QUALITY ASSURANCE PROJECT PLAN FOR AMBIENT AIR QUALITY MONITORING

PROJECT NAME
Parent company name, address, and contact information
Consultant name, address and contact information (if applicable)

PROJECT YEAR

Prepared by

CONSULTANT NAME or
FACILITY NAME
EIQ FACILITY ID# or
PERMIT # or ENFORCEMENT CASE #

Submitted to
Department of Natural Resources
Air Pollution Control Program
P.O. Box 176
Jefferson City, Missouri 65102-0176

or electronically to cleanair@dnr.mo.gov

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DISTRIBUTION LIST

Individual	Title	Agency Represented	# Copies
Patricia Maliro	**Air Monitoring Unit Chief**	**APCP/ MDNR**	**3 if paper copies; electronic submittal preferred**

Facility and/or consultant distribution list (individuals who need to receive the QAPP and any revisions) should be added here.

APCP APPROVAL

Air Monitoring Unit Chief **Date**

FACILITY APPROVALS

Facility Project Manager **Date**

Consultant Project Officer **Date**

A. Project Management

A.1 Project / Task Organization

Identifies key individuals involved in major aspects of the project, including consultants. List their areas of responsibility. Organization chart (Appendix 1) shows lines of authority and reporting responsibilities. Individuals involved in quality assurance must be independent of those involved in routine operation, data collection, and quality control.

A.1.1 Key Personnel / Areas of Responsibility:

	Personnel, (*Facility/Consultant*) Name and organization
Project Management (Project Officer):	
Sampling Operations:	
Sampling QC:	
Laboratory Operations:	
Data Processing Activities:	
Data Processing QC:	
Data Quality Review:	
Data Assessment:	
APCP Modeling:	
Performance Auditing:	
Technical Systems Auditing:	
Facility Project Manager:	
==========	
Overall MDNR QA:	**Keith Bertels, MDNR**
MDNR/Air Program Quality Assurance Coordinator (QAC)	**Stephen Hall, MDNR**
MDNR Project Coordinator:	**Patricia Maliro, MDNR**
Quality Assurance Review:	**David Malorin, MDNR**

MDNR/External Technical Systems Auditing: **Patricia Maliro, David Malorin, MDNR**

A.1.2 Major Functions of Organizations:

MDNR

APCP – Monitoring Unit

a. Coordinate state ambient air monitoring network.

b. Review and approve QAPPs.

c. Review and approve siting locations.

d. Review and approve monitoring reports, and provide comments as appropriate.

e. Conduct technical systems audits once per year, per parameter, per consultant.

ESP – Air Quality Assurance Unit

a. Review and evaluate QAPPs and SOPs from industries.

b. Conduct performance audits of industry monitoring sites as appropriate.

c. Review and evaluate QA/QC data from industries as requested by the APCP.

d. Provide technical assistance to air monitoring field staff as requested.

e. Together with APCP, conduct technical systems audits once per year, per parameter, per consultant.

Monitoring Facility and/or Consultant (revise as necessary; these are examples of typical activities)

a. Collect filter-based and/or continuous criteria pollutant and/or meteorological data. Review data for errors and malfunctions and make corrections.

b. Report data and quality control and assurance assessments to Air Pollution Control Program. Reports are to be both in hard copy and electronic format. Electronic data must be in US EPA AQS format, with site identification.

c. Perform required periodic checks of instruments at identified frequencies as detailed in this QAPP. Evaluate instrument performance and take corrective action when needed. Maintain appropriate instrument and standard material certifications.

d. Evaluate the condition of field equipment and maintain the replacement schedule for expendables associated with equipment. Purchase equipment and supplies needed to complete monitoring commitments.

e. Install new sites; install and calibrate monitoring instruments.

f. Conduct performance and technical systems audits on monitoring sites.

A.2 Problem Definition / Background

There are a variety of potential reasons for an ambient air quality monitoring project. Examples include Prevention of Significant Deterioration (PSD) pre- or post-construction monitoring, monitoring required by a consent agreement related to a State Implementation Plan (SIP), or monitoring required by an enforcement action. The following paragraphs are a general example of the problem definition and background for a PSD project. A specific project will have a more specific problem definition and background, and other types of projects will have a different problem definition and background.

The objective of PSD monitoring is to determine the effect that air emissions from a facility are having or may have on air quality in the area surrounding a new emission source or sources. The ambient air monitoring is being performed to satisfy the pre/post construction air monitoring PSD construction requirements, and to demonstrate continued compliance with the National Ambient Air Quality Standards (NAAQS), which are listed in Appendix 5. The results of the sampling will provide current air quality data so that conditions for permit approval can be established. The purpose of meteorological monitoring, where required, is to provide site-specific meteorological data that can be used for air quality modeling.

Principal uses of the data are as follows:

a. To establish background air quality concentrations in the vicinity of the proposed source or modification. These background levels are important in determining whether the air quality before or after construction, are or will be approaching or exceeding the NAAQS or PSD increment.

b. To provide an estimate of the accuracy of any modeled impacts.

c. Post construction monitoring for criteria pollutants may, in general, be conducted for the following reasons:

1. NAAQS are threatened – The post construction air quality is projected to be so close to the NAAQS that monitoring is needed to certify attainment or to trigger appropriate SIP related actions if non-attainment results.

2. Source impact is uncertain or unknown – Factors such as complex terrain, fugitive emissions, and other uncertainties in source or emission characteristics result in significant uncertainties about the projected impact of the source or modification.

3. *Include additional information specific to this project.*
Briefly, describe the industrial process at this facility and any special permit conditions related to this project.

A.3 Project/Task Description

a. *Project Description*

1. State specifics of parameters to be sampled, sampling project duration, and sample frequency required for pre- or post-construction PSD monitoring, monitoring required by a consent agreement related to a SIP, or monitoring required by an enforcement action. Reference Appendix 3.

