40 Code of Federal Regulations (CFR) Part 58 Technical Systems Audit (TSA) of Clean Air Status and Trends Network (CASTNET) Program Ozone Monitoring Process

by

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Summary

This document reports the audit findings made by RTI International (RTI) after conducting a Technical Systems Audit (TSA) on the ozone collection process and ozone data and data management operated by Air Resource Specialist, Inc. (ARS) for Clean Air Status and Trends Network (CASTNET) program. ARS is responsible for overseeing the operations of the CASTNET sites located at national parks and operated by National Park Service (NPS) staff. A Technical Systems Audit (TSA) was conducted to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data. The TSA consisted of an onsite visit to a NPS site (Great Great Smoky National Park – GRS420), a visit of the Ozone Calibration Laboratory at the ARS facility in Ft. Collins, Colorado (CO), and a review of ozone data collection and data management.

RTI prepared two questionnaires based on 40 Code of Federal Regulations (CFR) Part 58 and Appendix H of the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, (EPA-454/B-17-001) January 2017* (*QA Handbook*). The first questionnaire covered the onsite visit to the field site and the review of the Ozone Calibration Laboratory. The second questionnaire discussed activities related to the data review and data management for ozone data. Prior to the TSA, RTI submitted the questionnaires to the ARS staff to be interviewed and the CASTNET Program Manager, Mr. Kemp Howell, and the CASTNET Quality Assurance (QA) Manager, Mr. Marcus Stewart. The questionnaires were completed by the RTI auditors during the audit process and include responses from the ARS staff. The questionnaires are attached as Appendices A and C.

The RTI audit team consists of Mr. Jeff Nichol and Mr. Eric Poitras. Mr. Nichol was responsible for overseeing the auditing activities as well as leading the onsite review of the field site and Ozone Calibration Laboratory. He conducted interviews with the ARS staff on various aspects of the air monitoring program including such areas as network design, field operations, laboratory operations, data handling, and quality assurance and quality control procedures. Mr. Nichol visited the GRS420 site and the ARS facility in Ft. Collins, CO. Mr. Poitras was involved with reviewing the ARS Quality Assurance Project Plan (QAPP) and Standard Operating Procedures (SOPs) and updating the data review and data management questionnaire. Mr. Nichol conducted interviews with ARS staff regarding the review and handling of ozone data, the data validation and correction procedures, data processing, and internal and final reporting. He also reviewed the ozone raw data records from the GRS420 site and compared the data posted to AIRNow, the NPS website, and the US Air Quality System (AQS) database. He also performed a review of the overall ozone data management system and QA/QC checks from the site through ARS to these databases.

For the CASTNET program, the activities at the field sites and supporting laboratories are overseen and performed by two organizations. Amec Foster Wheeler is responsible for the sample collection activities at the US EPA field sites, providing filter pack and ozone support to the site operators, filter pack laboratory analyses support and data review/management/reporting for all of the CASTNET sites (US EPA and NPS), data reporting for ozone from the US EPA sites to AQS and filter pack results from all CASTNET sites to the CASTNET website. ARS is responsible for overseeing and providing support to the ozone collection operations at the NPS sites and assisting site operators with logistical support in the filter packs collection that are sent to the Amec Foster Wheeler Laboratory in Newberry, Florida (FL).

Findings

The findings listed below were based on a small sample set (one field site visit, a visit to the Ozone Calibration Laboratory, and a review of the ozone data streams from the GRS420 site) overseen by ARS. Continual review of the entire network should be conducted to verify if the findings are an anomaly or consistent throughout the entire CASTNET network.

During the audit of the CASTNET ozone process (field (NPS-governed sites), calibration laboratory, and data management reviews) performed by ARS, RTI was extremely impressed with several aspects of the program such as:

- ARS management structure that oversees the CASTNET program is precise and well organized and the ARS support staff are knowledgeable, cooperative, and supportive,
- ARS quality team has a newly assigned Quality Manager to oversee all QA operations for ARS and QA Officer(s) for QC activities for individual projects or contracts
- Supportive communication link between ARS (Ozone Calibration Laboratory and Information Management Center (IMC)) with the site operators is advantageous and valuable means of communication,
- Knowledgeable, reliable, and conscientious field team with NPS (Mr. Ethan McClure and Mr. Jim Renfro),
- Use of consistent and current state of art instrumentation (Thermo 49i, ESC data loggers, and mass flow controllers),
- Multiple calibration and verification checks conducted within the measurement system at the field sites and five levels of validation of data from field to reporting databases,
- Use of electronic means to maintain and store field information and provide instructions to the site operators in the forms of the QAPP, SOPs, checklists, and field notations on the DataView software system,
- Use of database program with e-mail prompts to track and schedule recertification of field equipment, and
- The levels of NIST-traceable standards used in the program (Level II transfer standards, Level III onsite standard, and Level IV site analyzer).

In October 2013, RTI conducted a TSA of the ozone collection and reporting system overseen by ARS on of the NPS site locations for the CASTNET program. At that time, RTI found five areas that ARS could improve to strengthen their program. During this TSA, Mr. Nichol reviewed those findings with the ARS staff and had open discussions on the progress. Four of the five 2013 findings have been remedied. The only finding still under investigation is the reviewing and updating process of the ARS-NPS Quality Assurance Project Plan (QAPP). For this TSA, RTI did have a few findings of deficiencies that should be addressed or clarified. The major deficiencies are listed below and are discussed in detail in this report.

- The October 2015 QAPP provided by the ARS QA Manager was outdated and has not been reviewed annually as stated in Section A.3 of the QAPP.
- The October 2015 QAPP lacks a current organizational chart of ARS management and working staff on the CASTNET program.
- Obsolete copies (hard copies) of field operation SOPs were found at the field site location (GRS420).
- Obsolete hard copy documentation of ARS contact information for supporting the field operator was found at the field site location (GRS420).

Key Improvements since last TSA (October 2013)

1. ARS developed a method to track and document training of field operators through the Safety Form and Site Operation Training Form.
2. ARS reviewed field operation SOPs and streamlined checklists used by the Field Specialist; removed checklists that were not used or did not provide additional information. Current checklists still in use are Site Visitation Checklist, Site Maintenance Preparation Checklist, and Tailgate Safety Meeting Form and Site Operation Training Form.
3. ARS has developed an SOP to outline a test plan for evaluating software updates and testing changes. This SOP also details how ARS tracks changes or updates of the software.

Section 1: Introduction

For the Clean Air Status and Trends Network (CASTNET) program, the activities at the field sites and supporting laboratories are overseen and performed by two organizations. Amec Foster Wheeler and Air Resource Specialist, Inc. (ARS) are responsible for overseeing the US Environmental Protection Agency (EPA) and National Park Service (NPS) field sites, respectively. This technical systems audit (TSA) involves the audit of the ozone operations performed by ARS located in Ft. Collins, Colorado (CO). At these sites, ozone data is collected based on the requirements stated in 40 Code of Federal Regulations (CFR) Part 58.

RTI International (RTI) performed TSAs of the ozone collection process and data and data management operated by ARS. The TSA consisted of an onsite visit to a NPS site (Great Smoky National Park – GRS420), a visit of the Ozone Calibration Laboratory at the ARS facility in Ft. Collins, CO, and a review of ozone data collection and data management. This audit was based on measuring ambient air quality (ozone) and reporting the data and other related information as stated in 40 CFR Part 58. The specific areas of monitoring criteria RTI reviewed and observed were:

1. Quality assurance procedures for monitor operation and data handling
2. Methodology used in monitoring stations
3. Operating schedule
4. Siting parameters for instruments or instrument probes
5. Minimum ambient air quality monitoring network requirements used to make decisions (network design requirements – number of sites and samplers used)
6. Air quality data reporting and requirements involved.

On April 25, 2017, Mr. Jeff Nichol conducted the TSA at the GRS420 field site in the Great Smoky Mountains National Park located near Townsend, TN. At the site, Mr. Nichol was able to discuss the field operations for the ozone collection process and CASTNET filter pack collection process with the site operator, Mr. Ethan McClure, and field manager and backup operator, Mr. Jim Renfro. The ARS Field Operations Manager, Mr. Mike Slate, and ARS Field Specialists, Mr. Dave Beichley, were also present to conduct the 6-month calibration of the CASTNET ozone and meteorological system and the annual NCore system calibration.

On May 3, Mr. Nichol visited the Ozone Calibration Laboratory at the ARS facility in Ft. Collins, CO. At the facility, Mr. Nichol visited the Ozone Calibration Laboratory and discussed the operations and support provided by ARS to the field sites and operators. Mr. Nichol also discussed the results and ARS remedies of the 2013 TSA and the current QA program for the NPS CASTNET program with the QA Manager. He later talked to the ARS Information Management Section Manager on the data reviewing process and data management for the ozone collection process. The key ARS staff involved during the auditing process was:

- Mr. Mike Slate (ARS Field Operations Manager),
- Ms. Emily Vander Hoek (ARS Quality Assurance Manager),
- Ms. Jessica Ward (ARS Information Management Section Manager), and
- Ms. Genevieve Lariviere (ARS Administrative Assistant).

Sections 2, 3, 4, 5, 6, and 7 of this report discuss the general findings of the ARS's ozone collection process; network management; field operations at the GRS420, site laboratory operations at the Ozone Calibration Laboratory; data management and quality assurance/quality control within the ozone collection process, respectively. The appendices are copies of the questionnaires and responses used during the audit, pictures of the GRS420 monitoring site taken during the site visit, a copy of the last 6-month audit of the GRS420 site, and a copy of the last Preliminary National Performance Audit Program (NPAP) of the GRS420 site.

Section 2: General Program

In 2011, the U.S. EPA upgraded all ozone monitoring equipment at the EPA CASTNET monitoring sites to comply with the requirements stated in 40 CFR Part 58. Each CASTNET site that collects hourly ozone data must meet the additional audit requirements and comply with the data reporting deadlines set forth in the CFR. ARS is responsible for providing technical support to the site operators (subcontractors); maintaining the operation of all field equipment; collecting, analyzing, and reporting the ozone data; and developing an auditing program to meet the CFR requirements for all NPS CASTNET sites. ARS submits the real time NPS CASTNET hourly ozone data to AIRNow and the NPS websites daily. In addition, ARS submits the CASTNET ozone data to the US EPA's Air Quality System (AQS) database.

During the visits to the field site, the Ozone Calibration Laboratory visit, and review of the ozone data and data management, the RTI auditors concluded that the requirements in the CFR were being met. The ARS management and support staff structure at the main laboratory in Ft. Collins, CO is well-organized and documented in the CASTNET Quality Assurance Project Plan (QAPP), Revision 9.0 dated October 2016 and posted at http://epa.gov/castnet/javaweb/docs/qapp_v8_Main_Body.pdf. The QA Manager and field support staff were knowledgeable of their job requirements and very cooperative during the audit. There is an established communication chain between ARS management and support staff and site operators by the use of an electronic program, DataView, that allows the site operators to communicate with ARS staff at all times.

Prior to the TSA, Mr. Marcus Stewart, the Amec Foster Wheeler QA Manager for the CASTNET program, provided the location (http://java.epa.gov/castnet/documents.do) of the QA documentation used for the CASTNET quality management system (QMS). At this website, the auditors found the current CASTNET QAPP, supportive ARS Standard Operating Procedures (SOPs), and quarterly QA reports. The current CASTNET QAPP contains information regarding the CASTNET project organization with U.S. EPA Clean Air Markets Division (CAMD), Amec Foster Wheeler, and the NPS. Prior to the audit (October 2016), Ms. Ward from ARS provided Mr. Nichol the link (http://ard-request.air-resource.com/project/) for the Gaseous Pollutant Monitoring Program (GPMP) website for the NPS. At this website, the ARS-NPS QAPP, field SOPs, 6-month calibration reports, field site contacts information, and project reports for the ozone collection program were found. The field operations SOPs were checked and confirmed against the SOPs listed under the CASTNET website (CASTNET QAPP Appendix 3 ARS SOPs).

Both QAPPs were written in accordance with U.S. EPA Guidance Documents, "*EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)*" (EPA, 2001), and "*EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5)*" (EPA, 2002) and contains all of the necessary elements for an EPA-approved QAPP. Each QAPP integrates all technical and quality aspects of a project, including planning, implementation, and assessment, and documents the quality assurance and quality control that are applied to an environmental data operation to assure the results obtained are of the type and quality needed and expected. The SOPs are written in accordance with U.S. EPA Guidance Documents, "*EPA Guidance for Preparing Standard Operating Procedures (SOPs) (EPA QA/G-6)*" (EPA, 2001). The CASTNET QAPP and SOPs are reviewed and updated annually, but the ARS-NPS QAPP has not been updated since October 2015 (this finding will be discussed further in Section 7).

Findings

No problems or issues based on the review of the QA documentation provided by Mr. Stewart and Ms. Ward from the CASTNET website and NPS GPMP website and discussions with the ARS QA Manager. The outdated ARS-NPS QAPP will be discussed in more detail in Section 7 of this report.

Section 3: Network Management

Amec Foster Wheeler and ARS operate and maintain the ozone collection network for the CASTNET program. ARS is primarily responsible for overseeing the NPS sites and reporting the data from those sites to AIRNOW, NPS, and AQS. Amec Foster Wheeler oversees the EPA sites and is responsible for the data collection, management, and reporting of the ozone data from the EPA CASTNET monitoring sites to AQS. The network consists of 83 monitoring sites. The most recent network assessment was the "CASTNET Plan for Part 58 Compliance" dated July 21, 2016 and the annual network plan can be found at the CASTNET website (http://epa.gov/castnet/ozone). Mr. Tim Sharac of U.S. EPA CAMD in Washington D.C. Office has custody of the network plan and the plan is maintained on the CASTNET website.

During this TSA, RTI visited Great Smoky Mountains National Park (GRS420) near Townsend, TN. Based on 40 CFR Part 58, the site is within siting criteria requirements and has not requested or received any waivers. At each site, the distance from roadways, obstructions, trees were all within the EPA criteria. The inlet heights were all within the required range in 40 CFR 58, Appendix E. The site is outfitted with a datalogger and data is backed up on the computer and a server database.

Exhibit 1 displays the current organizational chart for the ARS-NPS management and staff working on the CASTNET program and **Exhibit 2** provides the organizational chart for ARS working on the CASTNET program.

FINDINGS

No problems or issues based on the review of one field site visit (GRS420) and discussions with the ARS management and QA Manager.

Exhibit 1. NPS/BLM/ARS CASTNET Project Organization

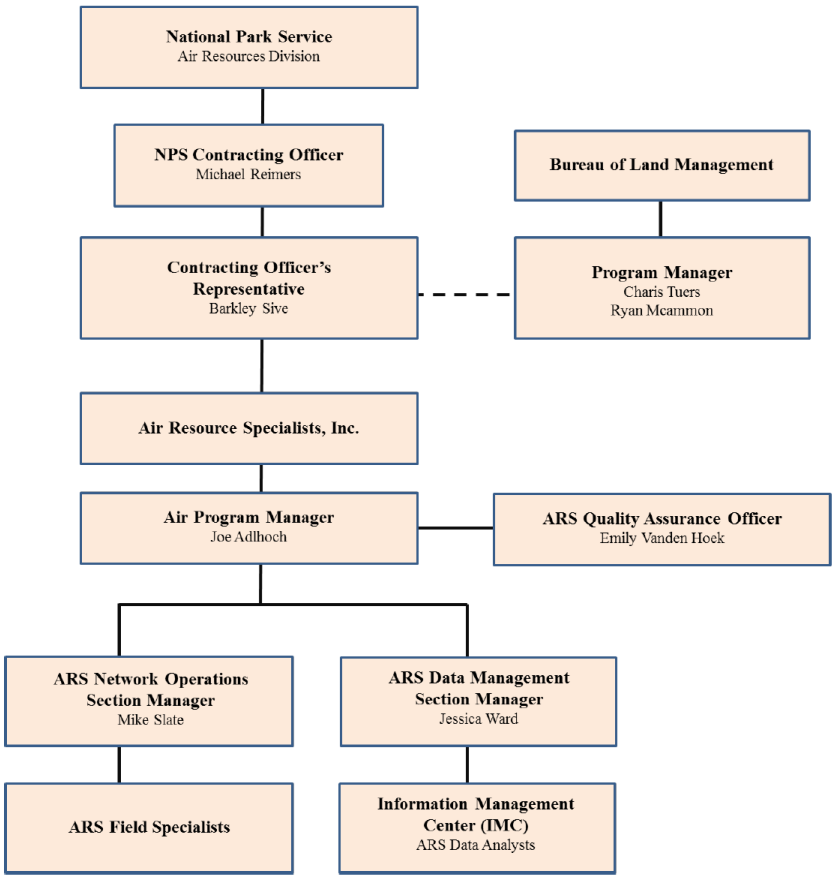
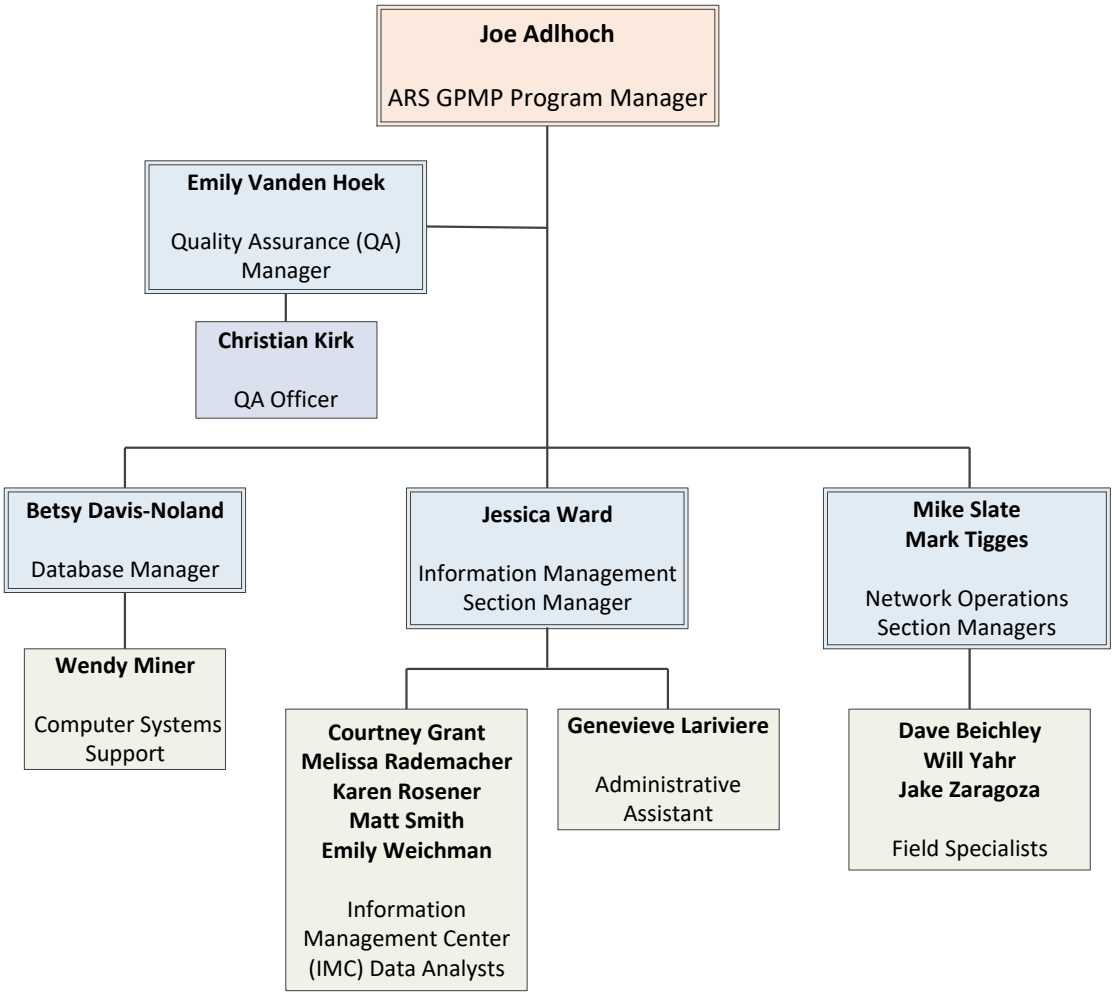


Exhibit 2. ARS-NPS Organizational Chart for CASTNET Program



Section 4: Field Operations

ARS oversees the NPS-governed CASTNET monitoring sites. During this TSA, RTI visited the GRS420 site near Townsend, TN. **Exhibit 3** displays information regarding the site location, site and backup operators, equipment for each site, GPS coordinates, and site elevation. The GPS coordinates and site elevation were measured by the RTI auditor and confirmed against the data for the sites on the CASTNET website.

