Audits (TSAs)

A TSA is a thorough and systematic on-site qualitative audit, where facilities, equipment, personnel, training, procedures, and recordkeeping are examined for conformance to the QAPP. A TSA may be performed as needed by ADEQ.

See the AMAS Internal TSA SOP for more information regarding this assessment.

Audits of Data Quality

The QA Team will conduct an audit of data quality (ADQ) as necessary on the data by the Humboldt Smelter PM_{10} Study Project Data.

The QA Team will utilize *SOP_0001_v1_Conducting an ADEQ Internal TSA or ADQ Audit* for any ADQs performed. The SOP contains checklists and questionnaires to maintain consistency. The ADQ should not be confused with the data quality assessment (DQA).

Data Quality Assessments

A DQA is a statistical analysis of air quality, or other environmental data, that is used to determine whether data generated by a particular air monitoring network have met the established DQOs and MQOs, and in doing so, are of adequate quality for use by decision makers. Data quality assessments can, but do not need to follow a strict analysis type. The structured DQA process is discussed in detail in Section D.3 of this QAPP.

Management Systems Review

A management systems review (MSR) is a qualitative assessment of a data collection operation or organization to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring the type and quality of data needed are obtained.

Table C.1 Summary of Internal Assessments Planned by ADEQ

Type of Assessment	Frequency
MSR	As Needed
TSA DQAs (all data) ADQ	As Needed
Surveillance	Ongoing

C.2 REPORTS TO MANAGEMENT

Effective communication among all personnel is also an integral part of a quality system. Reports to management provide the opportunity to alert management of data quality problems, to propose viable solutions to problems, and to procure necessary additional resources. Routine reporting also provides a means for tracking the following:

- adherence to scheduled delivery of data and reports;
- documentation of deviations from approved QA and test plans, and the impact of these deviations on data quality; and
- analysis of the potential uncertainties in decisions based on the data.

The following sections describe the quality-related reports and communications to management.

Final Report

ADEQ will produce a final report to management and to the public following the conclusion of the monitoring project.

Technical System Audit Reports

Internal TSA reports provided by the agency QA/QC specialists will be provided to the AMAS unit managers, and the AMAS manager. The reports will be filed appropriately.

Corrective Action Process and Performance-Related Records

A corrective action process is in-place for the AMAS. The program ensures personnel have a means of communicating any perceived problems involving potential safety issues that may present a risk to the site technicians, operators, and auditors, or, operational or procedural problems that may adversely affect data in a number of ways. The corrective action process is geared toward problems, or deficiencies, to which no prescribed corrective action has been identified in SOPs or QAPPs. The process is a closed-loop system intended to prevent recurrence of a problem by addressing its root cause. For more information on the corrective action process, see the SOP_QA_025_v3_Corrective Action Process.

SECTION D. DATA VALIDATION AND USABILITY

D.1 DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

Data review is the set of verification and validation procedures used to examine the products of data collection and data processing to determine their quality and usability. It spans a wide scope of tests from low level checks on sample identity to high level checks on spatial and temporal comparability. The main goal of the review is to determine if the data products (pollutant measurements) accurately represent the site-specific environment and meet the specific requirements for the respective EPA air monitoring program. In general, whenever an operation affects the data product, verification and validation; procedures are defined and implemented to assure the operation was done correctly.

Data review also provides feedback on field activities, if applicable. More information regarding this approach is provided in *SOP_DR_027_EBAM Data Review*. Ideally, data review is to be performed as soon as possible after data collection and on a regular schedule during the project to enable timely investigation of questionable data, to meet data reporting requirements, or to take corrective action.

Data verification and validation are defined as follows:

- **Data Verification** techniques confirm through provision of objective evidence that *specified requirements* have been fulfilled. Data verification ensures and documents that the data are what they purport to be, i.e., it verifies what was actually done and documents that the data fulfill applicable requirements. Data not meeting the requirements are to be identified and documented with the cause of the insufficiency.

- **Data Validation** techniques confirm by examination and through provision of objective evidence that the particular requirements for a specific *intended use* are fulfilled. Data validation focuses on the particular data needs for a project and ensures that reported values meet the quality goals of the environmental data operations. The purpose of data validation is to verify that data values are representative of air quality conditions at a sampling station and to detect those data values that do not represent actual air quality conditions.