2. Modify and reference Appendix 2 for site information. The locations must meet EPA siting criteria for comparison to NAAQS (see 40 CFR, Part 58, Appendix E)

3. State that the monitoring agency will self assess and report quarterly compliance with quality goals listed in Appendix 4. If goals are not met, documented investigation and corrective actions will be required.

b. *Schedule of events (fill in the table with dates specific to the project)*

	Target Date
1. Facility or consultant (F/C) submit QAPP to APCP*	As per permit condition or other requirement
2. APCP review, evaluate, and return QAPP to facility.	Goal is 60 days from receipt
3. APCP will approve site.	Goal is 30 days from notification of proposed site
4. F/C to begin sampling.	As per permit condition or enforcement action
5. F/C to perform technical systems audit	Within 90 days of beginning of sampling
6. F/C submit reports and data to APCP	Within 60 days of the end of each quarter
7. F/C inform APCP of monitored NAAQS exceedance.	Within 30 days of occurrence
8. APCP will communicate to F/C that monitoring is approved	Within 60 days of final report receipt

Sampling may begin prior to the QAPP review and evaluation process, however, APCP will reserve the right to refuse any data collected prior to approving the QAPP.

A.4 Data Quality Objectives and Criteria for Measurement Data

The tables in Appendix 4 should be modified to contain only the parameters to be monitored for the project, and the data quality objectives can be briefly summarized here.

1. See Appendix 4-A and/or 4-B for Data Precision, Bias, and Detection Limits requirements.
2. See Appendix 4-C for Performance Evaluation for gaseous species.
3. See Appendix 4-D for Data Representativeness requirements.
4. See Appendix 4-E for Data Comparability requirements.
5. See Appendix 4-F for Data Completeness requirements.

Measurement quality should be equal to or better than the limits of 40 CFR 58, Appendix B.

A.5 Special Training Requirements/Certification

Personnel assigned to ambient air monitoring activities are expected to have met the educational, work experience, responsibility, personal attributes, and training requirements for their positions. Appropriate training shall be available to all employees supporting the Ambient Air Quality Monitoring Program, commensurate with their duties. Ambient air monitoring professionals with several years of experience will have responsibility for conducting the most significant quality control and quality assurance activities on site. Training will be documented according to Standard Operating Procedures.

A.6 Documentation and Records

The Air Pollution Control Program will coordinate comments and MDNR approvals of the QAPP. The facility or consultant will coordinate distribution of the QAPP.

The following table represents the categories and types of records and documents that are kept related to air monitoring. Current copies of all documents will be maintained at the specified locations. Copies of past documents will be kept according to the retention time schedule. Any electronic records should be retained indefinitely.

Categories	**Record/Document Types**	**Location [Facility or Consultant (F/C), MDNR]**	**Minimum Retention Time (yrs.)**
Management and Organization	Quality Management Plan Quality Assurance Project Plan (QAPP) Personnel qualification and training	MDNR F/C&MDNR F/C	5 5 5
Site Information	Site audits	MDNR F/C	5
Environmental Data Operations	Standard operating procedures (SOP) Field and laboratory notebooks Quality control records Sample handling/custody records	F/C&MDNR F/C F/C F/C	5 5 5 5
Raw Data	Any original data	F/C	5
Data Reporting and Data Management	Data summary Reports Note: PSD, enforcement, and/or SIP records will be maintained by APCP consistent the MDNR records retention schedule. This schedule may be up to 100 years depending on the record.	F/C&MDNR (as received)	5

B. Data Generation and Acquisition

B.1 Sampling Process Design:

1. Briefly describe the size of the area, shape, volume, and timeframe that is to be represented by a sample (called the scale of representativeness; see 40 CFR, Part 58, Appendix D; 40 CFR refers to Title 40 of the Code of Federal Regulations, available online at www.ecfr.gov) as justification for how sampling sites and duration will be selected. Recommend including meteorological data as part of the justification. Also reference Appendix 2

2. Justify the frequency for sampling activities e.g. continuous or every 3-day or 6-day (see 40 CFR, Part 58.12).

3. Indicate how precision will be determined i.e. how many collocated monitors or samplers.

Note: See 40 CFR, Part 58, Appendix A PSD requirements for more information.

B.2 Sampling Methods:

Briefly describe the sample collection procedures, and what constitutes a sample.

1. *List EPA reference or equivalent methods used as applicable. See http://www.epa.gov/ttn/amtic/criteria.html*

2. *Reference facility or consultant SOPs for details on:*
   Equipment required
   Identification of performance requirements
   Descriptions of corrective actions.

3. *List AQS method codes to be used.*

B.3 Sample Handling and Custody:

1. Briefly describe conditions that will be necessary for these samples to keep their original condition during sample collection, transportation, and storage.

2. Describe who will maintain the field notebooks and who is responsible for sample custody in the field and sample receipt, custody, and ultimate disposal in the laboratory.

Note: This section applies to filter samples to be analyzed for lead, PM_{10}, $PM_{2.5}$, or any other samples which must be transported to another location for analysis; it is not applicable for continuous monitoring methods.

B.4 Analytical Methods:

Briefly describe analytical methods to be used along with validation information. Reference facility or consultant SOPs for details on analytical methods requirements, including specific section and subsection locations.

B.5 Quality Control:

List action levels and corrective action for the following checks:

1. *Zero*
2. *Span*
3. *Flow*
4. *Meteorological instrument checks*

Reference *facility or consultant* SOPs for description of quality control procedures, including specific section and subsection locations.

B.6 Instrument/Equipment Testing, Inspection, Maintenance, and Calibration:

Must list primary equipment that will be used during the project that should be inspected or tested routinely.

Reference *facility or consultant* SOPs for details on instrument/equipment maintenance and calibration requirements.

B.7 Inspection/Acceptance of Supplies and Consumables:

List collection filters and calibration gases.

Reference *facility or consultant* SOPs for details on inspection/acceptance requirements for supplies and consumables.

B.8 Data Management:

1. *Describe data management scheme from field to final use and storage.*

2. *Discuss standard record keeping, types of electronic documents, type of electronic data logger and data backup.*

Reference *facility or consultant* SOPs for details on data management.