Exhibit 3. GRS420 Site Information

	GRS420
Site Location Address	Great Smoky Mountain National Park Shipping Address 1300 Cherokee Orchards Road, Gatlinburg, TN 37738
AQS Number	470090101
Site Operator Contact Information	Ethan McClure Ethan_mcclure@nps.gov Other Contact Information was unavailable
Backup Site Operator Contact Information	Jim Renfro Jim_renfro@nps.gov Other Contact Information was unavailable
Site Ozone Analyzer (Manufacturer, S/N, EPA decal)	Thermo 49i S/N: 11306450193 (last calibrated on October 27, 2016)
Transfer Standard Site Ozone Analyzer (Manufacturer, S/N, EPA Decal)	Thermo 49i S/N: 1023943903 (last calibrated on October 27, 2016)
GPS Coordinates	N 35.6314º W 83.9422º
Elevation	2802 ft. (854 m)

The ARS field specialists oversee the field activities for the NPS-governed sites. The site operators (NPS ranger or other personnel) collect the field samples (filter pack) and complete the Site Status Report Forms (SSRFs) based on procedures listed in CASTNET QAPP Appendix 1 Standard Operating Procedures. The site operators uses the DataView software program on the site's laptop to document all activities at the site during their normal visit on Tuesday and non-routine visits due to issues or problems at the site. The site operator does not enter any ozone information on the SSRF. All data entries are electronic (DataView). Hard copy forms are only used if the DataView log is not working. There was no evidence of the DataView system not working, but there are several forms on hand at the site for the site operator just in case. The field oversight operation of the NPS-sites for the CASTNET program is led by Mr. Mike Slate and Mr. Mark Tigges. Site support is performed by a group of Field Specialists (Mr. Will Yahr, Mr. Jake Zaragoza, and Mr. Dave Beichley). The QA group is led by Ms. Emily Vanden Hoek, the QA Manager, and she is supported by Mr. Christian Kirk, the QA Officer for the CASTNET program at ARS. The CASTNET program for NPS sites is led by Mr. Joe Adlhoch. The data management and data review is led by the Information Management Section (IMC) Manager, Ms. Jessica Ward. Ms. Emily Wiechman leads the IMC and she is supported by four data analysts (Ms. Courtney Grant, Ms. Melissa Rademacher, Ms. Karen Rosener, and Mr. Matt Smith). As a group, the Field Specialists are responsible for calibration and maintenance of the ozone analyzers, maintenance of the monitoring site, training the site operators,

and conducting the 6-month calibrations of the analyzers. The data management group along with the Field Specialists is responsible for the field sites being fully operational and collecting valid data.

At the NPS sites, zero, span, and precision (ZSP) checks and monthly and multi-point calibration are performed on the ozone analyzers. The ZSP checks are automated and occur every day at 1:46 am (takes approximately 20 minutes). At this site (GRS420), the site operator performs the monthly multi-point verification check by following the step-by-step procedure on the DataView software program. The monthly multi-point calibration check is not performed at most of the NPS sites anymore. The site operator performs a 3-point calibration (200 ppb, 110 ppb, and 60 ppb) and zero point. All electronic data is saved on the site's laptop and transmitted by the data logger to the ARS primary server. ARS staff also uses the Site Status Log, which is a web-based interface to our AQDBMS at ARS, to log operational and maintenance issue at monitoring sites. This is more comprehensive than entries in the DataView log.

The site operators visit the site every Tuesday as stated in the ARS Field SOPs. In some cases the site operator might visit more frequently if they are responsible for other networks at that monitoring site. There is no independent flow rate check other than during the 6-month calibration, but the site operator does perform a leak check. The site operator also replaces the inline Teflon filter near the ozone inlet every Tuesday during the peak ozone months. After collecting their filter packs and verifying the ozone collection process is working properly, the site operator document all activities on the DataView software system and then submits sampled filter pack and SSRF to the Amec Foster Wheeler Laboratory in Newberry, FL.

4.1 Great Smoky Mountains National Park (GRS420) Field Site

On April 25, 2017, Mr. Nichol met with Mr. Slate and Mr. Beichley at a hotel in Townsend, TN and followed the ARS Field Specialists to the GRS420 field site. Mr. Slate and Mr. Beichley were at the site to conduct the 6-month calibration check on the CASTNET instrumentation and NCore instrumentation. Later in the morning, Mr. Jim Renfro, the site manager and backup site operator and Mr. Ethan McClure, the site operator, arrived to change out the filter and check the ozone system during their normal Tuesday operation. Mr. Nichol was able to observe Mr. McClure removing and loading the filter pack, replacing the inline filter and conditioning it for ozone collection, completing SSRF, and using DataView to check meteorological instrumentation and ozone check. Mr. Nichol also discussed training provided, general operations, use of DataView system, troubleshooting, maintenance, and repair/replacement of equipment at the site with Mr. McClure.

The GRS420 site has been collecting ozone data since July 23, 1988 and was established as a CASTNET site later that year on October 16. Operations at the site are performed by following Weekly Station Visit Checklist and Multi-point Calibration Checklist on the DataView log. The CASTNET and ARS-NPS QAPPs and current field SOPs are stored on DataView system on the site's laptop.

When reviewing documentation maintained at the field site, Mr. Nichol found a binder with old (obsolete) ARS SOPs for field operations at the site. Mr. McClure uses the DataView system for his visit, but when discussing the need for hard copies of SOPs at the site, Mr. Slate suggested these were used if the DataView system was down. It is a good plan to have backup hard copies of the SOPs when and if the computer system is down, but these SOPs need to be replaced with current SOPs. Mr. Nichol also found an obsolete hard copy document of ARS contact information for supporting the field operator at the field site location (GRS420). Mr. Slate stated the list was outdated and needs updating with current ARS, NPS, and Amec Foster Wheeler contacts. Mr. Slate removed the list when conducting the 6-month calibration and will provide NPS with updated contacts.

Site operators are trained three ways under the ARS-NPS program for CASTNET. The first option is from the previous site operator. In the case of GRS420, Mr. Renfro was the previous site operator and Mr. McClure was an intern under Mr. Renfro and later hired as a park ranger. Mr. Renfro provided thorough training to Mr. McClure and this training is reinforced by the second option, training by the ARS Field Specialists during the 6-month calibration checks. The Field Specialists now completes a Tailgate Safety Meeting Form and Site Operator Training Form (see **Exhibit 4** for the entries for the last training provided) so that any training provided is documented and signed off by the trainer (ARS Field Specialist) and trainee (site operator). This document is hand-written and later placed in PDF format and sent to the site for their training records on the site's computer. The third training option is when a new site is established or relocated. For this option, the Field Specialist will train the site operator and site manager. In all cases of training options, the training is documented, the documentation is

tracked and managed; and the site operators are provided with ARS contact information to answer any follow up questions.

Exhibit 4. Last GRS420 Tailgate Safety Meeting Form And Site Operator Training Form

Air Resource SPECIALISTS

TAILGATE SAFETY MEETING FORM
AND SITE OPERATOR TRAINING

Instructions
To be completed prior to the beginning of a new job, when changes in work procedures occur, or when additional hazards are present.

NAME, DATE, TYPE, LOCATION OF PROJECT OR WORK ACTIVITY:

GRSM, CV, CD, LR, CC, CM

NEAREST HOSPITAL:

Cherokee - Hospital
Urgent care Gatlinburg

COORDINATES OF WORK LOCATION

N 35.562 1214
W 83.497 4936

TOPICS/HAZARDS DISCUSSED:

- Park radio -
- Emergency communications
- Driving up to site
- Climbing
- Slips trips + fall
- Electrical hazards
- Eye protection and hearing
- lifting
- Roof top hazard on shelter roof

OPERATOR TRAINING CONDUCTED (Name, topics):

- Communications
- MSDS - Forms may need update
- Data view checklists
- Ozone inlet
- Met checks

Suggested Trainings:

☐ PM Monitor ☐ DataView ☐ Communications ☐ Met Checks ☐ Ozone ☐ CASTNET

NAMES OF ATTENDEES:	SIGNATURE OF ATTENDEES:
Mike Slate	
Will Yahr	
Jim Renfro	
Ethan McClure	

Supervisors Signature/Date: 10-20-17

Maintenance and repair work on instruments is performed at the monitoring site if possible by the Field Specialists during the 6-month calibration check. The Field Specialist completes a form as displayed in **Exhibit 5**. When repairs are not possible onsite, equipment is brought back to the ARS Ozone Calibration Laboratory, which serves as the centralized maintenance and repair facility.

Exhibit 5. Copy of the Semiannual Site Visitation Checklist

SEMIANNUAL SITE VISITATION CHECKLIST
NPS Ambient Air Quality Monitoring Program

Air Resource Specialists, Inc.

Station: Visit Conducted By:
Station Operator: Site Visit Dates:

1. SHELTER AND TOWER INTEGRITY (verify condition and proper operation)

ITEM	CORRECTIVE ACTION
☐ Shelter Exterior (roof, siding, door, etc.)	
☐ Shelter Interior (floor, walls, ceiling, door, racks)	
☐ Shelter Electrical (outlets, lights, grounding, polarity)	
☐ Shelter Heating and Air Conditioning (inspect, clean, check thermostats)	
☐ Meteorological Tower (supports, guys, hardware, grounding)	
☐ Flow Tower (supports, guys, hardware, grounding)	
☐ Other:	

2. SUPPORT SYSTEM INTEGRITY (verify condition and proper operation)

ITEM	CORRECTIVE ACTION
☐ Lightning Protection Panel (LPP)	
☐ Quality Assurance Monitor (QAM), STP Monitor	
☐ Power and Telephone Lines	
☐ Interconnect Cabling (tower and shelter)	
☐ Intake and Exhaust Manifolds (if applicable)	
☐ Other:	

3. AIR QUALITY EQUIPMENT CALIBRATIONS/MAINTENANCE

Pre Cal.	Maint. Completed	Post-Cal.	ITEM	CORRECTIVE ACTION
☐	☐	☐	O_3 Analyzer	
☐	☐	☐	O_3 Transfer Standard	
☐	☐	☐	Consumable Reagents Replaced (charcoal/dessicant)	
☐	☐	☐	Clean or Change Inlet Tubing	
☐	☐	☐	Other:	

4. DRY DEPOSITION SAMPLING EQUIPMENT CALIBRATION/MAINTENANCE

Pre Cal.	Maint. Completed	Post-Cal.	ITEM	CORRECTIVE ACTION
☐	☐	☐	Sampling System Leak Check	
☐	☐	☐	Flow Controller Calibrated (pre and post values must be documented)	
☐	☐	☐	Replace Balston Particulate Filter	
☐	☐	☐	Rebuild Pump	

5. METEOROLOGICAL EQUIPMENT CALIBRATIONS/MAINTENANCE

Pre Cal.	Maint. Completed	Post-Cal.	ITEM	CORRECTIVE ACTION
☐	☐	☐	Wind Speed Range (4 point)	
☐	☐	☐	Wind Speed Starting Threshold	
☐	☐	☐	Wind Direction Orientation and Linearity (8 point)	
☐	☐	☐	Wind Direction Torque	
☐	☐	☐	Temperature Probes (3 point)	
☐	☐	☐	Relative Humidity Sensor (hourly averages)	
☐	☐	☐	Aspirators (Climatronics/Qualimetrics/RM Young/Rotronics)	
☐	☐	☐	Solar Radiation (hourly averages)	
☐	☐	☐	Precipitation	
☐	☐	☐	Wetness	
☐	☐	☐	Other:	

-- Continued --

Exhibit 5. Copy of the Semiannual Site Visitation Checklist (Continued)

SEMIANNUAL SITE VISITATION CHECKLIST
NPS Ambient Air Quality Monitoring Program

Air Resource Specialists, Inc.

6. DATA ACQUISITION CALIBRATIONS/ MAINTENANCE/ OPERATIONAL VERIFICATION

Pre Cal.	Maint. Completed	Post-Cal.	ITEM	CORRECTIVE ACTION
☐	☐	☐	Datalogger Time and Date	
☐	☐	☐	Datalogger Keyboard (operations test, cleaned)	
☐	☐	☐	Datalogger Modem	
☐	☐	☐	DataView System (computer operational, software functioning, communication links functioning)	
☐	☐	☐	Printer (operations test, ribbon, cleaned)	
☐	☐	☐	Other:	

7. STATION MODIFICATIONS AND CONFIGURATION ENHANCEMENTS

Pre Cal.	Maint. Completed	Post-Cal.	ITEM	CORRECTIVE ACTION
☐	☐	☐		
☐	☐	☐		
☐	☐	☐		
☐	☐	☐		

8. OBSERVE/TRAIN STATION OPERATOR

ITEM	CORRECTIVE ACTION
☐ Observe Operator Competence	
☐ Review Log Notes, Data Documentation	
☐ Train, if necessary	
☐ Review Changes in SOPs or Other Operational Changes	
☐ Verify That On-Site SOPs are Available and Complete	
☐ Encourage/Answer Station Operator Comments or Questions	
☐ Inform Operator if Additional Action is Required	

9. VERIFY AND UPDATE SITE EQUIPMENT INVENTORIES AND DOCUMENTATION

ITEM	CORRECTIVE ACTION
☐ Inventory Completed	
☐ Site Documentation Photographs Taken:	
- Cardinal Directions	- All Other Exterior Instrumentation
- Shelter Exterior Close-up	- Interior Instrumentation
- Tower(s) with Instrumentation	- Scenic Photograph

10. SUPPLEMENTAL FLOW CHECKS (please note)

Pre Cal.	Maint. Completed	Post-Cal.	ITEM	CORRECTIVE ACTION
☐	☐	☐		
☐	☐	☐		
☐	☐	☐		

Semiannual visit checklist.doc (01/08)

-- End --

Site Description

The Look Rock site is located in the Great Smoky Mountains National Park on top of a mountain with an overlook to the north. The site is located at the end of a road secured by a locked gate (chain/post and barrage metal bar) limiting access to the site by unauthorized vehicles. The site does have a walking path to the overlook tower that passes by the site. During the audit, 12-15 people passed the site to the overlook tower. The site has a locked gate

and an 8-ft. tall metal fence with barbed wire at the top of the fence surrounding the instrumentation for the CASTNET program. The shelter (also has locked entry) is roughly 8-ft tall with 2 10-m towers along side. One tower houses the ozone inlet and filter pack. The second tower is used to secure the meteorological equipment. Also at the site is an NCore station that has its instrumentation housed in a separate locked shelter. This shelter is also fenced in with an 8-ft. tall metal fence with barbed wire. An IMPROVE sampler is located inside an 8-ft. tall metal fence. Pictures for 6 of the 8 cardinal directions were taken and will be provided with the report. Looking southeast and east could not be taken due to overlook of the cliff.

(Distance measurements and compass directions are from the ozone inlet on the 10-m tall tower)

Items	Compass Degrees	Distance (m)	Height (m)
A. 10-m tower with ozone inlet and filter pack	-	-	10
B. 10-m tower with meteorological equipment	340	1.9	10
C. AMoN passive sampler	290	2.7	2.2 (height above roof)
D. PM2.5 TEOM sampler inlet	190	1.2	1.7 (height above roof)
E. Nephelometer sampler	222	3.5	2.5 (height above roof)
F. Tipping bucket	210	3.7	1.6 (height above roof)
G. IMPROVE sampler	282 (shelter center)	7.7	2.6 (shelter height)
H. NCore system	70 (shelter center)	7.9	3.7 (shelter height)

See Appendix A for responses to questionnaire and Appendix B for photos of the GRS420 site.

FINDING 1:
Obsolete copies (hard copies) of field operation SOPs were found at the field site location (GRS420).