Data verification and data validation are typically sequential steps performed by different persons.

Data review is not the same as data quality assessment or evaluation of the DQOs. Only after the data set has been reviewed, verified, and validated can it be fully assessed and/or used to address the specific scientific and regulatory questions embodied in the DQOs. The following sections describe ADEQ's data review processes and requirements.

Process Overview

Table D.1 summarizes the frequency of data verification and validation:

Table D.1 Summary of Data

Frequency of QA Level 1	Frequency of QA Level 2	Frequency of QA Level 3
Daily	Daily	At the end of the project

The AirVision™ software performs automated data verification and validation checks, which reduces the amount of time required of personnel for lower level QA reviews.

Data Review, Validation, and the ADEQ Database

The data review and validation process is done within the AirVision™ database. AirVision™ offers some tools to assist data reviewers and validators throughout the data review and validation process. The degree to which each datum has been reviewed is documented in ADEQ's database through the QA Level data flags and annotations. The QA Levels range from raw data to QA Level 3. The raw data are considered to be the original data derived from the instrumentation and cannot be changed/modified by data reviewers. Any issues found will result in notes taken as specified DR-027 and stored in the AirVision database, in the Survey 123 data

D.2 VERIFICATION AND VALIDATION METHODS

All data collected by the AMAS must be reviewed and quality assured to the appropriate QA Level for the data type. The objective of each of these QA levels is to identify those measurements influenced by monitor performance. The remaining data are considered representative of their ambient environment; measurements above or below expected values are investigated to determine the nature of the environmental conditions they represent.

Data verification and validation requirements have been described in Section D.1. This section will describe the data review methods employed to verify and validate data at these levels and ensure that QA requirements have been met. These QA levels segregate the verification and validation checks to focus the data review in a particular way. QA Level 1 reviews the data from a single site. QA Level 2 focuses consistency on a site-by-site basis; data may be reviewed over a week (continuous data) or to examine the behavior of the data through time. QA Level 3 reviews the data over longer periods of time, investigating data behavior seasonally, annually, or in comparison with historic data. QA Level 3 also reviews the data spatially, looking at regional patterns and performs a final validation based on all information that was collected and documented during the sample collection and analysis process.

Data Verification and Validation Processes

The complete data review process spans a wide scope of tests from low level verification checks to high level validation checks on temporal and spatial comparability. For continuous measurements collected by AirVision™, ADEQ is solely responsible for the data validation. Data

are stored in AirVision™. As discussed in Section D.1, AirVision is used to perform certain data review checks and to move the data through the QA Levels. The data review methods used by ADEQ are described in the following sections.

Data Collection System and Data Review Methods

PM measurements are collected using AirVision™. Each monitoring instrument is connected to a data logger that continuously records and calculates hourly averages. AirVision™ will poll the site hourly and store the data file in AirVision™. When data are downloaded to AirVision™, the database is programmed to identify the presence and accuracy of all timestamps, all site and instrument metadata and initial flagging of outliers.

Levels of Data Review

The data review procedure at ADEQ requires all data measurements to move through multiple levels of QA- Level 1, Level 2 and Level 3. Following is a description of how data flow within the AirVision™ database. When each level of data review is completed, the data are assigned a QA Level flag that is entered into AirVision™, along with the status (valid, invalid, or suspect) of the data at that level and a code or flag that further describes the status. Those measurements not meeting the requirements are assigned an invalid or suspect status with a reason code describing the nonconformance.

The AirVision™ flagging protocol requires a "reason code" for each sample value at each QA level. The reason code format consists of a letter or a number depending on the code type. The data flag types are shown in Table D.2. Multiple flags may be placed on any data record to show the status.

Table D.2 Data VERIFICATON AND Validation Flags

Description	Flag
Arithmetic Error (math calculation error)	A
Flow Verification	F
Level 1 screened	1
Level 2 screened	2
Level 3 screened	3
Some Data Missing	>
Logger Invalid	<
Suspect	?
Audit	a
Bad Status	B
Calibration	C

Channel Disabled	D
Edited	E
Site Malfunction	e
Invalid Data	I
Maintenance	M
Power Failure	P
Precision Check	p
Conducted Further Research	V