C. Assessment and Oversight

C.1 Assessments and Response Actions: Performance and Technical Systems Audits

Performance audits consist of evaluation of analysis results for samples or challenging instruments with samples of known concentration to test the proficiency of a monitoring system. Technical systems audits consist of onsite review and inspection of an ambient air monitoring program to assess its compliance with established regulations and with predetermined procedures according to an approved QAPP and SOPs governing the collection, analysis, validation, and reporting of ambient air quality data. A technical systems audit may be required by MDNR; if so, the schedule should be defined in the QAPP, typically within 90 days of the beginning of sampling.

A performance audit or technical systems audit must be performed by different contractor personnel than those conducting sampling and quality control activities or by a different contractor or by MDNR. Equipment used for audits must be different than the equipment used for sampling quality control activities. Clear separation between QC personnel and QA personnel conducting audits should be included in the chain of command indicated in the organization chart.

It will be necessary to address the following in this section:

1. *List what audit activities will take place i.e. technical systems audits, performance audits, data audits, etc.*

2. *List the frequency of the audits (state that the first audit will be done within 90 days of beginning of project).*

3. *List audit goals both per audit and project duration.*

4. *If doing audits with internal personnel, describe the exact relationship within the organization*

5. *If external audits by a non-governmental agency, describe auditor's qualifications.*

6. *Identify what will happen and who will correct the situation in the event of an audit failure.*

Refer to the facility or consultant SOPs.

C.2 Reports to APCP

See Appendix 8 for detailed report requirements.

Type	Responsible Party Facility or Consultant (F/C) MDNR	Frequency	Receiving Agency Facility or Consultant (F/C) or APCP
1. Data Report (Hard Copy)	*(F/C)*	Quarterly	APCP
2. Data Report (Electronic File – Excel or Text – AQS Format)	*(F/C)*	Quarterly	APCP
3. NAAQS Exceedance	(*F/C)*	As Occurs	APCP
4. Performance Audit	*(F/C)*	Quarterly; Annual	APCP
5. Technical Systems Audits (if required)	(F/C) MDNR	W/I 120 days of project beginning Anytime during the project, as desired	MDNR APCP and F/C

D. Data Validation and Usability

D.1 Data Review, Verification, and Validation

If sample data is collected, it will be reported to MDNR.
It will be the responsibility of the facility or consultant to perform the following activities on the data set and submit the results to MDNR as a part of the Data Summary Report. Raw data will be submitted, and data revision conducted only as per the approved QAPP.

Discuss or refer to the facility or consultant SOPs for:

1. *Review sampling system and sample data by following these steps:*
   A. Perform Verification activities
   B. Perform Validation activities
   C. Perform Data Assessment

2. *As a part of the review process, it will be necessary to assign data validation qualifiers, e.g. zero/span performance, flow performance. AQS data validation codes may be found at https://aqs.epa.gov/aqsweb/codes/data/QualifierCodes.html*

3. *Identify by name and organization who will perform the specific steps in the process.*

4. *Describe the process for officially revising or amending data after it has been submitted.*

D.2 Verification and Validation Methods

All data will be verified and validated in accordance with facility or consultant SOPs. Ensure that the SOP details the steps and principles contained in EPA QA/G8, Guidance on Environmental Data Verification and Data Validation, EPA/240/R-02/004, available at http://www.epa.gov/sites/production/files/2015-06/documents/g8-final.pdf

Identify by name and organization who will have authority to invalidate within the organization.

Note: Data submitted to MDNR will be reviewed. If questionable, MDNR will request clarification from F/C.

D.3 Reconciliation with Data Quality Objectives

Once data results are compiled a review of the data to determine if they fall within the acceptable limits will be undertaken. Completeness will also be evaluated to determine if the completeness goal for this project has been met. If completeness

is inadequate, the APCP will advise of the need to provide additional monitoring data.

Steps for evaluation of data quality:

1. Calculate precision and bias for quarterly data set and when applicable for annual results.

2. Determine if quality goals were met. If not, state the impact on the data set.

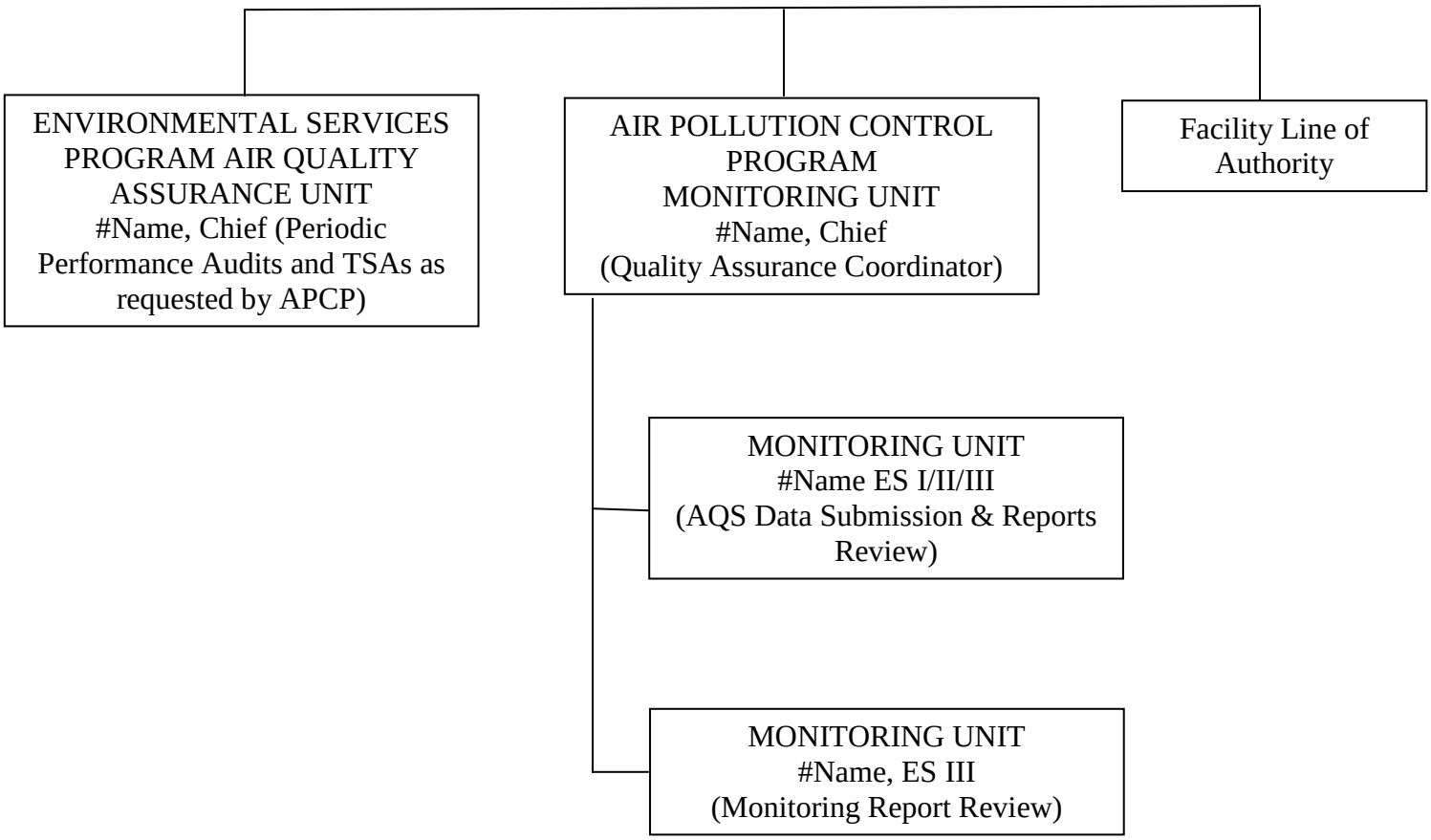
3. How did the results match up with the pre sampling conception? Analyze exceedances consistent with permit or other requirements.