Discussion:
When reviewing documentation maintained at the field site, Mr. Nichol found a binder with old ARS SOPs for field operations at the site. The site operator (Mr. McClure) uses the DataView system for his visit as he demonstrated during the TSA. But when discussing the need for hard copies of SOPs at the site, Mr. Slate suggested these hard copy SOPs were used if the DataView system was down (inoperative). This practice is a good backup plan to have hard copies for when the computer system is down, but these SOPs need to be replaced with current SOPs.

RECOMMENDATION:

RTI recommends removing the obsolete hard copy versions of the field SOPs and replacing them with the current versions. Obsolete SOPs should be checked at all of the other NPS sites under the CASTNET program. Based on Section 9 Verify and Update Site Equipment Inventories and Documentation on the Semiannual Site Visit Checklist suggest that removing obsolete documents should be done during the 6-month calibration visit. But this might be understood to verify the DataView system is operational and using the most up-to-date software version. RTI recommends the ARS Field Operations Specialist Manager, QA Officer, and QA Manager discusses the handling of obsolete documents (hard copies) and has a further discussion with the other Field Specialists to confirm they are also looking for obsolete documentation in the site's shelters.

ARS Response:

Hard copies of SOPs and checklists will be reviewed by the ARS field specialists during each maintenance visit. Outdated copies will be removed and replaced with current versions. The Site Visitation Checklist in SOP "F_VISIT_MTCAL_AQSITE_2016Oct_F_1.0" will be updated to reflect these new procedures.

FINDING 2:
Obsolete hard copy document for ARS contact information for support for the field operator was found at the field site location (GRS420).

Discussion:

Mr. Nichol presented the obsolete document with outdated contacts to Mr. Slate. He removed the list and stated he will replace it with current contacts.

RECOMMENDATION:

RTI recommends for the Field Specialist(s) when conducting their 6-month calibration check to review the documentation in the shelter and remove any obsolete documents. Further, before leaving for the site visits, prepare a hard copy packet of current documents (QA documents, contact list, checklist, etc.) to replace obsolete documents during the 6-month calibration check.

ARS Response:

Contact information posted in the monitoring shelters will be reviewed for accuracy by the ARS field specialists during each maintenance visit. All contact information placards will be replaced with generic contact information, directing site operators to call the main ARS office and request the "Tech of the Week" for assistance.

Section 5: Laboratory Operations (Ozone Calibration Laboratory)

The Ozone Calibration Laboratory is staffed by experts in ambient ozone measurements. The laboratory consists of a central laboratory for providing maintenance, repairs, testing, and verifying the equipment used in the ozone collection process. There also is a shipping room for sending equipment (onsite Level II transfer standards, Level III site analyzer, tubing, pumps, etc.) to the site operators by Fed-Ex. The Ozone Calibration Laboratory also ships and receives the Level II transfer standards used by the field technicians during the 6-month calibration checks.

Staff at the ARS Laboratory maintain and control all NIST-traceable certifications of their standards through a database controlled by Ms. Lariviere that can track, schedule, and maintain the certificates. This database informs Ms. Lariviere by an e-mail when a standard is coming close to being out of certification prompting her to schedule the recertification. This database allows the Field Specialists to prepare a standards package prior to visiting sites for a 6-month calibration check. The Level II standards are certified by NIST or EPA Regional Office and the Level III site analyzers are certified by ARS with Level II ozone analyzers. The Level II transfer standards used for the 6-month calibration check and the laboratory-controlled standards are listed on the CASTNET website with the most recent certification date. Currently, there are four Level II transfer standards (see **Exhibit 6**) and annual recertifications all of which are maintained in the database of certifications on the ARS server. The Ozone Calibration Laboratory also maintains two primary standards that remain in the laboratory at all times unless being recertified. These two standards are used as laboratory controls. Besides the ozone analyzers, the Ozone Calibration Laboratory also uses and tracks 27 flow meters (BGI tetraCals, BGI deltaCals, and BIOS Defender 220 units that are certified by MesaLabs, 19 temperature sensors certified annually at Micro Precision Calibration, and 3 barometric pressure sensors (2 within certification from Micro Precision Calibration).

Exhibit 6. Standards Used by ARS on CASTNET Program

		Manufacturer S/N and EPA Decal Number	Last Certification Date
Level II Transfer Standards			
1	Thermo 49i PS	S/N: 1130450195	February 15, 2017 by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)
2	Thermo 49i PS	S/N: 1130450196	January 20, 2017 by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)
3	Thermo 49i PS	S/N: 1130450197	April 11, 2017 by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)
4	Thermo 49i PS	S/N: 1130450192	October 14, 2016 by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)
Laboratory-Controlled Standards			
1	Thermo 49C	S/N: 75759-380	December 30, 2015
2	Thermo 49i PS	S/N: 733726105	December 30, 2015

A primary responsibility of the staff in the Ozone Calibration Laboratory is to provide technical support to the site operators that operate the CASTNET monitoring sites. The staff can be reached by telephone, and e-mail, but preferably through the DataView log or Site Status Log. All telephone calls relating to issues at the monitoring sites are documented into the Site Status Log. All records are electronically backed up and the QA Manager conducts internal reviews of the complete process.

The ARS QA Manager and QA Officer have worked with the Field Operations Manager to improve the documentation tracking of training provided to current Field Specialists and newly hired Field Specialists. **Exhibit 7** is an example of a Field Specialist's ARS Field Technician Technical Training Checklist that includes required EPA Air Pollution Training Online Course and field equipment used at the Ozone Calibration Laboratory and field

sites. When a Field Specialist completes a training task, a senior Field Specialist (trainer) signs off and dates the completion. This checklist is an internal checklist used by the Ozone Calibration Laboratory and is provided to the QA Manager as a record of performance capabilities.

Exhibit 7. Example of an ARS Field Technician Technical Training Checklist

ARS Field Technician Technical Training Checklist

Date completed	Employee Initials	Trainer Initials	Air Polution Training Institute Online Courses
			100 Basic Concepts in Environmental Sciences
1-10-17	JE	MS	105 Introduction to Air Pollution
			409 Basic Air Pollution Meteorology
			433 Network Design & Site Selection for Monitoring PM2.5 & PM10 in Ambient Air
			434 Introduction to Ambient Air Monitoring
			436 Site Selection for Monitoring of SO2 and PM10 in Ambient Air
			471 General Quality Assurance Considerations For Ambient Air Monitoring (1984)
			473A Beginning Environmental Statistical Techniques

Date completed	Employee Initials	Trainer Initials	Field Training
3-7-17	JE	MS	Tower training and tower rescue training
			First Aid/CPR Training
12-3-16	JE	MS	Review 49i and 49C Ozone Analyzer manual
			Review Teledyne API 400E/T400 Ozone Analyzer manual
1-10-17	JE	MS	Ozone Quality Assurance Training
1-10-17	JE	MS	Zero Air Source Maintenance Training
12-12-16	JE	MS	CASTNET Flow Calibration and Maintenance Training
12-12-16	JE	MS	Wind Direction Orientation Training
12-12-16	JE	MS	Wind Speed and Wind direction calibration and maintenace (RM Young and Climatronics)
12-12-16	JE	MS	Ambient Temperature Calibration and Maintenance Training
12-12-16	JE	MS	Relative Humidity Calibration and Maintenance Training
12-12-16	JE	MS	Precipitation Calibration and maintenance Training (Tipping Bucket)
12-12-16	JE	MS	Solar Radiation Calibration and Maintenance Training
			Barometric Pressure Calibration and Maintenance Training
3-29-17	JE	MS	Met One BAM 1020 Calibration and Maintenace Training
			Thermo TEOM 1400 AB Calibration and Maintenance Training
2-15-17	JE	MS	Thermo TEOM 1405/1405DF Calibration and Maintenance Training
			Thermo 5014i BAM Calibration and Maitenance Training
			Met One E-Sampler Calibration and Maintenance Training
			MetOne E-BAM Calibration and Maintenance Training
			TSI Dust Trak Calibration and Maintenance Training
12-12-17	JE	MS	BIOS Definer 220 Operation Training
3-29-17	JE	MS	BGI DeltaCal Operation Training
			Thermo 43C/43i SO2 Analyzer Calibration and Maintenance Training
			Teledyne API 100E SO2 Analyzer Calibration and Maintenance Training
			Thermo 42C/42i NO/NO2/NOx Analyzer Calibration and Maintenance Training
			Teledyne API 200E NO/NO2/NOx Analyzer Calibration and Maintenance Training
			Thermo 48C/48i CO Analyzer Calibration and Maintenance Training
			Teledyne API 300E CO Analyzer Calibration and Maintenance Training
12-12-16	JE	MS	ESC 8816/8832 Datalogger Training
			Campbell 23X Datalogger Training
12-5-16	JE	MS	Campbell CR850/CR1000/CR3000 Datalogger Training
12-12-16	JE	MS	Dataview Overview and Operation Training

The QA Department also has training checklist documents for staff (Field Specialist) for reading, understanding, and performing field SOPs for project work (see **Exhibit 8**). The QA Department also tracks through a checklist new Field Specialist understanding of 40 CFR Part 50 requirements as displayed in **Exhibit 9**. A senior Field Specialist will determine if the new employee has read and understood the SOPs and CFR requirements by observing their performance in the Ozone Calibration Laboratory and field site visits.

Exhibit 8. Example of an ARS Field Technician SOP Technical Training Checklist

ARS Field Technician Technical Training Checklist

Date completed	Employee Initials	Trainer Initials	SOPs to review
			· F_GAS_MTCAL_O3TransferStd_2016Oct_F_1.0
			· F_GAS_MTCAL_OZONEL2_2016Oct_F_1.0
			· F_GAS_MTCAL_OZONEL3_2016Oct_F_1.0
			· F_GAS_MTCAL_NOX_2016Oct_D_1.0
			· F_GAS_MTCAL_CO_2016Oct_D_1.0
			· F_GAS_MTCAL_SO22016Oct_D_1.0
			· F_PM_MTCAL_BAM_2016Oct_F_1.0
			· F_MET_MTCAL_ATbath_2016_F_1.0
			· F_MET_MTCAL_ATRH_2016Oct_F_1.0
			· F_MET_MTCAL_BAR_2016Oct_F_1.0
			· F_MET_MTCAL_RNF_2016Oct_F_1.0
			· F_MET_MTCAL_SOL_2016Oct_F_1.0
			· F_MET_MTCAL_WD_2016Oct_F_1.0
			· F_MET_MTCAL_WS_2016Oct_F_1.0
			· F_SITEOPERATOR_AQSITE_2016Oct_F_1.0
			· F_SITING_AQSITE_2016Oct_F_1.0
			· F_VISIT_MTCAL_AQSITE_2016Oct_F_1.0
			· L_MET_MTCAL_ATRH_2016Nov_F_1.0
			· L_MET_MTCAL_WD_2016Nov_F_1.0
			· L_MET_MTCAL_WS_2016Nov_F_1
			· 3350 COLLECTION OF AMBIENT AIR QUALITY AND METEOROLOGICAL MONITORING DATA
			· 3450 AMBIENT AIR QUALITY AND METEOROLOGICAL MONITORING DATA VALIDATION
			· 3456 CONTINUOUS PARTICULATE MONITORING DATA VALIDATION
			· 3550 AMBIENT AIR QUALITY AND METEOROLOGICAL MONITORING DATA REPORTING
			· IT_AQDB_UPDATES_2016Oct_F_1.0

Exhibit 9. Example of an ARS Field Technician 40 CFR Part 50 Technical Training Checklist

ARS Field Technician Technical Training Checklist

Code of federal regulations 40 part 50: National and secondary ambient air quality standards (measurement methods)

https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR :

Date completed	Employee Initials	Trainer Initials	
			· Appendix A-1 Reference Measurement Principle and Calibration Procedure for the Measurement of Sulfur Dioxide in the Atmosphere (Ultraviolet Fluorescence Method)
			· Appendix B Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)
			· Appendix C Measurement Principle and Calibration Procedure for the Measurement of Carbon Dioxide in the Atmosphere (Non-Dispersive Infrared Photometry)
			· Appendix D Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere
			· Appendix F Measurement Principle and Calibration Procedures for the Measurement of Nitrogen Dioxide in the Atmosphere (Gas Phase Chemiluminescence)
			· Appendix G Reference Method for the Determination of Lead in Total Suspended Particulate Matter
			· Appendix J Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere
			· Appendix L Reference Method for Determination of Fine Particulate Matter as PM2.5 in the Atmosphere
			· Appendix O Reference Method for the Determination of Coarse Particulate Matter as PM10-2.5 in the Atmosphere

Code of federal regulations 40 part 50: National and secondary ambient air quality standards (INTERPRETATION of standards)

https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR :

			· Appendix H Interpretation of the 1-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone
			· Appendix I Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone
			· Appendix K Interpretation of the National Ambient Air Quality Standards for Particulate Matter
			· Appendix N Interpretation of the National Ambient Air Quality Standards for PM2.5
			· Appendix P Interpretation of the Primary and Secondary National Ambient Air Quality Standards for Ozone
			· Appendix R Interpretation of the National Ambient Air Quality Standard for Lead
			· Appendix S Interpretation of the Primary National Ambient Air Quality Standards for Oxides of Nitrogen (Nitrogen Dioxide)
			· Appendix T Interpretation of the Primary National Ambient Air Quality Standards for Oxides of Sulfur (Sulfur Dioxide)
			· Appendix U Interpretation of the Primary and Secondary National Ambient Air Quality Standards for Ozone

During the TSA of the Ozone Calibration Laboratory, Mr. Nichol could not find any discrepancies in the operations as stated in the CASTNET QAPP or the ARS SOPs (Appendix 3 of the CASTNET QAPP).

FINDINGS

No problems or issues based on the visit to the Ozone Calibration Laboratory and discussions with ARS staff were found.

Section 6: Data and Data Management

Introduction

The evaluation of the data management system for ozone data was conducted by Mr. Nichol that included a visit to the GRS420 site, a review of the ozone raw data records from the site and a comparison of the data posted to AIRNow, CASTNET, the NPS Air Resource Division website and EPA's Air Quality System (AQS) database. He also performed a review of the overall ozone data management system and QA/QC validation procedure from the site through ARS to final data submission. The overall quantity and quality of CASTNET's project documentation was impressive, and the ARS personnel who assisted with the audit were knowledgeable and helpful. The data management audit looked at several aspects of the operation as well as verifying and comparing selected data, including calculated ozone concentrations, validity flags and status codes, and date/times.

Data Reviewed

The audit of the data review and data management was comprised of five parts: Data Handling/Review, Software Documentation, Data Validation and Correction, Data Processing, and Reporting (Internal and Externally) as well as tracking selected data from a site (GRS420) through data review, validation, and posting. ARS has prepared and documented SOPs designed to cover each of these sections and in most cases, multiple SOPs and Technical Instructions (TIs) that discuss the different components of the audited sections. All data review and data management SOPs are available on the CASTNET (under Appendix 3 of the CASTNET QAPP) and NPS GPMP websites and last reviewed and updated in September 2016. Ms. Ward, the Information Management Section (IMC) Manager, was responsible for reviewing, updating, and approving the SOPs.

Part 1 Data Handling/Review and Part 2 Software Documentation of the audit questionnaire, followed the processes involved with the transferring data points from the ozone analyzer through to the Air Quality Data Base Management System (AQDMBS). The data handling process involves transferring of data through three primary devices: the ESC datalogger, the DataView software housed on a site laptop, and the AQDMBS located at the ARS office location and is covered primarily in SOP 3350 and SOP 3345. A detailed process flow diagram can be found in SOP 3350 Figure 1-1. Software used in the data transfer and review process can be found in SOPs 3340 and 3650, with detailed software information provided Table 3-2 of SOP 3340. All roll-outs of new software are tested and validated by a newly created SOP titled "SOP Tracking Changes and Updates to ARS Developed Database Software (IT_AQDB_Updates_2016Oct_F_1.0) that outline the process for developing a design plan, test, plan troubleshooting, and acceptance plan for in-house developed software.

The RTI auditor reviewed and discussed Data Validation and Correction Procedures and Processes (Part 3 of the questionnaire) and Data Processing and Reporting (Part 4) with Ms. Ward and there was no issues observed. Mr. Nichol observed instances where flags were appropriately added to the data in the preliminary validation stage using the Validation Log and the data remained flagged in the final reporting steps. There exists sufficient validation review levels (five levels) and each step is well documented in SOPs 3450, 3340 and 3650. Reporting, based on polled results, is also adequate and available in a timely manner.

Internal Reporting (Part 5) steps are documented primarily in SOP 3550. Reports exist for audits (such as Technical System Audits (TSAs), 6-month site calibrations, maintenance review, etc.) and are distributed and discussed among the various personnel. The overall quantity and quality of the ARS project documentation was impressive, and the personnel who assisted with the audit were knowledgeable and helpful. The data management audit looked at several of the steps involved in the operation and verifying and comparing selected data, including calculated ozone concentrations, validity flags and status codes, and date/time stamps. Data were compared at the following points in the on-site process:

- "raw" data from site datalogger, viewed and recorded by Mr. Nichol while at the site
- "raw" data from site datalogger, provided by Mr. Slate at the site off the data collection laptop housing DataView software
- data extracted from the in-house database.

In addition, data were polled from external EPA, AIRNow, and NPS databases after uploading from the ARS's database. While each website contains multiple collection parameters and time durations, only hourly ozone data reported was tracked for this audit.

- The EPA/CAMD "CASTNET" website (http://epa.gov/castnet)

  This site allows ad hoc downloading of data from all CASTNET sites. Hourly ozone data are available for download within 24 hours of the sampling date. Because of this quick turnaround, the most recent data are not fully validated. Other types of data are also available from this site. Procedures used for transferring data are contained in the ARS SOP 3350 "Collection of Ambient Air Quality and Meteorological Monitoring Data" Revision 1.8, September 2016.

- EPA AQS system

  This is the final repository of fully validated data for compliance and reporting purposes. ARS uploads data to AQS as described in SOP 3550 "Ambient Air Quality and Meteorological Monitoring Data Reporting", Revision 5.4, September 2016.