Description	Flag	Level 1/ADVP	Level 2	Level 3
Arithmetic Error (math calculation error)	A			☑
Flow Verification	F		☑	☑
Level 1 screened	1	☑		
Level 2 screened	2		☑	
Level 3 screened	3			☑
Some Data Missing	>	☑		
Logger Invalid	<	☑		
Suspect	?	☑	☑	
Audit	a		☑	☑
Bad Status	B	☑	☑	☑
Calibration	C		☑	☑
Channel Disabled	D	☑		
Edited	E	☑		
Site Malfunction	e		☑	☑
Invalid Data	I	☑	☑	
Maintenance	M		☑	☑
Power Failure	P	☑	☑	☑
Precision Check	p		☑	☑
Conducted Further Research	V			☑

In general, data are corrected, flagged, or invalidated based on the best assessment of the individual situation. Data corrections and flagging are noted in regular QC reports to management. Systematic problems that lead to unacceptably large biases are investigated and documented by DM&QA. Corrective actions are initiated as needed.

Table D.3 ADEQ QA Levels for Continuous Measurements

QA Level	QA Objective	QA Results
Raw	Original unchanged sample data recorded by the monitor; to be archived.	None

QA Level	QA Objective	QA Results
1	Data are reviewed (programmatically) to determine if: • sample value produced came from proper and assumed instrument • instrument producing sample value came from proper and assumed site • instrumentation problems occurred, as documented by instrument flags or error log	• Flag data as valid, invalid, or suspect
2	Review Level 1 data to: • Identify outliers or anomalous data (typically temporal-based) and make a preliminary validation decision. • Identify media preparation problems, laboratory transformation problems, etc.	• Flag Level 1 data as valid, invalid, or suspect • Add annotations or flags to valid and suspect data, if necessary to further explain issues at hand • Initiate corrective action, if necessary
3	Review Level 2 data over longer periods of time (≥ one month for continuous data, and either ≥ one or ≥ three months for filter-based and canister-based data depending on the network). Additionally, Level 3 data review is intended to: • compare data both spatially and temporally • incorporate and verify the field generated QC results into the data review process • make a final determination on the validity of outliers identified during the previous QA Levels • identify environmental events (natural or human-caused) with appropriate flagging protocol	• Flag Level 2 data as valid or invalid • Add qualifiers to valid data, if necessary • Add annotations that help explain validation rationale, if necessary • Initiate corrective action, if necessary • Add Null codes to all invalid data
Final	Field generated QC data associated with environmental data are reviewed at the end of the monitoring period for precision, bias, and completeness.	• Final data

Data Collection System Level 1 Review:

QA Level 1 Review is done by AirVision™. Loading data into AirVision™ is a two-step operation consisting of automated checks as follows:

1. Automatic data upload from instrument and site dataloggers to AirVision™.

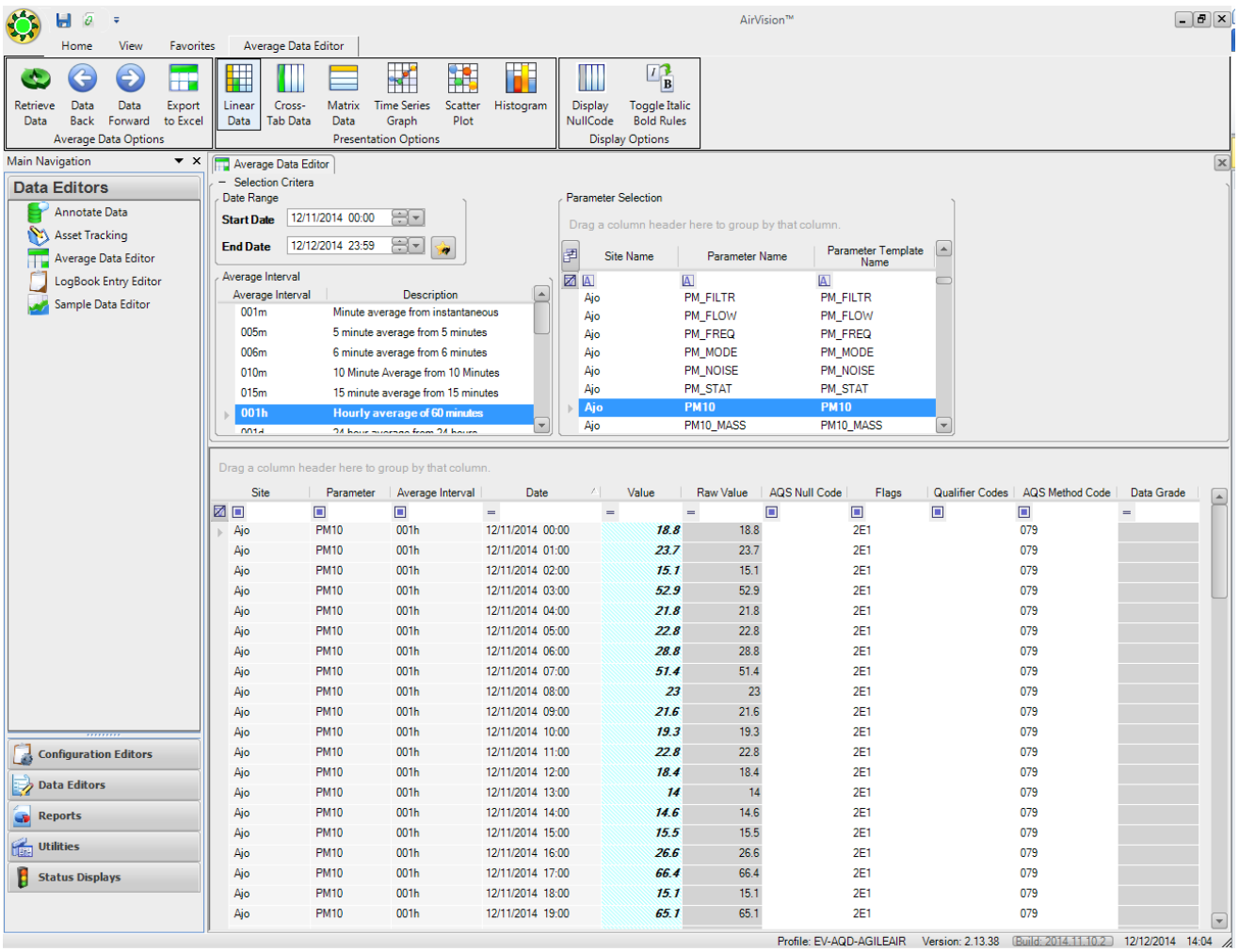
2. Data Verification:

   The data are then uploaded into the database where they can be accessed in the Average Data Editor (Figure D.1). The original value is displayed in the Raw Value column of the screen; the validated data are displayed in the left column of the screen at QA Level 1 with a QA status and QA reason code assigned in the Flags column. Data then go through the Automated Data Validation Process (ADVP).

The following automated validation checks are performed:

- Check for missing observations and fill-in the time period with a null value assigned for the raw value and the QA value at Level 1. A preliminary determination of the QA status and reason flag is assigned.
- Check for hour beginning or hour ending; adjust all data from hour ending instruments to hour beginning.
- Convert English unit measurements to metric units.
- Flag any values that are not representative of ambient conditions, i.e., data influenced by instrument checks or other outages.
- Check screening limits for the parameter and assign Level 1 QA status of Suspect if outside the limits.

Figure D.1 AirVision™ Average Data Editor Screen



Level 2 and 3 Review

Level 2 and 3 review are described in detail by the ADEQ EBAM Humboldt Smelter PM_{10} Study Project Data Review SOP. Checklists for data verifications are found in the Survey123 database as described in *SOP_SM_001_Operation and Maintenance of the MetOne EBAM Monitor*. Checklists for data validations are found in *SOP_DR_027_EBAM Data Review*.

D.3 RECONCILIATION AND USER REQUIREMENTS

On an annual basis, the ambient data collected by ADEQ and their associated QA/QC data are subjected to a data quality assessment (DQA). This DQA includes a final review of the ambient data (via a data summary review), a review of data completeness, and a review of the QA/QC data in comparison with the DQOs and/or MQOs that have been established for the Humboldt Smelter PM_{10} Study Project. This DQA serves two primary purposes:

1. To act as a final validation of the ambient data which typically results in official certification of the data
2. To serve as an overall assessment of data quality for a particular program or network by comparing the desired objectives with the actual results

Once it has been determined that the data collected meet the requirements, the data will be considered final by ADEQ.

DQOs, MQOs and Validation Templates

ADEQ developed a validation template to ensure that MQOs and DQOs are being met (see Table A.2).