There is a helpful US EPA resource for performing some of the data quality calculations: US EPA Data Assessment Statistical Calculator (DASC) available at: http://www.epa.gov/ttnamti1/qareport.html

Appendix 1 – Organization Chart

Organizational chart showing lines of authority and reporting responsibilities.

Name of the Facility Monitoring Project. "Facility Line of Authority" should show the Facility's Line of Authority for the project and show the various individuals involved in the project.



Appendix 2 – Ambient Air Monitoring Network Site Information

Include site(s) location (latitude and longitude) along with site photographs of the proposed monitoring site and from the proposed monitoring sites toward each cardinal direction. Include a topographical map of the area showing the location of the ambient air and meteorological monitoring stations. Include any background meteorological data if used for siting decisions.

Locations must meet EPA siting criteria, as appropriate. See 40 CFR, Part 58, Appendix E.

Requirements for Meteorological Monitoring sites:

Address the siting and exposure of each of the meteorological instruments that will be installed at the site. Because incorrect siting and/or exposure can lead to the collection of erroneous data, the following parameters should be described and identified in this section:

a. Meteorological Tower
    i. Tower type,
    ii. Location,
    iii. Distance from obstructions, and
    iv. Ground cover.
b. Wind Speed
    i. Description of surrounding terrain,
    ii. Measurement height,
    iii. Distance from obstructions, and
    iv. Ground cover.
c. Wind Direction
    i. Description of surrounding terrain,
    ii. Measurement height,
    iii. Distance from obstructions, and
    iv. Ground cover.
d. Temperature
    i. Measurement height,
    ii. Location
    iii. Avoidance of concrete or asphalt,
    iv. Distance from obstructions, and
    v. Ground cover.
e. Relative Humidity
    i. Measurement height,

ii. Location
iii. Avoidance of concrete or asphalt,
iv. Distance from obstructions, and
v. Ground cover.

f. Barometric Pressure
i. Measurement height,
ii. Location
iii. Avoidance of direct sunlight, drafts, and heaters,
iv. Distance from obstructions, and
v. Ground cover.

g. Solar Radiation
i. Measurement height,
ii. Location
iii. Avoidance of shadows, and
iv. Distance from obstructions.

h. Precipitation
i. Measurement height,
ii. Location
iii. Avoidance of concrete or asphalt,
iv. Distance from obstructions, and
v. Ground cover.

This appendix should be updated to include photographs of the meteorological data collection site once the tower is established and positioned according to the siting and exposure criteria outlined in Volume IV of the Quality Assurance Handbook for Air Pollution Measurement Systems: (http://www3.epa.gov/ttnamti1/files/ambient/met/draft-volume-4.pdf).

Appendix 3 – Parameter Tables (edit the table as needed for the specific project)

Code and Parameter	Method Reference	Sample Preservation
88101 $PM_{2.5}$ FRM	40 CFR 50 App L	*
88101 $PM_{2.5}$ FEM	"	NONE
86101 $PM_{10\text{-}2.5}$ FRM (Difference Method)	40 CFR 50 App O	*
81102 PM_{10}	40 CFR 50 App J	*
81102 PM_{10} continuous	"	NONE
85101 PM_{10c}		
88500 FDMS Raw	"	NONE
88503 DF and FDMS reference channel	"	NONE
86101 PMcoarse Continuous LC	40 CFR Pt. 58, NCore TAD	NONE
85101 PM_{10} Continuous LC	NCore	NONE
81102 PM_{10} Continuous STP	NCore	NONE
TBD PMcoarse Continuous Volatile Channel	NCore	NONE
14129 Lead	40 CFR 50 App G	*
85129 Lead $PM_{10\text{-}LC}$	40 CFR 50 App Q	NONE
42101 CO	40 CFR 50 App C	NONE
42401 SO_2	40 CFR 50 App A	NONE
42406 SO_2-5min Max	40 CFR 58.16	NONE
42602 NO_2	40 CFR 50 App E	NONE
42601 NO	40 CFR 58.16	NONE
42603 NOx	40 CFR 58.16	NONE
44201 O_3	40 CFR 50 App D	NONE
42600 NOy	40 CFR 58, NCore TAD	NONE
42612 NOy-NO	"	NONE
42401 SO_2 Trace Level	"	NONE
42101 CO Trace Level	"	NONE
68105 Average Temperature, Pb,PM2.5, PM10	40 CFR 58.16	NONE
62107 Temperature Indoor, hourly	"	NONE
62101 Outdoor Temperature	"	NONE
68108 Average Barometer Pressure	"	NONE
64101 Ambient Pressure, hourly	"	NONE
62201 Relative Humidity, hourly	"	NONE
61103 Wind Speed		NONE
61104 Wind Direction		NONE
63301 Solar Radiation		NONE
65102 Precipitation		NONE
62106 Delta T		NONE

*Holding Time
The following table lists meteorological parameters, units, and ranges that are required if on-site meteorological data will be used for air quality modeling; the table is based on requirements for the AERMOD model.