  NOTE: Unlimited access to AQS requires an EPA approved account, but subsets of the data are available to the general public through EPA sites such as AQS's DataMart described in the next bullet.

- DataMart (http://www.epa.gov/ttn/airs/aqsdatamarrt/)

  This public EPA website can be accessed by means of an easily obtained username and password, through which hourly ozone data (among multiple other parameters) are available. One limitation of the DataMart is lack of information regarding data flags, submitting agency, and submitted date. Information available to DataMart is readily available after submission to AQS. Files containing hourly Ozone data for the GRS420 site were downloaded from DataMart for comparison with the hourly data.

- AIRNOW (http://www.airnow.gov)

  This site is a valuable resource which allows public access to real-time ozone and meteorological data. Unfortunately it has a severe limitation in regards to the level of access to previously reported data; any data beyond after a single day of collection is not readily available. Similar to DataMart, there exists a site which requires an easily obtained username and password and is linked directly to AIRNow. Some of the reported information contained in this report is taken from this site (https://ofmext.epa.gov/AQDMRS/aqdmrs.html).

- NPS Air Resource Division collects hourly data (www.nature.nps.gov/air/data/current/index.cfm)

  This site includes 8-hour averages and timeline trends. Validated data is also available and updated monthly through http://ard-request.air-resource.com/data.aspx**.**

Site ID's used in all data queries are as follows:

- AQS ID: 47-009-0101
- NPS ID: GRSM-LR
- CASTNET ID: GRS420

Data Evaluation Activities of Typical Reports:

RTI reviewed data streams from the ozone analyzers at the monitoring sites to the posting on several databases. The evaluation of the data reporting system for ozone was reviewed during the on-site portion of the site visit and laboratory audit and off-site during the post-audit review by Mr. Nichol. A comparison of raw data from the ozone analyzer through each of the controlling devices was compared to each other and the 1-minute collected data was averaged to hourly results that were compared to data posted to NPS, CASTNET, and AIRNow. The results of this review are summarized in **Exhibit 10**. The data (reported in ppb) on the analyzer's display screen is reported in tenths of a ppb and truncated to whole numbers in the data file.

Ozone data values read directly from the Thermo 49i primary ozone analyzer by the RTI auditor were observed and immediately compared with listed values on the ESC datalogger system. Variations between the two reported values involved the number of significant figures and the interval with which each was updated. The Thermo 49i updated approximately every 3 seconds while the datalogger updated every second. Comparative Ozone values between the ESC datalogger and values displayed on the site laptop running the DataView software were also made with no discrepancies or flags observed. One-minute data was collected from the DataView software from April 25, 2016 from 8:31 to 9:12 am, which coincides with some of the time the RTI Auditor was at the site. All readings in Exhibit 10 are within acceptable limits.

Exhibit 10. Real-Time Ozone Readings

		Ozone Reading				Ozone Reading				Ozone Reading	
Interval	Time	Screen	Data file	Interval	Time	Screen	Data file	Interval	Time	Screen	Data file
1	8:31	26.3	26	**16**	8:46	29.7	30	**31**	9:01	26.4	26
2	8:32	28.2	28	**17**	8:47	29.2	29	**32**	9:02	28.3	28
3	8:33	27.1	27	**18**	8:48	28.3	28	**33**	9:03	28.3	28
4	8:34	26.1	26	**19**	8:49	29.1	29	**34**	9:04	29.1	29
5	8:35	25.4	25	**20**	8:50	29.8	30	**35**	9:05	29.7	30
6	8:36	25.3	25	**21**	8:51	31.3	31	**36**	9:06	30.2	30
7	8:37	29.8	30	**22**	8:52	30.8	31	**37**	9:07	28.2	28
8	8:38	28.1	28	**23**	8:53	30.4	30	**38**	9:08	29.9	30
9	8:39	26.8	27	**24**	8:54	29.4	29	**39**	9:09	29.9	30
10	8:40	27.4	27	**25**	8:55	30.3	30	**40**	9:10	28.4	28
11	8:41	28.4	28	**26**	8:56	29.8	30	**41**	9:11	27.2	27
12	8:42	29.2	29	**27**	8:57	27.3	27	**42**	9:12	28.2	28
13	8:43	30.8	31	**28**	8:58	28.3	28	**43**	9:13	28.4	
14	8:44	30.2	30	**29**	8:59	28.9	29	**44**	9:14		
15	8:45	30.3	30	**30**	9:00	27.9	28	**45**	9:15		

RTI requested for ARS to provide 1-minute data from their server for three dates. This 1-minute data was converted to hourly data to compare against reported data to AIRNow, CASTNET, and AQS databases. The first two dates (November 20, 2016 and February 16, 2017) would allow RTI to compare data from the file to AIRNow, CASTNET, and AQS. The data for the second date (February 16, 2017) has not been posted as of yet, thus the data can only be reviewed against AIRNow and CASTNET. The last date (April 24, 2017) would be something more recent to track flagging issues and compare the raw file data to data posted at AIRNow and CASTNET. **Exhibits 11**, **12**, and **13** display this comparison. There are slight variations that may be attributed to rounding differences between raw data (off the site laptop) and reported data (websites), or are attributed to slight value adjustments made during the data validation process. Since reported validation codes are not available, values changed by validation adjustments cannot be verified. Due to the minimal amount of change in the values, this is not considered a finding. Based on all the data points collected there exists good cross-agreement from all reporting agencies, and the data collection to submission process detailed in ARS SOP 3550, appears to work as intended.

Exhibit 11. Hourly Reported Data for November 20, 2016

Time	Raw Data File (PPB)	AIRNow (PPB)	CASTNET (PPB)	AQS (PPB)
0:00	34	34	34	34
1:00	33	34	33	33
2:00	32	32	32	32
3:00	33	33	32	32
4:00	32	32	31	31
5:00	32	32	32	32
6:00	32	32	31	31
7:00	31	31	31	31
8:00	31	31	30	30
9:00	31	30	30	30

10:00	31	30	30	30
11:00	32	32	32	32
12:00	33	32	32	32
13:00	35	34	34	34
14:00	36	35	35	35
15:00	38	37	38	38
16:00	39	38	38	38
17:00	38	38	38	38
18:00	38	38	38	38
19:00	38	38	38	38
20:00	37	37	37	37
21:00	36	36	36	36
22:00	35	35	34	34
23:00	36	36	35	35

Exhibit 12. Hourly Reported Data for February 16, 2017

Time	Raw Data File (PPB)	AIRNow (PPB)	CASTNET (PPB)	AQS (PPB)
0:00	44	45	44	-
1:00	43	44	42	-
2:00	42	44	41	-
3:00	41	45	40	-
4:00	40	46	40	-
5:00	41	44	40	-
6:00	39	42	39	-
7:00	40	41	40	-
8:00	40	40	39	-
9:00	40	40	39	-
10:00	40	40	40	-
11:00	41	40	40	-
12:00	42	39	42	-
13:00	45	40	44	-
14:00	46	39	45	-
15:00	47	39	46	-
16:00	47	40	47	-
17:00	48	40	47	-
18:00	48	42	48	-
19:00	49	44	48	-
20:00	48	45	48	-
21:00	49	46	48	-
22:00	48	48	48	-
23:00	48	48	47	-

Exhibit 13. Hourly Reported Data for April 24, 2017

Time	Raw Data File (PPB)	AIRNow (PPB)	CASTNET (PPB)	AQS (PPB)
0:00	20	28	20	-
1:00	21	29	20	-
2:00	17	23	17	-
3:00	17	20	16	-
4:00	23	20	23	-
5:00	18	20	18	-
6:00	22	17	22	-
7:00	17	16	17	-
8:00	15	23	14	-
9:00	14	8	13	-
10:00	17	22	17	-
11:00	19	17	19	-
12:00	24	14	23	-
13:00	28	13	28	-
14:00	30	17	30	-
15:00	33	19	33	-
16:00	34	23	33	-
17:00	105	28	105	-
18:00	85	30	85	-
19:00	31	33	30	-
20:00	32	33	31	-
21:00	31	303	30	-
22:00	31	30	30	-
23:00	27	30	27	-

Data Evaluation Activities of Incorrectly Reported Data:

There were no instances of instrument malfunctions at the GRS420 site in the past year disclosed to Mr. Nichol during the audit.

FINDING 1:

No problems or issues based on the data reviewed and discussion with the QA Manager and IMC Section Manager. The development of the SOP to test and validate updates and changes to software was the only issue in the 2013 TSA and that has been resolved.

Section 7: Quality Control and Quality Assurance

Quality Management Documentation

The quality management system (QMS) consists of the ARS-NPS QAPP and SOPs located on the NPS GPMP Project website (http://ard-request.air-resource.com). Mr. Nichol also reviewed the CASTNET QAPP and QAPP Appendix 1 CASTNET Field SOPs (filter pack operation) and Appendix 3 ARS SOPs (ozone collection process) from the CASTNET website (http://www.epa.gov/castnet). Within the QMS is a controlled document network that consists of SSRFs; DataView Call Log; site and laboratory logbooks; results from internal and external audits and assessments; ARS databases and back-up copies on Amec Foster Wheeler servers; and records of e-mail transmittals.

On the CASTNET website, the current CASTNET QAPP and supplementary SOPs are in the 9.0 Revision and dated October 30, 2016. The QAPP is titled "Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP)" is written in accordance with EPA Guidance Document "*EPA Requirements for Quality Assurance Project Plans EPA QA/R-5*" and "*EPA Requirements for Quality Assurance Project Plans EPA QA/G-5*," and contains all necessary elements for an EPA-approved QAPP. The QAPP is divided into five sections (Project Overview, Field Operations, Laboratory Operations, Data Operations, and Quality Assurance) plus a References and Revision Tracking Sheet. The Project Overview section details purpose of the project, the organizational charts and personnel responsibilities for management of the CASTNET project, schedules and deliverables, data quality objectives (DQOs) and criteria, training, and data management requirements. The Field Operations section describes field activities such as sampling design, frequency, and acceptance criteria for collecting samples, field equipment verification and calibration, and field data management. The Laboratory Operations section details the sample handling and custody, the analytical methods, quality control, and data processing. The Data Operations section describes the software, verification and validation, calculations, and data submittal to EPA and NPS. The Quality Assurance section explains the assessment responsibilities through audits and reviews, examines the DQOs and data quality indicators (DQIs), and corrective action to nonconformities.

The ARS-NPS QAPP was prepared in October 2015 and also follows the EPA Guidance Document "*EPA Requirements for Quality Assurance Project Plans EPA QA/R-5*." This document resides on the NPS GPMP website and is not on the CASTNET website. This was noted during the October 2013 TSA and Amec Foster Wheeler and ARS have decided it was not necessary to post the ARS-NPS QAPP on the CASTNET website. The ARS-NPS closely follows the management structure and steps outlined in the ARS SOPs listed on both the NPS GPMP and CASTNET websites. Mr. Nichol reviewed the ARS-NPS QAPP and noted two concerns:

- In Section A.3 of the QAPP, it states the QAPP will be reviewed at least annually, or at any time that major network changes are implemented, and updated as necessary. There are no records of an annual review. (Finding 1)
- The QAPP lacks an organizational chart show staffing involved with the CASTNET program for the NPS sites. (Finding 1)

Both websites, CASTNET and NPS GPMP, contain current field SOPs used at the Ozone Calibration Laboratory and NPS field sites for the CASTNET program. These SOPs appear are to be reviewed annually and are up-to-date.

Audit and Assessment Program

QC and QA describe the two sets of practices related to a monitoring program that give agencies confidence that the data they collect represent the true air quality of the area. They are the mechanisms by which an organization manages its data collection in a systematic, organized manner and provides a framework for planning, implementing, and assessing work performed by an organization. A properly developed QA/QC program encompasses a variety of technical and administrative elements, including policies and objectives, organizational authority, responsibilities, accountability, and procedures and practices.

QA is a management or oversight function; it deals with setting policy and running an administrative system of management controls that cover planning, implementation, and review of data collection activities, and the use of

data in decision making. QC is a technical function that includes all the scientific precautions, such as calibrations and duplications that are needed to acquire data of known and adequate quality.

As stated in Section 5, all onsite ozone transfer standards are certified as Level II because they have been calibrated by a Level I ozone standard. The Level II transfer standards are used to calibrate the onsite ozone transfer standards twice per year during the 6-month check. The Level II transfer standards are calibrated once per year at NIST or at one of the EPA regional laboratories by a Standard Reference Photometer (SRP), otherwise known as a Level I standard. The CASTNET ozone analyzers undergo nightly zero, span, and precision (ZSP) checks to quickly diagnosis any problems with the system and also a multi-point verification every month. A data review is performed daily on the ZSP checks by an automatic screening system. Every CASTNET ozone analyzer within the network is audited once per year by an independent auditor who completes a Performance Evaluation (PE). The PE results are required to be submitted to AQS before annual data can be certified. In addition, each year 20% of the network participates in the National Performance Audit Program (NPAP). State, local and Tribal agencies participate in the NPAP to provide consistency in the data across all monitoring organizations.

For the GRS420 site, the last 6-month calibration prior to the TSA was conducted on October 30, 2016 (see **Appendix D**), the last PE by EEMS was performed on October 27, 2016 (see **Appendix E**), and the fourth quarter NPAP audit conducted by the state of TN was reported on November 21, 2016 (see **Appendix F**). **Exhibit 14** below states the acceptance criteria for each of the assessments performed at the CASTNET monitoring sites.

Exhibit 14. Acceptance Criteria for Calibration and Audit Checks

Assessment	Acceptance Criteria
ZSP Checks	Zero value $\leq \pm 10$ ppb Precision/Span $\leq \pm 7\%$ between supplied and observed concentrations
6-Month Calibration Checks	All points within ±2% of full scale of the best fit straight line ±5% of actual for any value, $r^2 > 0.9950$, 0.9500 < slope < 1.050 -3.0 ppb < intercept < 3.0 ppb
PE Audits	All points within ± 2% of full scale of best fit straight line Linearity error < 5%

ARS has applied sufficient steps in the electronic data management system for the ozone collection process to manage both data input and QA/QC to provide precise data quality reporting. ARS management and the QA Manager have done an excellent job of maintaining good quality monitoring data for the CASTNET program and the current staff and management have displayed the commitment to provide informed quality data to AIRNow, NPS, and AQS. By applying some improvements in the current practices such as developing a schedule to review the ARS-NPS QAPP and development of an organizational chart for staff working on the CASTNET program will help ensure that these practices continue in the future.

FINDING 1:

The October 2015 QAPP provided by the ARS QA Manager was outdated and has not been reviewed annually as stated in Section A.3 of the QAPP and is lacking a current organizational chart of ARS management and working staff on the CASTNET program.

Discussion: Mr. Nichol discussed the findings of the previous TSA conducted in October 2013 with the QA Manager, Ms. Vanden Hoek. The main focus was on the improvements in the QA documentation other than the lack of annual QAPP review. Ms. Vanden Hoek is in the process of developing a list of changes/corrections to be sent to the Program Manager of the NPS GPMP for revising the QAPP. Her plan is to send changes to the 2015 QAPP and add changes as an addendum. The addendum will be attached to the 2015 QAPP and incorporated in to a revised QAPP at a later date. The QAPP will still be reviewed annually, with addendum added as changes, and a schedule will be developed to add all addendums to a revised QAPP. Ms. Vanden Hoek will also develop an organizational chart which will be added to the addendum.

RECOMMENDATION:

RTI agrees with Ms. Vanden Hoek plan to create an addendum of additions/deletions/changes to the 2015 QAPP and submit the addendum to NPS for approval. At a later date, the QAPP needs to be updated to include those addendums. NPS and ARS need to decide on a schedule frequency for adding the addendums to the QAPP and updating/revising the QAPP and go through the complete approval process. An organizational chart needs to be developed and included on the first addendum review and updated as needed of changes annually.

ARS Response:

ARS will follow the above recommendation for QAPP revisions in conjunction with NPS. An organizational chart was provided to the auditor and will be included in the next QAPP addendum.

APPENDIX A

Great Smoky Mountains National Park
(GRS420)
Field Site Questionnaire

Technical Systems Audits (TSAs) for Ozone Measurements in the Clean Air Status and Trends Network (CASTNET) Program

Monitoring Site
Technical Systems Audit Form

RTI International
3040 Cornwallis Road
Research Triangle Park, NC 27709
Telephone (919) 541-6000

Table of Contents

Technical Systems Audits (TSAs) for Ozone Measurements in the Clean Air Status and Trends Network (CASTNET) Program

Monitoring Site
Technical Systems Audit Form

This audit form was prepared by RTI International (RTI) to evaluate the technical systems for ozone measurements at the CASTNET air monitoring sites operated by Air Research Specialists, Inc. (ARS). This form will be used to evaluate the QA/QC documentation, network management, basic site operations (ozone specific), sample siting requirements, and data management at the Great Smoky Mountains National Park (NP) – Look Rock (GRS420) in Tennessee and the ARS CASTNET Ozone Calibration Laboratory in Ft. Collins, Colorado. All questions are based on 40 Code of Federal regulations (CFR) Part 58 Ambient Air Quality Surveillance and Appendix H of Volume II of the EPA QA Handbook for Air pollution Measurement Systems. RTI will use the current CASTNET Quality Assurance Project Plan (QAPP), Standard Operating Procedures (SOPs) and quarterly Quality Assurance Reports posted on the CASTNET website (www.epa.gov/CASTNET). The current CASTNET QAPP is Revision 9.0 dated October 2016 with ten appendices. Several of these appendices or particular sections of the appendices will used as a basis to prepare questionnaires for the TSA of the field site (ozone activities), CASTNET Calibration Laboratory (ozone), and data management system for ozone reporting to EPA AQS. Those appendices are:

- CASTNET QAPP
- Appendix 1 CASTNET Field SOPs, and
- Appendix 3 ARS SOPs.

RTI will also use the following QA documents from the National Park Service (NPS) Air Resources Division Gaseous Pollutant Monitoring Program (GPMP) at the NPS website (https://ard-request.air-resource.com/Project/documents.aspx). The current GPMP QAP is Revision 3 dated October 2015.

- GPMP QAPP,
- Checklist Instructions,
- SOPs, and
- Site Visits Reports.

Part 1. General Information

Monitoring Site Information

NAME/LOCATION OF MONITORING SITE: (Ozone): **Great Smoky Mountains National Park (NP) – Look Rock**

MONITORING SITE (Shipping) ADDRESS: **1300 Cherokee Orchards Road, Gatlinburg, TN 37738**

MONITORING SITE AQS NUMBER: **47-009-0101** CASTNET SITE NUMBER: **GRS420**

MONITORING AGENCY AFFILIATION: **CASTNET**

NAME OF ANALYSIS/SUPPORT LABORATORY: **Air Research Specialist (ARS), Inc. in Ft. Collins, CO**

AUDIT TEAM MEMBERS/AFFILIATIONS: **Jeff Nichol (RTI)**

AUDIT DATE: **April 25 and May 3, 2017**

PERSONNEL INTERVIEWED:

NAME	POSITION	PHONE/E-MAIL
Site		
Ethan McClure	**Site Operator**	**ethan_mcclure@nps.gov**
Jim Renfro	**Backup Site Operator**	**jim_renfro@nps.gov** **865-436-1708**
ARS Ozone Calibration Laboratory and Data Handling		
Emily Vanden Hoek	**ARS (CASTNET) QA Manager**	**evandenhoek@air-resource.com** **970-484-7941**
Mike Slate and Mark Tigges	**ARS Field Operations Manager**	**mslate@air-resource.com** **mtigges@air-resource.com** **970-484-7941**
Will Yahr, Jake Zaragoza, and Dave Beichley	**ARS Field Specialists**	**wyahr@air-resource.com** **jzaragoza@air-resource.com** **dbeichley@air-resource.com** **970-484-7941**
Jessica Ward	**ARS Information Management Section Manager**	**jward@air-resource.com** **970-484-7941**

OPERATIONAL AREAS THAT WERE OBSERVED: Auditor observed site operator (Ethan McClure) removing and loading the filter pack, replacing inline filter and conditioning it for ozone collection, completing SSRF, and using DataView to check meteorological instrumentation and ozone check. We also discussed training provided, general operations, use of DataView system, troubleshooting, maintenance, and repair/replacement of equipment at site.

Part 2: Basic QA/QC

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. QAPP and SOPs				
1. Is there an EPA approved quality assurance project plan (QAPP) specific to the CASTNET work being conducted by the laboratory?			X	Current CASTNET QAPP in Revision 9.0 dated October 2016 for EPA-sponsored sites and laboratory (filter pack) operation. National Park Service (NPS)-sponsored sites use another QAPP developed for the NPS programs titled "Gaseous Pollutant Monitoring Program Quality Assurance Project Plan (QAPP)", Revision 3 dated October 2015.
2. What is the level of detail Category (i.e., 1, 2, 3, etc.) consistent with EPA guidelines) of the QAPP?				Both QAPPs are Category 1.
3. Does the QAPP reflect, present, and address specifications (i.e., MQOs, DQIs, MDLs, etc.) that are in accordance with those specified for the CASTNET program?	X			
4. Does the QAPP follow the guidelines and requirements outlined in the EPA Guidance Documents (EPA QA/G-5 and EPA QA/R-5)?	X			
5. Does the QAPP identify a reviewing process for the QAPP and other QA documentation?	X			In Section A3, the QAPP is to be reviewed annually.
6. Are all the elements of the EPA Guidance Documents met in the QAPP?	X			
7. Has it been reviewed by all personnel (lab, field, management, etc.) associated with conducting the CASTNET work?	X			CASTNET QAPP (EPA-Melissa Puchalski-EPA Project Officer) Amec Foster Wheeler management (H. Kemp Howell-Project Manager, Ann Bernhardt- Project Quality Assurance Supervisor, and Marcus Stewart-Quality Assurance Manager) ARS-NPS QAPP (NPS-Barkley Sive-Program Manager) ARS management (Joe Adlhoch-Program Manager and Emily Vanden Hoek-QA Manager) The NPS serves as the regulatory agency.
8. Has the Regional EPA Clean Air Markets Division (CAMD) Project Officer and QA Officer reviewed the QAPP?			X	CASTNET QAPP Melissa Puchalski-EPA Project Officer Andy DuPont-EPA QA Officer Barkley Sive-NPS Contracting Officer's Technical Representative Ryan McCammon-Bureau of Land Management ARS-NPS QAPP Barkley Sive-NPS Program Manager John Vimont-NPS Chief of Research and Monitoring Branch

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
9. Has the CAMD Project Officer and QA Officer approved and signed the QAPP?			X	CASTNET QAPP Date: October 2016 Melissa Puchalski (1/18/17)-EPA Project Officer Andy DuPont (1/30/17)-EPA QA Officer Barkley Sive (1/31/17) NPS-Contracting Officer's Technical Representative ARS-NPS QAPP Date: October 2015 No EPA staff signature Barkley Sive (10/8/15)-NPS Program Manager John Vimont (10/8/15)-NPS Chief of Research and Monitoring Branch For ARS, NPS serves as the regulatory agency
10. Has the National Park Service (NPS) Contracting Officer's Technical representative approved and signed the QAPP? (Listed on the distribution list)	X			Barkley Sive (10/8/15)-NPS Program Manager John Vimont (10/8/15)-NPS Chief of Research and Monitoring Branch
11. Has the ARS Project Officer and QA Manager approved and signed the QAPP? (Listed on the distribution list; not QA Manager)	X			ARS-NPS QAPP Joe Adlhoch (10/8/15)-Program Manager Emily Vanden Hoek (10/8/15)-QA Manager
12. Is the purpose of the QAPP clearly stated?	X			
13. Is the project organization clearly identified with their roles and responsibilities?	X			
14. Is the organizational chart in the QAPP up-to-date?		X		The ARS-NPS QAPP refers to Figure 1 as the project organizational chart, but the auditor could not locate the figure in the QAPP. The QAPP list Table 1 as the roles and responsibilities of key personnel. ARS comment: Two IT staff have retired, Contracting Specialist left for another position, and there also has been turnover in field staff.
15. Is a copy of the approved QAPP available for review by the field operator(s)? If not, briefly describe how and where QA and QC requirements and procedures are documented.	X			
16. Is a signed copy of the approved QAPP onsite and available to the field operator(s)?	X			Electronic version on DataView system.
17. Has the approved QAPP been reviewed (or will be reviewed) on a periodic basis? Ask to see.		X		In Section A3, the QAPP is to be reviewed annually, but has not been reviewed since October 2015.
18. Is this review of the QAPP documented (or will it be documented)?	X			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
19. Are there amendments or deviations from the approved QAPP?		X		
20. Have they been EPA approved?			X	The NPS serves as the regulatory agency.
21. Are they available for review?			X	The NPS serves as the regulatory agency.
22. Has the QAPP been reviewed or will be reviewed on a periodic basis and re-approved? What is the review/approval schedule?		X		As-needed In Section A3, the QAPP is to be reviewed annually, but has not been reviewed since October 2015.
23. Are reviews/approvals documented? Review.	X			
24. Does the QAPP cover the complete field/laboratory operation for the CASTNET program?	X			Between the CASTNET (Amec Foster Wheeler) and the NPS (ARS) QAPPs, all field and laboratory operations are covered between the two companies.
25. Is there an internal assessment program to determine conformity to quality assurance has been maintained? What assessments are performed?	X			Regular meetings with program director and QA review of all calibration results The internal assessment program at the site for ozone collection includes: a daily ZSP check, a monthly multi-verification check, a 6-month calibration, and an annual PE for the ozone analyzer. During the 6-month calibration and annual PE, a TSA is conducted that might involve the site operator. The data from the DataView log is transmitted to the ARS Office. The field specialist and data analyst can view the data in the Site Status log.
26. Are Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) identified in the QAPP? How are realized?	X			DQO/DQIs are presented in ARS-NPS QAPP Section A7 and limits are presented in Tables 8-11.
27. What steps are performed if DQOs are not achieved and maintained?				
28. Is there a corrective action process in place when Measurement Quality Objectives (MQOs) or operational specifications (e.g., out-of-control calibration data) are not met?	X			Depending on the issue, if an instrument fails to meet acceptance criteria it is calibrated or repaired and data are invalidated as appropriate.
29. Are written and approved standard operating procedures (SOPs) in place for the various samplers and analyzers?	X			
30. Does the format of the SOPs follow the guidelines outlined in the EPA Guidance Document s (EPA QA/G-6)? If not, describe what significant information is missing?	X			
31. Does the SOPs reflect, present and address specifications and operations that are in accordance with those applicable to the CASTNET program?	X			
32. Are the SOPs signed by management and QA staff?	X			
33. Are the SOPs available for review by auditor?	X			
34. Are the SOPs controlled documents?	X			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
35. Are signed copies of the SOPs available to the field operator?	X			Electronically stored on the DataView system. The site also has obsolete hard copies of older SOPs in a 3-ring binder.
36. Does site operator have current up-to-date SOPs onsite? Electronic or hard copies.	X			Electronically stored on the DataView system. The site also has obsolete hard copies of older SOPs in a 3-ring binder. Some of these SOPs dated back to 2000.
37. Are there deviations from the SOPs?		X		
38. If yes to Question 37, have these deviations been documented and approved?			X	
39. Are documented deviations available for review?			X	
40. Has training been conducted for these SOPs?	X			Training occurs in three possible ways: 1-from previous site operator 2- during new site or relocation setup 3-during each semi-annual visit Training is re-enforced during each semi-annual calibration and maintenance visit.
41. Is this training documented?	X			After the 6-month calibration, the ARS Field Specialist goes through all of the procedures conducted during the visit with the site operator and completes a Tailgate Safety Meeting Form and Site Operator Training Form. This form is handwritten by the Field Specialist and signed and dated by the Field Scientist and site operator. A PDF version is submitted back to the site operator and posted on the DataView system.
42. Are the SOPs current and up-to-date and met the specifications presented in the CASTNET program?		X		Hard copies in binder need updated if site still plans to maintain a hard copy version.
43. Is there a process in place to remove obsolete SOPs? Describe the process and where is it documented.	X			Once all ARS SOPs have been revised a memo describing the removal of obsolete SOPs will be prepared. Discuss with Emily. The fact that the auditor found hard copies of SOPs that were outdated could present a concern that other sites have obsolete hard copies of SOPs.
44. Have the SOPs been reviewed on a periodic basis?	X			
45. What are the frequency and the approach?				Annual review – revised as needed
46. Is this review documented? (Review).	X			SOPs are current (reviewed and updated in September-October 2016).
47. Is there an ARS CASTNET project work organizational chart available? (obtain a copy)		X		Obtain a copy of current organizational chart from Emily. Also, note that contact list at the site was obsolete with ARS and Amec Foster Wheeler contact information of staff no longer with either company. Needs updated.

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	

Additional Comments:

14. There is no project organizational chart in the QAPP. The RTI auditor discussed ARS organization for the CASTNET program (NPS) with Emily (QA Manager) and recommended an organizational chart for her list of revised/updated comments on the 2015 NPS-ARS QAPP.

17, 22. The NPS-ARS QAPP has not been revised since October 2015 even though in Section A.3 of the QAPP states it will be reviewed annually. Emily is in the process of developing a list of changes/corrections to be sent to NPS (Barkley Sive) for revising the QAPP. Her plan to send changes to the 2015 QAPP and add changes as an addendum. The addendum will be attached to the 2015 QAPP and incorporated in to a revised QAPP at a later date. The QAPP will still be reviewed annually, with addendum added as changes, and a schedule will be developed to add all addendums to a revised QAPP.

35, 36, 42, 43. When reviewing documentation maintained at the field site, the auditor came across a binder with old ARS SOPs for field operations at the site. The site operator uses the DataView system for his visit, but when discussing the need for hard copies of SOPs at the site, Mike Slate suggested these were used if the DataView system was down. It is a good idea to have hard copies for when the computer system is down, but these SOPs need to be replaced with current SOPs.

47. The contact list at the site was outdated and needs updated with current ARS, NPS, and Amec Foster Wheeler contacts. Mike Slate removed the list when conducting the 6-month calibration and will provide NPS with updated contacts.

B. Organization and Responsibilities

1. Key staff that oversee CASTNET operations:				
a. CASTNET Project Manager				Name: Kemp Howell
b. CASTNET Quality Assurance (QA) Manager				Name: Marcus Stewart
c. NPS Contracting Officer's Technical Representative				Name: Jim Renfro
d. ARS (CASTNET) Project Manager				Name: Joe Adlhoch
e. ARS (CASTNET) QA Manager				Name: Emily Hoek
f. CASTNET QA Auditor(s) 6-month calibration				Name: Will Yahr
g. ARS Field Operations Manager				Name: Mark Tigges and Mike Slate
h. ARS Field Specialist				Name: Will Yahr, Jake Zaragoza, Dave Beichley
i. ARS Information Management Section Manager				Name: Jessica Ward
j. ARS IMC Team Leader				Name: Emily Wiechman
k. ARS IMC Data Analyst				Name: Courtney Grant
l. ARS Data Technician				Name: Melissa Rademacher
m. ARS IMC Air Quality Technician				Name: Matt Smith
2. Name of management responsible for (indicate which apply):				
a. Development of monitoring site,				Name: Field Specialists
b. Coordinates field operations,				Name: Mike Slate
c. Logistical support of field operations,				Name: Field Specialists
d. Training monitoring site operators, and				Name: Field Specialists
e. Review of routine sampler data and quality control data.				Name: Data Management Group and Field Specialists

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
3. Name of ARS staff or subcontractor responsible for (indicate which apply):				
a. Operation of samplers/monitors/equipment,				Name: NPS
b. Calibration of samplers/monitors/equipment,				Name: ARS Field Specialists
c. Maintenance of samplers/monitors/equipment,				Name: ARS Field Specialists
d. Maintenance of monitoring site,				Name: ARS Field Specialists
e. Operation of ozone monitor,				Name: ARS Field Specialists
f. Calibration of ozone monitors, and				Name: ARS Field Specialists
g. Maintenance of ozone monitor.				Name: ARS
4. Is there someone who reviews the following completed forms:				
a. Field forms or electronic entries? Who?	X			Name: Administrative Assistants and Field Specialists
b. Chain of Custody (COC) forms? Who?		X		Name: No COC forms used
c. Review of electronic data from monitors? Who?	X			Name: Data Management Group and Field Specialists
d. Review of field logbooks (site, monitor). Who?	X			Name: Data Management Group and Field Specialists (site uses electronic entries – DataView)
5. Has the review of completed field and COC forms been done?	X			The site operator does not enter any ozone information on the Site Status Report Form (SSRF). All data entries are electronic (DataView)
6. Is anyone responsible for QA audits of the site? If so, who?	X			QA: Field Specialists
7. What is the role of the ARS QA Manager in regards to the CASTNET program?				The QA Manager oversees the quality assurance program, reviews QA documentation, discusses with management the training and source needs for the program, and provides guidance to QA Officer(s).
8. What is the role of the ARS QA Officer in regards to the CASTNET program?				The QA Officer provides the QC guidance and requirements for specific programs, has technical capability to apply to the program, and provides and follows through training requirements and capabilities for each program.
9. Are there two levels of management separation between QA and QC operations? The QC operations can be performed by the site operator.	X			
10. Does the QA auditor have unique standards and equipment? (The QA audit should not be using the same standards, equipment, etc. as the site operator that performs the QC checks.)	X			
11. Has an audit(s) been performed? If so, when?	X			Date: Semi-annual calibration visit conducted 10/30/2016. Audit was performed 10/27/2016.

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
12. Were there any findings during the audits in Question 11?	X			During the calibration visit CASTNET Flow was found at 2.1% low and required calibration. No findings from 10/27/2016 audit.
13. Are audits documented? How?	X			Data reported "as found" and "as left" in trip report posted to NPS website
14. Are the audit results available for review by staff and auditors? Ask to view audits from this program.	X			
15. Does the site operator conduct performance checks of the ozone monitor? Frequency?	X			This site conducts a monthly multi-point calibration check at 0, 200, 110, and 60 ppb.
16. What types of QC checks are conducted?				Daily ZSP checks are automatically performed at 01:46. Monthly checks are performed manually by the site operator using the DataView system and ozone generator in the sampling ozone monitor at specially calibrated levels of ozone to check both secondary ozone standard and collection ozone monitor.
17. Are the results of these checks available for review by staff and auditors? Ask to view check results from this program.	X			On DataView log
18. Is there any internal auditing program for the ozone monitor?	X			6-month visits include calibration challenge (internal PE) and site conditions check among other checks. A multi-point monthly is conducted, but this is not a calibration, just a supplemental check.
19. If yes to Question 18, who conducts the internal audit?				Site Operator and field specialists
20. What is the frequency and where are the results posted?				6-months. Results posted on NPS website.
21. Is there a designated schedule for calibrations of the ozone monitor? Frequency?	X			Every 6 months
22. Are the calibration checks available for review by staff and auditors? Ask to view calibration checks from this program.	X			The 6-month calibration checks are stored in the database and later posted on the NPS website.
23. Are the staff that work at the site agency employees? How many?	X			Site operators are part of the NPS for Great Smoky National Park
24. Do any contractors work at the site? How many? Name?		X		
25. What steps are taken to ensure contract staff meets training and experience criteria?				Training occurs in three possible ways: 1-from previous site operator 2- during new site or relocation setup 3-during each semi-annual visit Training is re-enforced during each semi-annual calibration and maintenance visit.
26. Is this documentation maintained? Where?	X			The semi-annual maintenance and calibration results are stored in the database and later posted on the NPS website. Tailgate form used to track site operator training needs.