On-Site Meteorological Data Parameters-Necessary for Regulatory Dispersion Modeling	**Unit**	**Range***
Day		1 - 31
Month		1 - 12
Year		0 - 99
Hour		0 - 24
Minute		0 - 60
Insolation (Solar Radiation) at 2 meters	watts/square meter	0 - 1250
Net radiation	watts/square meter	-100 - 800
Temperature at 2 meters (TT02)	°C	-30 - 40
Temperature at 10 meters (TT10)	°C	-30 - 40
Temperature difference	°C	-2 - 5
Precipitation	millimeters*100	0 - 25400
Sea level pressure	millibars*10	9000 - 10999
Station pressure	millibars*10	9000 - 10999
Height at 2 meter (HT02)	meters	0 - 4000
Height at 2 meter (HT10)	meters	0 - 4000
Wind direction at 10 meter (WD10†)	degrees from north	0 - 360
Wind speed at 10 meter (WS10†)	meters/second	0 - 50
Dew-point at 2 meters (DP10)	°C	-65 - 35
Relative humidity at 2 meters (RH10)	whole percent	0 - 100
Standard deviation of horizontal wind at 10 meters (SA10)	degrees	0 - 35

*The ranges listed here are intended to be meeting the requirements for AERMOD modeling input and may differ from those listed below in Appendix 4.
†Report both scalar and vector channels clearly labeled in the data package.

Appendix 4 - Data Quality Requirements and Assessments

A. Data Quality Requirements and Assessments, Meteorological Measurements

Specifications and descriptions based on US EPA, Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final), 2008.

Parameter	Range	Resolution	Accuracy	Audit Method (Audit Frequency: Annual)
SLAMS/SPM Non-NCore Meteorology Parameters				
61103 Wind Speed	1.1-112 mph (0.5-50 m/sec), 2.2 mph (1 m/sec) threshold*	0.56 mph	0 to 11 mph: ±0.56 mph > 11 mph: ±5%	NIST-traceable synchronous motor, collocated transfer system (CTS) method; torque watch*
61104 Wind Direction	0-360° (540°)	1°	± 5° total system error	Solar noon, GPS, or magnetic compass
Temperature	-30 to +50° C	0.5° C	± 1.0° C	3-point water bath with NIST-traceable thermistor or thermometer
Relative Humidity	0-100%	1% RH	± 10% RH	NIST-traceable psychrometer, or standards solution

NCore Meteorology Parameters

61103 Wind Speed	1.1-112 mph (0.5-50 m/sec), 2.2 mph (1 m/sec) threshold*	0.22 mph	0 to 11 mph: ±0.56 mph > 11 mph: ±5%	NIST-traceable synchronous motor, collocated transfer system (CTS) method; torque watch*
61104 Wind Direction	0-360° (540°)	1°	± 5° total system error	Solar noon, GPS, or magnetic compass
Temperature	-30 to +50° C	0.1° C	± 0.5° C	3-point water bath or thermo-electric chamber with NIST-traceable thermistor or thermometer
Relative Humidity	0-100%	0.5% RH	± 7% RH	NIST-traceable psychrometer, or standards solution
63301 Solar Radiation	0-1100 W/m^2	10 W/m^2	± 5% of mean observed interval	NIST-traceable pyranometer
Barometic Pressure	600-1100 mb	0.5 mb	± 2.25 mmHg	NIST-traceable barometer
Precipitation	0-25 mm/hr	0.2 mm	± 10% of input volume	Separatory funnel and graduated cylinder

Regulatory Dispersion Modeling
Meteorology Parameters† **‡Audit Method (Audit Frequency: Semi-annual- (1/6 months)**

Insolation (Solar Radiation)				
Net radiation				
Temperature TT02	-40 to +60° C	0.1° C	± 0.5° C	3-point water bath with NIST-traceable thermistor or thermometer
Temperature TT10				
Temperature difference	-5 to +15° C	0.02° C	0.1° C	3-point water bath with NIST-traceable thermistor or thermometer
Precipitation	0-25 mm/hr	0.25 mm	± 10% of input volume	Separatory funnel and graduated cylinder
Sea level pressure				
Station pressure	600-1100 mb	0.5 mb	± 3 mb	NIST-traceable aneroid barometer
Height HT02				
Height HT10				
61103 Wind Speed (report both scalar and resultant (vector) channels	1.1-112 mph (0.5-50 m/sec), 2.2 mph (1 m/sec) threshold*	0.22 mph	±0.45 mph	NIST-traceable synchronous motor, collocated transfer system (CTS) method; torque watch*
61104 Wind Direction (report both scalar and resultant (vector) channels	0-360° (540°)	0.5°	± 5° total system error	Solar noon, GPS, or magnetic compass, CTS method
Dewpoint at 2 meters	-40 to +60° C	0.1° C	± 0.5° C	NIST-traceable psychrometer, or standards solution
Relative humidity at 2 meters				
Standard deviation of horizontal wind SA10				

*Starting threshold should be between 0.45 and 2.2 mph (0.2 and 1 m/sec); it should be verified at acceptance and audit with a torque watch and the torque converted to starting threshold and checked against vendor specifications.