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
27. Is there a written procedure for the QA audit, QC checks, calibration, or internal audits for the CASTNET program?				
a. QA audit?	X			Performed once per year on a fixed schedule by an EPA subcontractor (EEMS) and four times a year by state auditor.
b. QC checks?	X			ZSP checks are performed daily at 1:46 A.M and monthly multi-point checks are performed by the site operator.
c. Calibrations?	X			Every 6 months by a field specialist
d. Internal audits?			X	Some checks performed during semi-annual maintenance and calibration visit.
28. Who is responsible for reviewing results from audits and checks to determine of data should be invalidated?				Data Management Group and QA Officer (Christian Kirk)
29. How is the audit data reviewed and what are the decisions (criteria) based on?				ARS follows the limits listed in QA Handbook Volume II with regards to evaluation ZSP checks (10% for data validity) The acceptance criteria for the ozone analyzer is: All points within ±2% of full scale of the best fit straight line, ±5% of actual for any value, r^2>0.9950, 09500<slope<1.050 -3.0 ppb < intercept < 3.0 ppb RTI auditor reviewed the last two months of ZSP checks from March 1 through April 24, 2017 and all checks were within criteria.
30. Is this process documented? Where?	X			The semi-annual maintenance and calibration results are stored in the database and later posted to the NPS website.
31. Are there corrective action steps in place?	X			All data collected "as found" and the audit (calibrator) makes corrections as needed and documents changes. The results are recorded in DataView, the database, and ultimately posted on the NPS website.
32. Where are these steps documented? Review examples of corrective action, if possible.	X			In the checklist forms of the Semi-Annual Site Visitation Checklist
Additional Questions or Comments:				
C. Training, Safety and Chain-of-Custody				
1. Have the monitoring site operators been trained on equipment, operation, maintenance, and data collection/documentation? If so, when?	X			Training occurs in three possible ways: 1-from previous site operator 2- during new site or relocation setup 3-during each semi-annual visit Training is re-enforced during each semi-annual calibration and maintenance visit.
2. Is it fully implemented?	X			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
3. Is this training documented in a training record?		X		Training is documented on tailgate safety meetings and site operator training form, as well as the site laptop.
4. Is the training record available for review?	X			On DataView laptop (Tailgate forms)
5. Is there a process of training, testing, and qualification for job responsibilities?	X			
6. How is training provided and how often is training provided?	X			Training occurs in three possible ways: 1-from previous site operator 2- during new site or relocation setup 3-during each semi-annual visit Training is re-enforced during each semi-annual calibration and maintenance visit.
7. Has the operator been trained in the particular hazards of the instruments/materials that they are using?	X			
8. Are personnel outfitted with any required safety equipment?	X			
9. Are personnel adequately trained regarding appropriate safety procedures?	X			
10. Are personnel adequately trained regarding cylinder handling?			X	
11. Does the site use field data sheet (FDS) and Chain-of-Custody (COC) forms other than the Site Status Report Form (SSRF) provided by the Amec Foster Wheeler laboratory for the filter packs?		X		
12. Are these forms (SSRF) being completed properly?			X	
13. Does sample ID's match the COC?			X	
14. What information regarding the ozone collection is placed on the SSRF.				The site operator does not add any information regarding the ozone collection on the SSRF.
Additional Questions or Comments:				
D. Monitoring Site Housekeeping				
1. How long has this site been used for the CASTNET program?				CASTNET established: October 16, 1998 Ozone collection began: July 23, 1988
2. Are all site logbooks and/or forms filled in promptly, clearly, and completely?	X			Hard copy forms only used if the DataView log is not functioning properly. There was no evidence of the DataView system not working, but there are several hard copy forms available at the site if the operators need to utilize them.
3. Does the operator(s) keep the handling area neat and clean?	X			
4. Is there adequate room to perform the needed operations?	X			
5. Does the samplers appear to be well maintained and free of dirt and debris, bird/animal/insect nests, excessive rust and corrosion, etc.?	X			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
6. Are the walkways to the station and equipment kept free of tall grass, weeds, and debris?	X			
7. Is the shelter (if any) clean and in good repair?	X			
8. Does the site have safety equipment (fire extinguisher, first aid kit, etc.)?	X			
9. Is the ground surface mostly natural materials?	X			
10. Are there separate Operation and Maintenance (O+M) logs for the CASTNET samplers/monitors/equipment?			X	Entries made in the DataView log system. ARS staff also use the Site Status Log, which is a web-based interface to our AQDBMS to log operational and maintenance issues at monitoring sites. There is more comprehensive than entries in the DataView log.
11. If yes to question 10, check the O+M or instrument logs against the SOPs. Are these acceptable?			X	
Additional Questions or Comments:				
F. Documentation				
1. Is there a document control program?	X			The program consists of the QAPP and several attached appendices for SOPs used in the program. An electronic data system (DataView) is used for field entries on a weekly, monthly, and semi-annual basis.
2. Are the following necessary documents for this project in the controlled document program:				
a. EPA-approved QAPP for the CASTNET Program work?		X		Not required for GPMP – National Park Service is regulatory agency. The site collects filter packs to send to CASTNET (Amec Foster Wheeler).
b. SOPs?	X			
3. Have the following necessary quality documents for this project been reviewed, approved and signed:				
a. QAPP – by the CAMD Project Officer and QA Officer, the NPS Contracting Officer's Technical Representative, Amec Foster Wheeler Project Officer and QA Manager, and ARS Project Manager and QA Manager		X		The CASTNET QAPP (Version 9.0) has been approved by all required management leads. This site works under the NPS-ARS QAPP that includes the proper management signatures. The response provided by ARS is correct for their QAPP.
b. SOPs – by the ARS Project Manager and Program QA Manager	X			
4. Is distribution of the project documents controlled to prevent unauthorized copies from being made/distributed? If so, how?	X			All versions are electronically controlled; no hard copies
5. Are outdated controlled documents collected and disposed of at the sites?		X		Hard copies of obsolete SOPS were found at site along with old contact list.
6. Are procedures in place if out-of-date documents are found? If so, briefly describe.			X	
7. Are the following being filled out promptly, legibly, and clearly:				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
a. Logbooks?			X	Site operator uses the DataView system for logging activities at the site.
b. Forms?	X			SSRF forms for filter packs are maintained. Auditor was able to view old forms back to January 2014. Older forms are maintained at Jim Renfro's office in Gatlinburg.
8. Are the logbooks and forms maintained at the site? Where and how?	X			SSRF forms for 3 years
9. If yes to Question 8, are the logbooks/forms available for review?	X			The site operator uses the DataView system for logging visits to the site. These electronic entries (DataView log) are printed out and maintained in the National Park Service Air Quality Station Log binder. The site had entries dating back to July 2000.
10. Are all entries being made in indelible ink (preferably a dark color)?	X			SSRF forms
11. Are corrections to the data being made with a single line through the entry so as not to obliterate the original entry, initials of the corrector, and date of the correction?	X			
12. Has a review of the logbooks/forms been performed? By whom?	X			Checklist forms are maintained on the DataView log on the on-site computer.
13. Are archived logbooks/forms stored at the site? How?			X	Electronic entries made on DataView system.
14. Does the site operator make electronic entries of field activities?	X			
15. If site operator is using is recording field operations electronically, how does he/she record activities if electronic recording is not available such as power outage and no telephone service?	X			Hard copy forms only used if the DataView log is not functioning properly and several hard copy forms are available at the site if the operators need to utilize them.
16. Are hard copy records maintained for short term? Long term?	X			Site operator electronically scans the hard copy record and e-mails or faxes it to the data management group. The information is uploaded to the DataView log.

Additional Questions or Comments:

5. Hard copies of obsolete operational SOPs were found at the site in a 3-ring binder. The site operator generally uses the electronic versions on the DataView system. These SOPs should be updated with current versions.

Part 3: Network Management

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENTS
A. Key Individuals				
1. List all key individuals, job titles, e-mail extensions, and telephone numbers associated with this site.				
(Site operator)				Ethan McClure
(Backup operator)				Jim Renfro
2. Other than CASTNET, what other networks is the site associated?				EPA NCORE site operated by ARS
3. What type of samples is collected at this site?				Filter pack and ozone
Additional Questions or Comments:				
B. Network Planning				
1. What is the date of the most recent network assessment (monitoring network plan)? (mostly likely performed by EPA CAMD)				CASTNET Plan for Part 58 Compliance dated July 21, 2016 for 2016 work plan
2. Is the annual network plan up-to-date?	X			See here - https://www.epa.gov/castnet/ozone
3. Do you collect collocated samples?	X			At MCK131/131 and ROM406/206
4. What is the date of the current network plan?				Previous CASTNET Plan for Part 58 Compliance dated July 21, 2016 for 2016 work plan.
5. Review the network plan includes the information required for each site.				
a. AQS Site ID Number	X			
b. Street Address and geographic coordinates	X			
c. Sampling and Analysis Method(s)	X			
d. Operating Schedule	X			
e. Monitoring objective and scale of representativeness	X			
f. Site suitable/not suitable for comparison to annual NAAQS standards	X			
g. Metropolitan Statistical Area (MSA), Core Based Statistical Area (CBSA), or Combined Statistical Area (CSA) indicated as required?	X			
6. Does the network plan include proposed changes to the network?	X			
7. Does any proposed change affect this site?		X		Changes are addressed as required. No changes are listed for GRS420.
8. Who (person) has custody of the network plan and where and how is it maintained?				EPA CAMD (Tim Sharac) on the EPA CASTNET website.
9. List any non conformance waivers for the site visited?			X	
10. Where are the waivers documented and who gave approval?			X	

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
C. Monitors, Samplers, and Equipment at the Site				
1. List of monitors/ samplers/equipment at the field site and confirm the instrumentation manufacturer, model number, and serial number with the ARS Ozone Calibration Laboratory.				
a. Thermo 49i ozone analyzer (Site)				S/N 11306450193
b. Thermo 49i ozone analyzer (Transfer)				S/N 1023943903
c. Zero air System pump				Werther Model PC7014 pump
2. Check for certification, validation, and calibration labels for samplers, monitors, and equipment.				
Flow pump				Thomas Model 107CAB18 S/N 0191007233
Temperature sensor for shed				YSI Model 44000 Series sensor
Datalogger				ESC Model 8832 S/N A4115K
3. List of calibration (include transfer) and verification standards and certificates. ARS uses 4 transfer standards for 6-month calibration checks and 2 primary standards maintained at the ARS Ozone Calibration Laboratory. All six standards are Level 2.				Level 2 Ozone Standards used for Semi-Annual Calibration Audit
a. Thermo 49i PS ozone analyzer (last calibrated February 15, 2017) by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)				S/N: 1130450195
b. Thermo 49i PS ozone analyzer (last calibrated January 20, 2017) by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)				S/N: 1130450196
c. Thermo 49i PS ozone analyzer (last calibrated April 11, 2017) by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)				S/N: 1130450197
d. Thermo 49i PS ozone analyzer (last calibrated October 14, 2016) by US EPA in RTP, NC by Scott Moore using NIST SRP (NIST Certified on 5/26/2016)				S/N: 1130450192
e. (Primary) Thermo 49i PS ozone analyzer (last calibrated October 14, 2016) by US EPA region 8 by Joshua Rickard using NIST SRP (NIST Certified on 12/30/2015)				S/N: 733726105
f. (Primary) Thermo 49i PS ozone analyzer (last calibrated June 14, 2016) by US EPA region 8 by Joshua Rickard using NIST SRP (NIST Certified on 12/30/2015)				S/N: 75759380
Additional Questions or Comments:				

Part 4: Specific Sampling Criteria (Ozone Sampling)

(There are four operations (site installation and initiation, site operations, field calibrations, and field operations) conducted at each site. The following sections will discuss each operation.

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. Site Installation				
1. Is there a required training program for the ARS staff that perform site installation?	X			The training program consists of senior field specialists training junior field specialists
2. Is there any certification records for instrumentation used to install a CASTNET site? (Examples of this instrumentation would be compasses, inclinometers, measuring tapes, voltmeters, etc.)	X			
3. Does ARS use subcontractors for site installation? Does an ARS staff member oversee all of the installation process?	X			Overseen by ARS staff
4. Is there a checklist the Field Installation Team updates during installation?	X			New Site/Site Relocation Form in SOP "F_SITING_AQSITE_2016Oct_F_1.0"
5. If yes to Question 4, where is it maintained and can the GRS 420 form be reviewed? If not, could ARS provide a completed form from another site?				Records are maintained on the Air Quality Database Management System (AQDBMS) server.
6. Does ARS need to obtain EPA approval for CASTNET site location? Discuss steps in determining site.	X			NPS and EPA approvals
7. Does ARS perform an acceptance test or burn-in of all instrumentation prior to install at the site?	X			
8. Are record maintained of this acceptance testing and where are these records maintained?	X			Included in trip packet maintained on primary file server
9. Are records maintained for the initial onsite equipment calibration for GRS 420? If not, could ARS provide records from another site?	X			When at cal lab, ask for records
10. If yes to Question 9, where is it maintained and can it be reviewed?				Information is stored on the AQDBMS server
11. If calibration standards are used, can ARS provide records of certification? Records maintained where.	X			Records are maintained on the primary server
12. Does the CASTNET sites need to be inspected by local municipalities for Building Codes and Restrictions during the installation process?	X			
13. If yes to Question 12, where are these records maintained?				Records are maintained on the primary server
14. Who provides the training to the site operator?				ARS Field Specialists
15. Is there a checklist or confirmation documentation that the site operator has completed the training?	X			Tailgate Safety Meeting Form and Site Operator Training Form.
16. If yes to Question 15, is this documentation maintained and where?	X			On the AQDBMS server and the DataView system at the site.
17. Is the data acquisition system (DAS) validated during the initial installation? By whom? Records?	X			The Field Specialist verifies the DAS is working properly and the results are included in the Semi-Annual Site Visitation Checklist (Section 6). These records are maintained on the AQDBMS server.

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
18. Are records (Capital Equipment Inventory Checklist) maintained for the inventory of instrumentation installed at the site such as manufacturer, model number, ARS Property Number, EPA decal, etc.?	X			
19. If yes to Question 18, who is responsible for maintaining the inventory records and where are they maintained?				Administrative assistant and records are maintained on the AQDBMS server
20. Does an ARS management staff need to approve the site installation before sampling can begin?	X			
21. If yes to Question 20, is this documented and where?			X	ARS has not yet installed a new CASTNET monitoring site, otherwise the documentation is stored on the AQDBMS server
Additional Questions or Comments:				
B. Site Operations Procedure				
1. Is the ozone sampling performed within the guidelines of an EPA- and ARS-approved SOP?	X			
2. On the average, how often do you visit the monitoring site per week?				Once per week (Tuesday)
3. Is ozone sampling conducted year round? If not, document the timeframe.	X			
4. What is the frequency of sample collection during the peak season? (requirement = hourly)				Hourly
5. Does the site measure ozone during the off season? If yes, what is the frequency of sample collection?	X			Hourly
6. Does the site operator follow the SOP for the weekly site visit? Any deviations? Is a copy of the SOP readily available?	X			
7. Where does the site operator document all procedures performed during each site visit?				DataView log Weekly Station Visit Checklist View checklist
8. If the site operator has a problem, who does he/she communicate with and how?				Information Management Center (IMC) and/or ARS Field Specialist
9. Where does the site operator obtain local weather conditions? Alternate source?				From the temperature sensor on the 10-meter tower. Weather app on SmartPhone
10. What device does the site operator use to confirm shelter temperature? Are values recorded with 20 to 30 ^{o}C?	X			YSI Model 44000 Series sensor last calibrated on October 30, 2016. Shelter temperature probe has traceable calibration. Hourly data are collected and stored.
11. Is this device certified? Frequency?	X			During every semi-annual maintenance and calibration visit (October 13, 2016)
12. Does the site operator complete and document activities in checklists? Which checklist instructions does the site operator use for ozone sampling? (Observe.)	X			Weekly Station Visit Checklist
13. Are the checklists maintained and where?	X			DataView log
14. Is the DataView System Station Log available to track entries? (Review entries.)	X			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
15. What steps does the site operator perform to verify a zero, span, and precision check occurred on the ozone monitor?				ZSP checks are performed automatically at 0146. The site operators only perform ZSP check if requested to do so by ARS.
16. If the operations in Question 15 were not successful, what does the site operator do?				IMC contracts the field specialist to discuss and identify the issue; troubleshoot as needed.
17. Does the site operator perform a flow rate and leak check of the ozone monitor?	X			Leak checks are performed every two weeks or as needed. The operator does check for alarms weekly which would alert them to a low flow condition. Also, the flow rates are checked and noted during the semi-annual visit. If flows are below manufacturer specifications the pump is rebuilt or replaced
18. What device (standard) does the site operator use to measure the flow rate?				The site operator does not measure flow rates at the site for the ozone collection process.
19. Is this standard certified? Review documentation.			X	
20. Where are these values (flow rate and leak checks) documented? Review previous entries if possible.				Leak checks are documented weekly in the DataView log.
21. Is there any documentation on the FDS/COC forms for ozone sampling?		X		The site operator does not enter any information regarding ozone collection on the SSRF.
22. How are telephone conversations documented between the site operator and ARS?				Site operators primarily use the DataView station log to communicate with ARS. There are hard copy forms available in the event DataView is not working properly. These forms are e-mailed, faxed or mailed to the IMC and the information is entered into the AQDBMS by IMC. Additionally, field specialists use the Site Status Log to document correspondence with site operators regarding operational issues.
23. Review and discuss the DAS with the site operator. a. Data from ozone monitor to datalogger (ESC 8816 or 8832). b. Datalogger to network router. c. Network router to computer for review onsite. d. Modem to ARS by Internet.				
24. Is uninterruptable power supplies or backup power sources at the site?		X		
25. What instruments or devices are protected (electrically)?				None
26. How are the ambient ozone sampling and zero, span, and precision check (ZSP) controlled?				Electronically
27. What device is used for the ZSP checks?				Manufacturer: Thermo Model: 49i Serial Number: 1030450193
28. What is the frequency of the ZSP checks?				Daily at 1:46 A.M.
29. Are the ZSP checks documented? Where and how.	X			DataView Log
30. Are steps in place if ZSP checks fail? Review.	X			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
31. How long does it take to conduct a ZSP? Time of Day.				Approximately 20 minutes, beginning shortly before 2:00 A.M.
32. Can the results of the ZSP be reviewed at the site? Review, if possible.	X			
33. What is the height of the inlet for the ambient ozone sampling?				10 meters
34. What is the supply line made of?				Teflon tubing
35. Does it connect to a manifold or designated supply line to the monitor?				Designated supply line to the analyzer.
36. Does the air stream flow through any filters before entering the ozone monitor?	X			A Teflon filter (outside) at the top of the tower.
37. What is the reporting measurement unit for the ozone measurement?				Parts per billion (ppb)
38. What device delivers zero air during the ZSP checks? List the device: manufacturer, model, and serial number.				The zero air supply consists of a compressor with a reserve tank (Werther Model PC7014 pump)
39. Does the air flow go through desiccant and carbon canisters from the zero air system during the ZSP checks?	X			
40. During the ZSP checks, does the air flow from the transfer ozone monitor to the inlet and then to the ambient ozone monitor?	X			
41. What concentrations are evaluated during a ZSP checks?				Zero air, 200 ppb ozone (span), and 60 ppb ozone (precision check).
42. Are MQOs being met at the site for ZSP checks?	X			Zero (±10% ppb) and precision and span (≤±7% between supplied and observed concentrations). ZSP checks are charted.
43. What is the frequency of multi-calibrations of the ozone monitors?				At this site, a multi-point calibration verification check is performed monthly by the site operator. Four ozone concentrations are: 0, 200, 110, and 60 ppb. A calibration check is performed by an ARS Field Specialist every 6 months.
44. How many calibration points are checked?				Four ozone concentrations for the monthly check at: 0, 200, 110, and 60 ppb. Six points (including zero) for the 6-month calibration verification check at: 200, 150, 100, 80, 60, and 0 ppb.
45. How are the multi-point calibration (Pre-Maintenance Ozone Calibration Form) reported and where is the data maintained? (Review data.)				The semi-annual calibration verification results are stored on the primary server.
46. Who are the results reported to?				Results are initially submitted to the QA Manager and/or officer for review, then provided to the IMC and ultimately posted on the NPS website.
47. Who repairs the monitors if outside acceptance during the calibration?				Field specialists
48. Where is the Operation Support Center located?				This is part of the IMC at the ARS offices in Fort Collins, CO

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
49. What is the frequency of checking and replacing the ozone particulate filter?				Filters are inspected weekly by the site operator and replaced as needed. The site operator replaces the filter every week during the summer months. The filter is conditioned by running a ZSP and verified data is acceptable.
50. Who does the site operator contact if there is a problem with the DAS?				Data analyst in the IMC.
51. Discuss Data View software and document site operator's knowledge of the software and entries that he/she would make.				Operators are instructed to document any pertinent information.
52. Does the site operator follow the SOP for data entries in to the DAS?	X			
53. Who is responsible for performing preventive maintenance?				The site operator inspects the site every Tuesday and reports issues to the IMC.
54. Is special training provided for site operator for performing preventive maintenance on the monitors/ samplers/equipment? Briefly comment on background or courses.	X			1-from previous site operator 2- during new site or relocation setup 3-during each semi-annual visit Training is re-enforced during each semi-annual calibration and maintenance visit.
55. Is this training routinely reinforced?	X			During each semi-annual maintenance and calibration visit.
56. What is the site's preventive maintenance schedule for the ozone measuring system?				Six months, or if issues arise.
57. If maintenance, troubleshooting, or replacement of a sampler is required, who does the site operator contact and at what phone number?				Field Specialists are available during business hours for operator support via telephone and/or email (970) 484-7941
58. Who provides support to the site operator when a sampler replacement is preformed? How are these directions provided?				Field Specialist. Direction is provided via telephone support and email with photographs and/or diagrams if required.
60. Does the agency have service contracts or agreements in place with instrument manufacturers? Indicate below or attach additional pages to show which instrumentation is covered?		X		
61. Comment briefly on the adequacy and availability of the supply of spare parts, tools and manuals available to the field operator to perform any necessary maintenance activities. Do you feel that this is adequate to prevent any significant data loss?	X			Sufficient spare parts are available in the ARS laboratories.
62. Is the agency currently experiencing any recurring problem with equipment or manufacturer(s)? If so, please identify the equipment or manufacturer, and comment on steps taken to remedy the problem.		X		
63. Have you lost any data due to repairs in the last 2 years? More than 24 hours? More than 48 hours? More than a week?		X		
64. Explain any situations where instrument down time was due to lack of preventive maintenance of unavailability of parts.				N/A

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
C. Field Calibrations Procedure				
1. Has a biannual TSA been conducted at the site? When and who performed the last TSA.	X			The last TSA was performed by EEMS on October 27, 2016. These are typically performed every other year.
2. Has a biannual performance evaluation (PE) been conducted at the site? When and who performed the last PE.	X			EEMS performed the last annual PE audit on October 27, 2016. These typically occur annually.
3. Is 'as found' data recorded?	X			
4. Is "as found" data provided to the site operator after a PE is conducted? If so, review last few PEs.	X			
5. Has an ARS 6-month calibration been performed at this site? When and who performed the last calibration.	X			Field Specialist (Mike Slate) performed the last maintenance and calibration visit on October 30, 2016.
6. Are the results of the calibration documented? If so, where and review if possible.	X			NPS website
7. What is the frequency of the ARS site calibration?				Six months
8. Review Data View System Station Log to track entries made during calibration.				Review completed on site.
9. Is the transfer ozone monitor allowed time to stable? If yes, what amount of time is allowed?	X			
10. What device is used to provide air for the zero air check for the calibration?				Werther air compressor
11. During the calibration are ozone calibration points taken over the range from 0 to 475 PPB?		X		
12. Is line loss test performed?	X			
13. What does a high line loss indicate (greater than 5%)?				Bad inlet tubing
14. How is this issue resolved and documented?				Inlet tubing is replaced.
15. Is there criteria in place to determine if the ambient ozone or transfer ozone monitor used for ZSP checks need calibration?	X			
16. What is that criteria?				ZSP criteria: Zero value ≤±10 ppb Precision/Span ≤±7% between supplied and observed conditions. Semi-annual calibration verification criteria: All points within ±2% of full scale of the best fit straight line, ±5% of actual for any value, $r^2 > 0.9950$, 09500 < slope < 1.050 -3.0 ppb < intercept < 3.0 ppb
17. Besides running different concentrations of ozone through the site's ozone analyzer, what other steps are performed for the ozone collection system?				Bi-weekly leak checks are performed on the ozone collection system.

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
18. Does the calibrator use NIST-traceable standards when conducting the calibration?	X			
19. Where is the documentation (certificates) maintained? Are they available for review during the audit?	X			On the primary server.
20. Is there a Pre-trip Preparation checklist? If so, who completed it, where is maintained, and can it be reviewed?	X			The Field Specialist completes the pre-trip preparation checklist. The checklist is stored on the primary server.
21. If yes to Question 20, who completed it, where is maintained, and can it be reviewed?				The field specialist completes the pre-trip preparation checklist. The checklist is stored on the primary server.
22. Is there a checklist (Semiannual Site Visitation Checklist) for the 6-month site visit?	X			
23. If yes to Question 22, who completed it, where is maintained, and can it be reviewed? Review GRS 420 last 6-month check.				The field specialist completes the checklist. Following the visit, the checklist is given to the administrative assistant and stored on the primary server.
24. If an analyzer does not perform within acceptance criteria, what does the calibrator do?				Troubleshoot the problem and repair or replace the analyzer.
25. Who determines when an analyzer can be repaired in the field or needs to be shipped back to the ARS Ozone Calibration Laboratory?				Field specialist
26. If an analyzer is removed from the field for calibration failure, what are the steps for replacement and is there a documentation trail? Where is the documentation maintained?				Document maintained on the primary server and the Equipment Maintenance/Repair Record (blue card)
27. If an analyzer fails the 6-calibration, is previous data collected from that site reviewed? By whom?	X			The IMC Data Manager and team lead review the data in conjunction with the field specialist and/or QA department.
28. Is there a form for documenting instrument's maintenance or repair for the 6-month site visit?	X			Field form (excel spreadsheet with several worksheets)
29. If yes to Question 28, who completed it, where is maintained, and can it be reviewed? Review GRS 420 instrumentation blue cards at lab.				Completed October 30, 2016 by Mike Slate and stored on the primary server.
30. What steps are taken to confirm valid ozone data was collected?				ZSP checks are reviewed by data analyst and field specialist
31. Who is responsible for calibration the DAS?				Field Specialist
32. Is there a calibration check form to document the DAS calibration? If so, where is it maintained and review latest DAS calibration for GRS 420 site.		X		ARS has determined this is no longer necessary with the ESC 8816/8832 dataloggers. Although the analog outputs of the ozone analyzers and station reference instruments are tested during semi-annual site visits, analog communications are being phased out and replaced with digital communications.
33. Who is responsible for providing maintenance to the DAS?				The Field Specialist tracks any maintenance performed on the DAS.
34. Who determines if the DAS is operating properly after a calibration check?				The Field Specialist confirms all systems are operating prior to leaving the site.

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
35. Who is responsible for calibration the analog input card on the ESC datalogger?				Since the network transitioned to ESC 8816-8832 series dataloggers, it is not necessary to calibrate the analog input card.
36. Is there a calibration check form to document the ESC datalogger calibration? If so, where is it maintained and review latest ESC datalogger calibration for GRS 420 site.		X		Since the network transitioned to model 88/16/8832 dataloggers, the ESC voltage Analog Input Card Check is no longer performed.
37. Who is responsible for providing maintenance to the ESC datalogger?				Field Specialist
38. What type of training has been conducted during the 6-month site visits?				Training is conducted on any aspect of the instrument/station operations, including ZSP checks, data reporting, data transmittal or other operational requirements where deficiencies are observed.
39. Where is this training documented?				Tailgate safety and site operator training forms.
Additional Questions or Comments:				
D. Field Operations Procedure (performed by the ARS Ozone Calibration Laboratory)				
1. Is there a procedure used by the lab to certify their ozone transfer standards? What is the SOPs title?	X			Lab standards are sent to EPA for certification annually
2. Is there an ozone primary standard for the lab? Obtain copy of most recent certification.	X			What is primary standard (Manufacturer, model, and serial number)
3. Is this unit (primary standard) certified? By whom and at what frequency? Review documents.	X			annually
4. What are the test points used for verifying the ozone transfer standards?				0 ppb, 225 ppb, 180 ppb, 125 ppb, 90 ppb, 50 ppb
5. What is the minimum frequency of certifying the ozone transfer standards?				Level 2 transfer standards are certified annually
6. Who performs the ozone transfer standard process?				Level 2 transfer standards are certified by EPA Regional Offices
7. Is there any required training to perform the process and is there any documentation of this training?			X	Performed by EPA
8. Is this documented (Ozone Transfer Standard Certification Worksheet) and are the documents available for reviewing?	X			
9. How many sample runs are performed during the transfer standards certification?				Six
10. Where is this data maintained? Is it reviewable?	X			Ozone Transfer Standard Certification form stored on the primary server.
11. Describe the certifying process for transfer standard? SOP F-Gas_MTCAL_O3TransferSTD2016_F_1.0				Level 2 transfer standards are certified by EPA annually.
12. How are the transfer standard evaluated? A single point or linear regression over concentration range?				Linear regression
13. What is the evaluation criteria?				The acceptance criteria for the ozone analyzer is: All points within ±2% of full scale of the best fit straight line, ±5% of actual for any value, $r^2 > 0.9950$, $0.9500 < slope < 1.050$ -3.0 ppb < intercept < 3.0 ppb

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
14. Who gives final approval the transfer standard performed acceptable?				QA Officer (Christian Kirk)
15. Is the certification of the transfer standards performed manually or automatic?				Manually
16. Describe the traceability process of all ozone analyzers used in the CASTNET program? (Level I, II, and III)				Level 2 transfer standards are certified by EPA Regional Offices, Level 3 station reference analyzers are certified by ARS using a traveling Level 2 transfer standard.
17. Is there a SOP that identifies maintenance requirements for the ozone transfer standards at the ARS Ozone Lab?		X		
18. Is there a maintenance and calibration schedule for the ozone transfer standards? If yes, where is it maintained and review?	X			Primary server
19. Is there an SOP that identifies the acceptance limits for the temperature and barometric pressure sensors in the ozone analyzers?		X		Limits are based on manufacturer's specifications and recommendations.
20. What is the acceptance limit for the temperature sensor in the ozone sampler? What is done if the sensor is outside the limit? What standard is used to confirm the temperature sensor?				Limit: 2°C Corrective Action: replace sensor NIST-certified transfer standard
21. What is the acceptance limit for the barometric pressure sensor in the ozone sampler? What is done if the sensor is outside the limit? What standard is used to confirm the pressure sensor?				Limit: 5 mm Hg Corrective Action: calibrate NIST-certified transfer standard
19. Is there an SOP that identifies the acceptance limits for leak checks or ozone loss test in the ozone analyzers?		X		
20. What is the acceptance limit for the leak check in mm Hg for the ozone sampler? What is done if the leak check is outside the limit? What standard is used to measure the leak pressure?				Limit: 250 mm Hg Above 230 mm Hg prompts corrective action, which is to replace tubing and check transducers.
21. For the ozone loss test, what ozone certification detector is used? When was it last certified and by whom. Are records of the certifications maintained and where?			X	
22. Is the flow rate checked on the ozone analyzers? If yes, what device is used? Is it certified? Last certification.			X	
23. How are transfer standards tracked when shipped to sites? Where is this documented?				FedEx Courier Service
24. For what reasons would you need to calibration an ozone analyzers?				- Acceptance testing of a new instrument - Installation of instrument at monitoring site - Whenever control limits are exceeded - Prior to any corrective action, service, or maintenance to any portion of the instrument that affect its operation principle - at a maximum interval of 6 months
25. Who performs the calibrations of the site analyzers and transfer standards?				Field specialists
26. How is data tabulated?				Ozone Transfer Standard Certification form on primary server

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
27. Is the data available for review? Review calibration for the primary ozone analyzer at GRS 420.	X			
28. Provide records of purchased equipment for site GRS420 relating to the ozone sampling operation. Where is this information maintained? (Equipment Inventory Database) (QAPP Section 6.2)				
29. Provide the SOP that gives guidance for purchasing, maintaining inventory records, testing, and calibration of equipment procurements. (QAPP, Section6.2)			X	Equipment inventory database and inventory report (provided to program manager annually) are available for review by the auditor.

Additional Questions or Comments:

Genevieve Lariviere (administrative assistant) oversee the scheduling of the standards (ozone, temperature, barometric pressure, flow rate, and voltmeters) used for the CASTNET Ozone collection program. She used a database to track the scheduling, certificates, and location of the standards. An improvement from the previous audit where the standards were tracked by hard copy records, but some electronic records were also found in 2013.

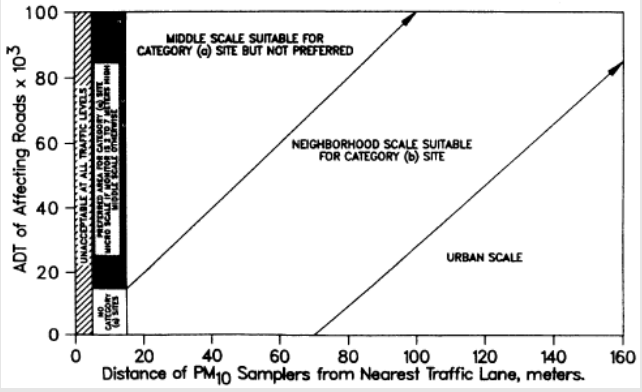
PART 5. Sampler Siting

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. Sampler Siting				
1. Does the location for the samplers conform to the siting requirements of 40 CFR 58, Appendix E?	X			
2. Are there any visible hazards or noticeable problems at the site?		X		
3. Are there any changes at the site that might compromise original siting criteria (e.g., fast-growing trees or shrubs, new construction)?		X		
4. Are there any visible sources that might influence or impact the monitoring instrument?		X		
5. Is the spatial scaling for the site visited neighborhood (0.5 to 4 km), urban (50+ km), or regional (100+ km)?	X			Urban to regional
6. Sampler siting as stated in 40 CFR Part 58 Appendix E. Indicate Y/N to criteria for each sampler, and if no, specify why:				
a. The inlet probe must be between 2-15 m above ground level.	X			
b. The probe must be at least 1 m vertically or horizontally away from any supporting structure, wall, parapets, etc., and away from dusty or dirty areas. If the probe is located near the side of a building, it should be located on the windward side relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.	X			
c. Spaced properly from minor sources. (Away from direct flow of plumes, furnaces, etc.)	X			
d. The probe must have unrestricted airflow and located away from obstacles so that the distance from the monitoring path is at least twice the height the obstacle protrudes above the monitoring path.	X			
e. The monitoring path must be clear of all trees, brush, buildings, plumes, dust, or other optical obstructions, including potential obstructions that may move due to wind, human activity, growth of vegetation, etc.	X			
f. Airflow must be unrestricted in an arc of 270 degrees around the sampler except for street canyon sites.	X			
g. The predominant direction for the season with the greatest pollutant concentration potential must be included in the 270-degree arc.	X			
h. The probe must be at least 20 m from the drip line of the tree or trees.	X			
i. Spacing from roadways. If the area is primarily affected by mobile sources and the maximum concentration area(s) judged to be a traffic corridor or street canyon, the monitor should be located near roadways with the highest traffic volume. See Figure 2 below or 40 CFR 58 App. E.	X			
7. What are the GPS coordinates (latitude and longitude) for the field site:				35.6314° N 83.9422° W

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
8. What is the elevation of the site (feet)?				2,802 feet (854 meters)
9. Nearest meteorological site?				A temperature sensor (6 meters high) is in operation on the 10 meter tower.
Additional Questions or Comments:				

For Ozone Sampling	
Roadway Average daily traffic, vehicles/day	**Minimum separation distance, m**
<10,000	**10**
15,000	**20**
20,000	**30**
40,000	**50**
70,000	**100**
>110,000	**250**

Figure 2. Acceptable Areas for PM_{10} Micro, Middle, Neighborhood, and Urban Samplers Except for Microscale Street Canyon Sites.