†Meteorological monitoring parameters can vary depending on the specific PSD or modeling project. (e.g. scalar and resultant units are needed for wind speed and wind direction data to ensure data can be used for all potential applications). Precision, accuracy, and units of measure depend on the specific model data input needs. Consult with APCP modeling staff for specific requirement needs to establish these criteria and record these in the project QAPP.

‡Quarterly Quality Control checks are required unless otherwise specified to ensure meeting data completeness and accuracy requirements for the project.

B. Ambient Air Monitoring - Measurement Quality Objectives

Method	CFR Reference (40 CFR Part58, Appendix A)	Coverage (annual)	Minimum frequency	MQOs
Automated Methods				
One-Point QC: for SO_2, NO_2, O_3, CO NOy, CO Trace, SO Trace	Section 3.2.1	Each analyzer	Once per 2 weeks	**O_3** Precision Goal – 90% CL CV≤ 7%, Bias Goal – 95% CL Absolute Bias ≤ 7%. **SO_2, NO_2, CO** Precision Goal - CV 10% , Bias Goal – Absolute Bias ± 10% Critical Criteria – Span Span ≤10% Difference, ≤7% Difference Ozone **NOy SO_2 Trace** Same as SO_2, NO **CO Trace** Precision Goal - CV 15% , Bias Goal – Absolute Bias ± 10% Critical Criteria – Span Span ≤10% Difference **All Species*** Zero drift per project SOPs and control as needed to meet precision MQOs
Annual performance evaluation for SO_2, NO_2, O_3, CO NOy, CO Trace, SO_2 Trace	Section 3.2.2	Each analyzer	Once per quarter for PSD; otherwise per project requirements See: Table A-1 of Appendix A to Part 58 for differences between SLAMS and PSD projects.	± 15 % for each audit concentration. 95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation **NOy, CO Trace, SO_2 Trace** Currently under Development by EPA. Use ± 15 % for each audit concentration as a goal. EPA may develop guidance on low concentration ppb criteria rather than % difference criteria at the lowest concentrations.

Flow rate verification PM_{10},$PM_{2.5}$, $PM_{10-2.5}$	Section 3.2.3	Each sampler	Once every month	± 4% of standard and 5% of design value total flow only?
Semi-annual flow rate audit PM_{10}, $PM_{2.5}$, $PM_{10-2.5}$	Section 3.2.4	Each sampler	Once every 6 months	±4% of standard and 5% of design value
Collocated sampling $PM_{2.5}$, $PM_{10-2.5}$,(PM10 not required)	Section 3.2.5	15%	Every six days	$PM_{2.5}$ 10% precision $PM_{10-2.5}$ 15% precision
PM Performance evaluation program $PM_{2.5}$,$PM_{10-2.5}$,(PM10 not required)	Section 3.2.7	1. One valid audit 2. All samplers in 3 years.	Over all 4 quarters See: Table A-1 of Appendix A to Part 58 for differences between SLAMS and PSD projects.	$PM_{2.5}$ ± 10% bias $PM_{10-2.5}$ ± 15% bias
Manual Methods				
Collocated sampling Pb, PM_{10}, , $PM_{10-2.5}$, $PM_{2.5}$	3.3.1 and 3.3.5	15%	Every 12 days PSD -every 6 days	PM_{10}, TSP, $PM_{2.5}$, ± 10% precision $PM_{10-2.5}$ ± 15% precision Pb Precision Goal ± 20% CV PQAO - 90% CL of CV < 10%
Flow rate verification PM_{10} (low Vol),$PM_{10-2.5}$, $PM_{2.5}$	3.3.2	Each sampler	Once every month	± 4% of standard and 5% of design value
Flow rate verification PM_{10} Pb (High-Vol),	3.3.2	Each sampler	Once every quarter	± 4% of standard and 5% of design value or ± 10% of standard and design value
Flow rate audit PM_{10} , $PM_{10-2.5}$, $PM_{2.5}$(low Vol),	3.3.3	Each sampler, all locations	Each sampling quarter	± 4% of standard and 5% of design value
Flow rate audit PM_{10} Pb (High-Vol),	3.3.3	Each sampler, all locations	Each sampling quarter	± 7% of transfer standard and 10% from design value
Analysis audit Pb	3.3.4	1.. Analytical (lead strips)2 levels 3 audit strips per level	Each sampling quarter	Bias + 15% Absolute bias
Performance evaluation program $PM_{2.5}$, ,(PM10 not required)	3.3.7 and 3.3.8	1. 5 valid audits for primary QA orgs, with < 5 sites 2. 8 valid audits for primary QA orgs, with > 5 sites 3. All samplers in 6 years	Over all 4 quarters	$PM_{2.5}$ ± 10% Bias
Performance evaluation program $PM_{10-2.5}$,	3.3.8	One valid audit per PQAO	Once each year	$PM_{10-2.5}$ ± 15% Bias
Performance evaluation program Pb	3.3.4.4	1. One valid collocated sampler audit and four valid collocated filter audits for PQAOs with ≤ 5 sites 2. Two valid collocated sampler audits and six valid collocated filter audits for PQAOs with > 5 sites	Over all 4 quarters	Pb - 95% CL Absolute bias ±15%

*Zero Drift Acceptance Criteria: see http://www.epa.gov/ttn/amtic/cpreldoc.html

C. Annual Performance Evaluation for SO_2, NO_2, O_3, or CO.

Each calendar quarter (during which analyzers are operated), each analyzer that checks for SO2, NO2, O3, or CO will be evaluated. The evaluation will be conducted by a trained experienced technician other than the routine site operator who conducts span checks and calibrations.

(a) The evaluation is made by challenging the analyzer with audit gas standard of known concentration (effective concentration for open path analyzers) from at least three consecutive audit levels. The audit levels selected should represent or bracket 80 percent of ambient concentrations measured by the analyzer being evaluated:
(b) Select 3 consecutive levels from Table C-1 that would replace the current table in 40 CFR 58 Appendix A for each pollutant concentration range anticipated to be monitored at the monitoring site for the duration of the project.
(c) An additional 4th level is encouraged for those monitors that have the potential for exceeding the concentration ranges described by the initial three selected.

Audit Level	Concentration Range, ppm			
	O3	SO2	NO2	CO
1	0.004-0.0059	0.0003-0.0029	0.0003-0.0029	0.020-0.059
2	0.006-0.015	0.0030-0.0049	0.0030-0.0049	0.060-0.099
3	0.016-0.025	0.0050-0.0079	0.0050-0.0079	0.100-0.399
4	0.026-0.045	0.0080-0.0199	0.0080-0.0139	0.400-0.999
5	0.046-0.065	**0.0200-0.0499**	0.0140-0.0399	1.000-1.999
6	**0.066-0.085**	**0.0500-0.0999**	**0.0400-0.0699**	2.000-4.999
7	0.086-0.105	**0.1000-0.1499**	**0.0700-0.1499**	**5.000-15.999**
8	0.106-0.125	0.1500-0.2599	0.1500-0.2999	16.000-25.999
9	0.126-0.145	0.2600-0.7999	0.3000-0.5999	**26.000-36.999**
10	0.146-0.180	0.8000-1.000	0.6000-1.000	37.000-50.000

Red font related to a NAAQS concentrations still on the books

The QA EYE, Issue 9, July 2010, EPA OAQPS Publication
http://www.epa.gov/ttn/amtic/files/ambient/qa/qanews9.pdf

D. Data Representativeness:

See the Missouri Ambient Air Monitoring Network regarding scale of representation.

E. Data Comparability:

Parameter	Parameter Name	Units	Decimals
88101	PM2.5 FRM Filter Based PM2.5	µg/m^3	1
88101	PM2.5FEM Continuous (All)	µg/m^3	1
86101	PM10-2.5 FRM Filter Based (Difference method)	µg/m^3	1
88500	PM2.5 TEOM	µg/m^3	1
85101	PM10_LC	µg/m^3	1
88502	PM2.5 Continuous-Proposed ARM Method (Troost only)	µg/m^3	1
88503	PM2.5 Continuous Volatile Channel (all)	µg/m^3	1
81102	PM10	µg/m^3	0
81102	PM10 Continuous (Stp. conditions)	µg/m^3	0
85101	PM10 (Local conditions)	µg/m^3	1
86502	PMcoarse Continuous Pmcoarse local conditions	µg/m^3	1
14129	Lead	µg/m^3	3
85129	Lead PM_{10}	µg/m^3	3
42101	CO	ppm	1
42101	CO (Trace level)	ppm	3
42401	SO2	ppb	1
42406	SO2 5-min max in hr	ppb	1
42401	SO2S	ppb	1
42406	SO2S 5-min max in hr	ppb	1
42401	SO2 (Trace level)	ppb	1
42406	SO2 (Trace level) 5-min max in hr	ppb	1
44201	O3	ppm	3
42602	NO2	ppb	1
42601	NO	ppb	1
42603	NOx	ppb	1
42600	NOy (Trace level)	ppb	1
42601	NO (Trace Level)	ppb	1
42612	NOy-NO	ppb	1
84313	Aethalometer/Black Carbon	ug/m3	3
61103	Ws	Mph	1
61104	Wd	Degrees	0
63301	Sol. Rad.	W/m2	2
62107	Inside Temperature	o C	1
62101	Outside Temperature	o C	1
64101	Pressure	mm Hg	0
62201	Humidity	% Rel.	0
68105	Avg Ambient Temp-for Pb	o C	1
68108	Avg Baro Press-for Pb	mm Hg	0
88378	URG	LPM	2
88301	Met 1 red Nylon	LPM	2

88502	Met 1	green	Teflon	LPM	2

F. Data Completeness:

The APCP recommends >80% pollutant measurement data completeness for PSD projects as suggested in EPA-450/4-87-007, page 8,
http://www.epa.gov/region7/air/nsr/nsrmemos/monguide.pdf
The goal of the >80% pollutant measurement data completeness for PSD projects is to minimize data loss for projects that generally are conducted for only one year.

Most modern data acquisitions systems apply 75% data completeness criteria for auxiliary averages making up a valid hourly average concentration which is acceptable for PSD projects.

The data completeness requirement for meteorological data is 90%.

The data collected for longer term NAAQS compliance projects must be complete enough for NAAQS analysis based on the applicable NAAQS averaging periods. The form and completeness requirements for NAAQS and associated 'interpretation of the NAAQS' appendices can be found in 40 CFR 50.

For purposes of evaluation, minimum criteria are generally 75% of possible readings per quarter except for St. Louis and Kansas City ozone monitors which require 75% daily completeness during the ozone season, March 1st - October 31st and an average of 90% completeness over any three year period. For the eight-hour ozone standard, eighteen valid eight-hour average samples must be collected.

The data completeness requirement for lead is that the average completeness for each 3-month period (i.e., the average of the 3 monthly completeness percentages) must be greater than or equal to 75%. Up to 2 makeup samples may be taken per month and used in calculating the monthly average and in calculating completeness. Makeups must be taken either before the next scheduled sampling day or exactly 1 week after the missed day, either with the usual sampler or with a collocated sampler of the same type. Because a 3-month period with less than 75% completeness can affect an area's attainment status, completeness must be closely monitored and makeup samples taken at the required time as needed to maintain 75% completeness. As a general guideline, if more than one sample day is missed in a month, every effort should be made to make up the second (and third, if applicable) missed sample(s). The table below provides general indicators of the required numbers of samples; the number can vary slightly depending on the number of days in a month and the sampling schedule. See 40 CFR, Part 50, Appendix R for details of completeness calculation and makeup requirements.

The data completeness requirements for 24-hour samples are summarized in the following table.

24-Hour Samples (PM_{10}, $PM_{2.5}$)

Time Period	**Minimum Requirement for 75% Completeness**
24-hr sample every 6th day*	
Quarterly	12 samples
Yearly	4 complete quarters
24-hr sample every third day	
Quarterly	23 samples
Yearly	4 complete quarters
24-hr sample every day	
Quarterly	69 samples
Yearly	4 complete quarters

24-Hour Samples (Lead); see text for details

Time Period	Minimum Requirement for 75% Completeness
24-hr sample every 6th day*	
Monthly	4 samples in a 5-sample month, 5 samples in a 6-sample month (up to 2 samples per month can be makeups)
3-month period (assuming 90 days)	12 samples
24-hr sample every third day	
Monthly	8 samples in a 10-sample month, etc. (up to 2 samples per month can be makeups)
3-month period (assuming 90 days)	23 samples
24-hr sample every day	23 samples in a 30-day month, etc. (up to 2 samples per month can be makeups)

The data completeness requirements for continuously monitored parameters are summarized in the following table.

Continuously Monitored Data (CO, NO_2, NOx, NO, O_3, SO_2, Wind Speed, Wind Direction, $PM_{2.5}$, PM_{10} Solar Radiation, Outdoor Temperature.)

Time Period	Minimum Requirement for 75% Completeness
3-hr average	3 of 3 1-hr samples
8-hr averages	6 of 8 1-hr samples
24-hr average	18 of 24 1-hr samples
Daily 8-hr ozone	18 valid eight-hour averages
Quarterly	75% of hourly values quarterly for gaseous, 75% complete daily samples quarterly for PM10 and PM2.5 90 % Meteorological data completeness for Regulatory Dispersion Modeling applications (all parameters).
Yearly	4 complete quarters

All quarters and years are calendar quarters and years, except for lead, which uses a rolling 3-month average, i.e., the average of 3 consecutive monthly averages.

Appendix 5 - US EPA – National Ambient Air Quality Standards (NAAQS)

EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (μg/m^3).

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 μg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [80 FR 65292, Oct 27, 2015]		primary and secondary	8-hour	0.070ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 μg/m^3	annual mean, averaged over 3 years
		secondary	Annual	15 μg/m^3	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 μg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

APPENDIX 6 – LIST OF ACRONYMS

ALPD	- Air and Land Protection Division
APCP	- Air Pollution Control Program
AQAU	- Air Quality Assurance Unit
AQMS	- Air Quality Monitoring Section
CAA	- Clean Air Act
CAFDF	- Custody and Field Data Form
CAS	- Chemical Analysis Section
CFR	- Code of Federal Regulations
COC	- Chain of Custody
DBMS	- Database Management System
DOPO	- Delivery Order Project Officer
DQO	- Data Quality Objective
EMPACT	- Environmental Monitoring Public Access Community Tracking
EPA	- United States Environmental Protection Agency
ESP	- Environmental Services Program
FEM	- Federal Equivalent Method
FRM	- Federal Reference Method
GC	- Gas Chromatography
IMPROVE	- Interagency Monitoring of Protected Visual Environments
MDNR	- Missouri Department of Natural Resources
MSA	- Metropolitan Statistical Area
NAAQS	- National Ambient Air Quality Standards
NAMS	- National Air Monitoring Station
OAQPS	- Organization of Air Quality and Planning Standards
PAMS	- Photochemical Air Monitoring Station
PARS	- Precision Accuracy Reporting System
PPM	- Parts Per Million
$PM_{2.5}$	- Fine Particulate Matter
QA/QC	- Quality Assurance/Quality Control
QAPP	- Quality Assurance Project Plan
QCM – AAM	- Quality Control Manual – Ambient Air Monitoring
RO	- Reporting Organization
RSC	- Regional Speciation Coordinator
SIP	- State Implementation Plan
SLAMS	- State/Local Air Monitoring Station
SOP	- Standard Operating Procedure
SPMS	- Special Purpose Monitoring Stations
XRF	- X-Ray Fluorescence

APPENDIX 7 – REFERENCES

Following are references for air quality monitoring:

U. S. Code of Federal Regulations, Title 40, Part 58 (40 CFR, Part 58)

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, U. S. EPA, 2013, EPA-454/b-13-003, http://www.epa.gov/ttn/amtic/files/ambient/pm25/qa/QA-Handbook-Vol-II.pdf

Following are references for meteorological monitoring:

Guideline on Air Quality Models, U. S. Code of Federal Regulations, Title 40, Part 51, Appendix W.

Meteorological Monitoring Guidance for Regulatory Modeling Applications, U. S. EPA, 2000, EPA-454/R-99-005, http://www.epa.gov/ttn/amtic/files/ambient/met/Volume%20IV_Meteorological_Measurements.pdf

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, U. S. EPA, 2008, EPA-454/B-08-002, http://www.epa.gov/ttn/amtic/files/ambient/met/Volume%20IV_Meteorological_Measurements.pdf

APPENDIX 8 – REPORTS and RECORDS

Field and lab notebooks to be maintained-Include hardbound notebooks or e-records documenting activities related to the project.
Laboratory:
Particulate filter weights
Laboratory conditions:

1. Temperature
2. Pressure
3. Relative humidity
4. Preventative and corrective maintenance records

Field examples include:

1. Site visit entries by any personnel
2. Preventative and corrective site maintenance
3. Instrument maintenance
4. Power failures and instrument changes

Quality control records-These include:

1. Span and zero checks
2. Flow checks
3. Calibration records
4. Certifications and traceablitites of standards

Sample handling records-Any records related to internal or external sample tracking to include shipper tracking records and internal chain of custody.

Raw data-This can include raw electronic data, filter media and trace recorder charts.

Data Reports-Will include:

1. Any data algorithms used to process the raw dataset.
2. Agency internal data management plans with flow charts.
3. The results of the verification process
4. The results of the validation process
5. The results of the data quality assessment which will state whether or not data provided meets the quality, quantity and type required.
6. Precision and Bias results and the equations used to calculate.
7. Completeness percentages.
8. List of any missing, invalidated or manipulated data with detailed information about each occurrence.
9. Validated dataset in electronic or paper form. Electronic form is preferred. The electronic version to be in the new AQS format.

Performance audit reports-Summarize and include audits both external and internal (NPAP if applicable).

System audits- Summarize and include any system audits.