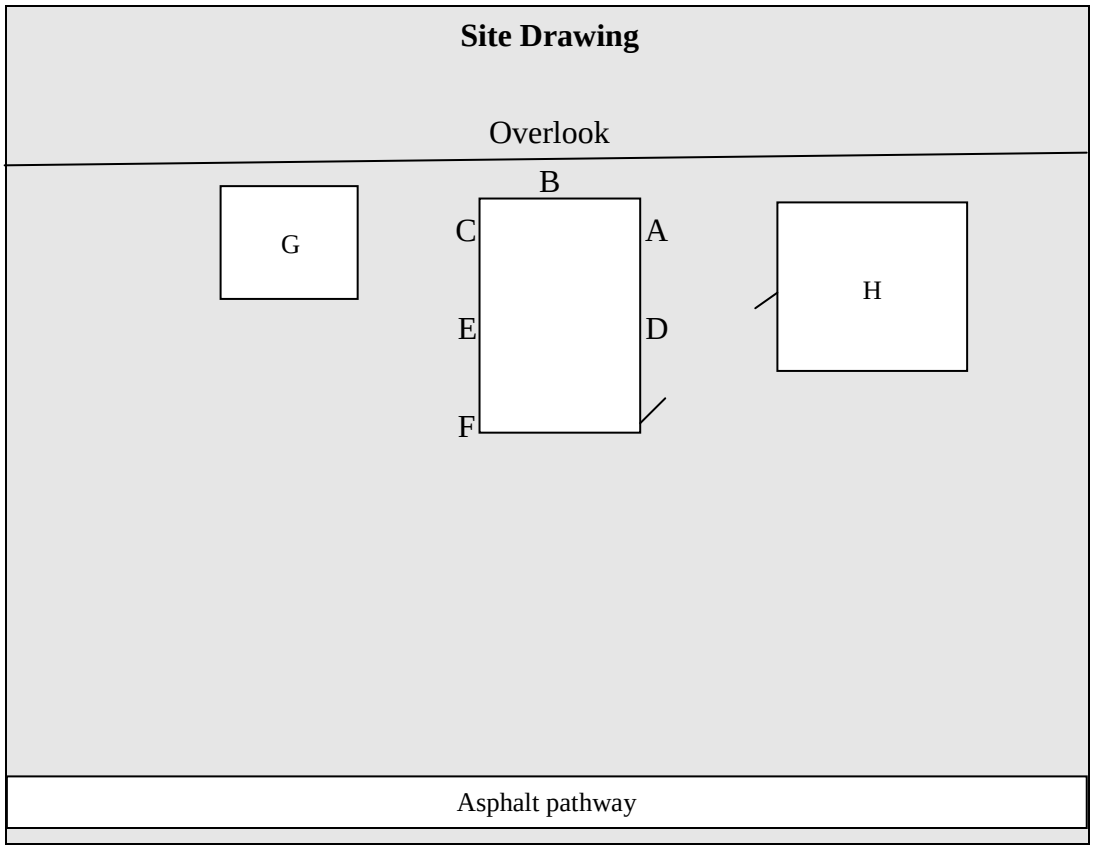
B. Site Sketch

Great Smoky Mountains – Look Rock (GRS 420) Measurements

The Look Rock site is located in the Great Smoky Mountains National Park on top of a mountain with an overlook to the north. The site is located at the end of a road secured by a locked gate (chain/post and barrage metal bar) limiting access to the site by unauthorized vehicles. The site does have a walking path to the overlook tower that passes by the site. During the audit, 12-15 people passed the site to the overlook tower. The site has a locked gate and an 8-ft. tall metal fence with barbed wire at the top of fence surrounding the instrumentation for the CASTNET program. The shelter (also has locked entry) is roughly 8-ft tall with 2 10-m towers along side. One tower houses the ozone inlet and filter pack. The second tower is used to secure the meteorological equipment. Also at the site is an NCore station that has its instrumentation housed in a separate locked shelter. This shelter is also fenced in with an 8-ft. tall metal fence with barbed wire. An IMPROVE sampler is located inside 8-ft. tall metal fence. Pictures for 6 of the 8 cardinal directions were taken and will be provided with the report. Looking southeast and east could not be taken due to overlook of the cliff.

(Distance measurements and compass directions are from the ozone inlet on the 10-m tall tower)

Items	Compass Degrees	Distance (m)	Height (m)
A. 10-m tower with ozone inlet and filter pack	-	-	10
B. 10-m tower with meteorological equipment	340	1.9	10
C. AMoN passive sampler	290	2.7	2.2 (height above roof)
D. PM2.5 TEOM sampler inlet	190	1.2	1.7 (height above roof)
E. Nephelometer sampler	222	3.5	2.5 (height above roof)
F. Tipping bucket	210	3.7	1.6 (height above roof)
G. IMPROVE sampler	282 (shelter center)	7.7	2.6 (shelter height)
H. NCore system	70 (shelter center)	7.9	3.7 (shelter height)



Part 6. Data Management (Site)

Data to gather at the field monitoring sites:

- Download or print data from Ozone instrument, if possible. Include time and O_3 ppb data at a minimum, but include other information such as ambient temperature, BP, RH, shelter temperature, flow rate, etc., if available. Include a zero-span check if available. Later, the times and O_3 results will be compared with the reported data in AQS.

- Hand-record several minutes of ozone from the front panel (table below) and compare it with the data above while you are on site. No follow-up should be necessary unless discrepancies are found.

		Ozone Reading				Ozone Reading				Ozone Reading	
Interval	**Time**	**Screen**	**Data file**	**Interval**	**Time**	**Screen**	**Data file**	**Interval**	**Time**	**Screen**	**Data file**
1	8:31	26.3	26	**16**	8:46	29.7	30	**31**	9:01	26.4	26
2	8:32	28.2	28	**17**	8:47	29.2	29	**32**	9:02	28.3	28
3	8:33	27.1	27	**18**	8:48	28.3	28	**33**	9:03	28.3	28
4	8:34	26.1	26	**19**	8:49	29.1	29	**34**	9:04	29.1	29
5	8:35	25.4	25	**20**	8:50	29.8	30	**35**	9:05	29.7	30
6	8:36	25.3	25	**21**	8:51	31.3	31	**36**	9:06	30.2	30
7	8:37	29.8	30	**22**	8:52	30.8	31	**37**	9:07	28.2	28
8	8:38	28.1	28	**23**	8:53	30.4	30	**38**	9:08	29.9	30
9	8:39	26.8	27	**24**	8:54	29.4	29	**39**	9:09	29.9	30
10	8:40	27.4	27	**25**	8:55	30.3	30	**40**	9:10	28.4	28
11	8:41	28.4	28	**26**	8:56	29.8	30	**41**	9:11	27.2	27
12	8:42	29.2	29	**27**	8:57	27.3	27	**42**	9:12	28.2	28
13	8:43	30.8	31	**28**	8:58	28.3	28	**43**	9:13	28.4	
14	8:44	30.2	30	**29**	8:59	28.9	29	**44**	9:14		
15	8:45	30.3	30	**30**	9:00	27.9	28	**45**	9:15		

NOTE: Data (1 minute) and ZSP checks from March 1 through April 25, 2017 were downloaded from the Datalogger and saved to a portable hard drive.

- Make a note of any interruption in monitoring data that occur due to the TSA (however, no interruptions of data are planned). Record exact times when the ozone data was interrupted. This will be checked later against the data records.

NOTE: No disruption in the data collection.

- With the Site Operator, discuss any recent instances when data was flagged because of malfunctions, weather, site conditions, or any other reason. Get a copy, if possible, of the reporting forms, logbook pages and any other backup data. This information can be examined at the data center as part of the validation process audit, and later when the flags in AQS data are checked.

NOTE: No recent events of data lost or flagged due to malfunction, weather, or site conditions.

Activities and data gathering at the laboratory or data management center:

- Review findings of recent PE audit reports and discuss these findings, corrective actions, and data flagging with the data management and validation staff. Make notes of site ID, dates and times so that we can look at the flags in AQS.

NOTE: **Obtained the last NPAP audit and last two state PEs from ARS when visited the ARS Ozone Calibration Lab.**

- Observe the data validation process using the IMS software and other procedures and software – follow the SOP to the extent possible. Download electronic data and take screen shots, if possible, of O_3, shelter temp, ambient temp, flow, BP, RH, and other data that were downloaded or printed during the on-site audit. Note any deviations from the SOP and discuss. If any validity flags were applied while you were observing the process, include them as examples to use for the next item.

NOTE: Raw data was received from ARS during lab visit for 1-min and 1-hr ozone results for April 24, 2017 (within a month), February 16, 2017 (prior quarter), and November 20, 2016 (within 6 months). Place data on flash drive to check against data placed on AQS.

- Ask the data management staff to identify a few examples where they had to add data flags or change/invalidate data, as a result of higher level data validation. Record the reason for the change, and site IDs, dates and times of the data affected. Example data need not be for the two sites that had field TSAs. If changes were made to data that had previously been entered into an external database (AQS), also record the date/time when the change was uploaded to the external database.

NOTE: This was completed at the ARS Laboratory in Ft. Collins, CO when RTI visited the laboratory for ARS Ozone Calibration Laboratory and data management review.

- Perform other records checking that you would normally do for a TSA. If you encounter any information that should have resulted in data flags or changes, make a note so that the data changes can be verified later in AQS.

NOTE: ZSP checks were downloaded from the datalogger to a portable hard drive from March 1 through April 24, 2017. All ZSP checks were within acceptable limits.

APPENDIX B

Great Smoky Mountains National Park
(ROM 406)
Site Photos


LOOKING NORTH
LOOK ROCK AIR QUALITY STATION


LOOKING NE


LOOKING EAST


LOOKING SW


LOOKING WEST


LOOKING NW
LOOK ROCK AIR QUALITY STATION

APPENDIX C

Data and Data Management Questionnaire

DATA REVIEW AND DATA MANAGEMENT

Auditee Identification: **Air Research Specialist (ARS), Inc. facility**

Location of Audit: **Ft. Collins, CO**

Audit Date: **May 3, 2017 and e-mail exchanges prior to and after visit**

Auditor's name and affiliation: **Jeff Nichol (RTI)**

PERSONNEL INTERVIEWED:

NAME	POSITION	PHONE/E-MAIL
Jessica Ward	ARS Information Management Manager	jward@air-rources.com 970-484-7941
Emily Vanden Hoek	ARS (CASTNET) QA Manager	evandenhoek@air-rources.com 970-484-7941

OPERATIONAL AREAS THAT WERE OBSERVED: Auditor discussed previous audit findings from the 2013 audit with Emily and Jessica and ARS's actions to remedy the issues. The auditor discussed the five levels of data review with Jessica. She demonstrated:

- the data collection process through the DataView system at the site as the data is transferred to the Ft. Collins facility database (AQDBMS).
- the Level 0 review of data stackplot (daily, weekly, and monthly) and the generation of the monthly data validation log.
- the review, verification, and update of validation codes, flagging data, and corrective actions in the preliminary stage. Use of data validation log and data correction spreadsheet.
- the development of the 3rd level review packet by a peer reviewer.
- the final review by the IMC Manager and discussion of data with NPS and posting data to NPS, AIRNow, and AQS during the monthly and annual reporting phase.

Data Management Questions

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
Audit Questionnaire Part I – General (adapted from Appendix H of QA Handbook) **Data Handling**				
1. Is there a procedure, description, or a chart which shows a complete data sequence from point of acquisition to point of submission of data to EPA?	X			
2. Is there a detailed data flow diagram that shows the data flow within the reporting organization, including inputs and outputs from the system?	X			
3. What hardware components are used in each step of the procedure from acquisition to submission? Is there a data flow diagram that represents the components of the data management system?				See Figure 3-1 in SOP 3340
4. Are procedures for data handling (e.g., data reduction, review, etc.) documented?	X			
5. Does any personnel (site operator, field specialist, data analyst, etc.) have the permission/ability to change or alter any of the data on the collection instrumentation? Has there been any situation where this was done?		X		
6. Are site operator comments included in any reports?	X			
7. How are these comments captured and utilized?				Site operator comments are entered in the station logs on the laptop computer. These comments are collected digitally via an automated process and loaded into the database. From there they are used in the monthly data validation process.
8. Are field specialist comments included in any reports?	X			
9. How are these comments captured and utilized?				Field specialist comments are logged in either the site status logs or in the trip reports when they perform a semi-annual maintenance visits. Both of these are maintained digitally and used during the monthly data validation process.
10. In what media (e.g., diskette, data cartridge, or telemetry) and formats does data arrive at the data processing location?				Electronic transfer in ASCII format.
11. How often are data received at the processing location from the field sites and laboratory?				Data are collected every hour. Daily calibration results are downloaded nightly.
12. Is the routine data retrieval process conducted automatically?	X			

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
13. Who is responsible for the conducting the data retrieval? Who is their back-up?				Matt Smith is primary and Melissa Rademacher is the back-up. Wendy Miner is the software developer/programmer and can also be used as a back-up when needed.
14. What are the processes if a reporting location cannot transmit data?				A new site status log is opened and the issue is tracked here until resolved. The site operator is contacted to help troubleshoot remotely. If this issue cannot be resolved quickly, data are retrieved from the DataView laptop.
15. If part of dataset (i.e. ozone results) is not transmitted, is an attempt made to retransmit the whole dataset or just the missing information? If the whole dataset is retransmitted successfully, does repeated data overwrite already captured data?	X			The entire dataset for the missing hour is retransmitted. Data already successfully captured and uploaded to the database are not overwritten.
16. Is there documentation accompanying the data regarding any media changes, transcriptions, or flags which have been placed into the data before data are released to agency internal data processing?	X			
17. How is data actually entered to the computer system (e.g., computerized transcription (copy from disk or data transfer device), manual entry, digitization of strip charts, or other)?				Data are automatically consumed by the database every time a file is collected.
18. If data is manually entered by a person, is it checked for transcription errors? Is data doubly entered and automatically checked for comparability?		X		Data are never manually entered.
19. Is Blank-filling done at any point before Level 0 Validation? If so, what circumstances would cause this?	X			Missing records may be blank-filled automatically when transferring real-time data. A blank-filled record is just a placeholder until the hour is filled in.
20. What information/data is contained in: a. ESC datalogger b. Computer with DataView How often is each queried? Can systems be controlled remotely?				The logger contains hourly data with flags as well as 1-minute data for ozone. The DataView laptop retrieves its data from the datalogger. It also stores station logs. The datalogger is queried hourly. The DataView laptop is queried twice per week or as needed. Both can be controlled remotely.
21. How frequently are collected and calculated data stored? Where and how are they stored?				Data are collected and stored every hour. They are stored in the original ASCII files as well as in the database.
Software Documentation				
22. Does your agency use any AQS Manual?	X			

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
23. Does your agency use any AirNow Manual?	X			
24. If yes, list the title of manual used including the version number and date published.				https://www.epa.gov/aqs AIRNow-I AQCSV Format Specifications Document Version 3.0
25. Please list the documentation for the most important custom software currently in use for data processing. Include the original author, current revision number and date. Include the required operating system and application (e.g., Microsoft Windows, Oracle Version, etc.)				Oracle database Betsy Davis-Noland is the database manager
26. Do any Network Operating Systems (SOP 3340 Table 3-2) still operate on Microsoft Windows XP? If so, are there any plans to upgrade given Microsoft no longer supports the XP operating system?		X		
27. Are there any software incompatibilities which require human transcription/transfers of datasets to achieve final reported data? If so, which process in the chain requires human intervention?		X		
28. How often are software updates/changes made and by whom?				Workstation and Network software updates/changes are ongoing and are managed by the IT department.
29. What determines the need for the changes?				A variety of things such as a new ozone standard (requires new report products be created based on the new rules), the clients need for new report products, changing technology needs, etc.
30 How thoroughly are internal programs tested, and by whom?				Betsy Davis-Noland is the database manager and the ARS software development team revises and updates the software. They use the SOP Tracking Changes and Updates to ARD Developed Database Software (Version 0, IT_AQDB_Updates_2016Oct_F_1.0). Workstation patches and updates are ongoing and applied as recommended by vendors. They are initially released to a test group of users to allow for testing of internal commercial and custom software before being released to all workstations.

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
31. Have there been any upgrades since 2013?				Yes, many upgrades have occurred since 2013. These include: • Windows 7 and 10 OS updates • Micro Focus Open Enterprise Server Client (previously Novell Netware Client) File, Email, Database server software patches are applied within a few weeks of release. Basic services and network connectivity are tested immediately after application. The systems include: • Micro Focus (formerly Novell) SUSE Linux Enterprise Server 11 SP3 • Oracle Database Standard Edition 2 12c Release 1
32. Are procedures in place to protect data and minimize downtime in the event of a significant computer problem, power outage, etc. at the datacenter? Cite documentation that describes contingency planning applicable to this program.	X			Disaster recovery procedures are detailed in "ARS Computer System Disaster Recovery 201704" (attached)
33. Has data processing software been tested to ensure its performance? (See QA Handbook, Volume II, Section 14.0.) Are any previous test results available?	X			Data output products are compared to AQS products and reviewed annually. Software is constantly being utilized in production; automatic processes running 24x7 and manual processes during normal business hours. Database performance, network, and process monitoring software are in place to alert the IT department via text message and email whenever automatic processes fail and if metric thresholds are exceeded.
34. What software packages (if any) are used to automatically review the data?				Multiple products that were developed and are maintained in house. AQDBMS and Stackwin are the primary tools.
35. Does any software package have the capability of automatically changing the data?		X		Raw values are never changed.
36. Does any software package have the capability to automatically assign validation flags? Can the flags be changed if they are assigned in error?	X			Logger flags are used by the database to determine the appropriate validation code (which is applied in a separate field). The data analyst has the ability to change any flag that is assigned in error.
37. Is there a unique log-in into programs where data can be changed? Who has access to make the changes?	X			The primary data source is the AQDBMS. Only IMC staff have access to this database. Raw values are never changed.
38. Who has the technical expertise to make changes to the Oracle database? AQDBMS database?				The database administrator (Betsy Davis-Noland) and the data manager (Jessica Ward).
39. Is data automatically sorted into defined tables after transmission? Is this process QC checked to ensure data is incorporated into the correct location?	X			Data review would reveal if data were incorporated into the wrong location because all plots that are used for data review are configured to retrieve data from a specific location.

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
40. Is software capable of disseminating multiple units (ppb/ppm, °C/°F, etc.) and correcting values automatically? Is user intervention ever needed?	X			The only user intervention needed would be to select the units desired when exporting data if non-standard units are desired.
41. Does the agency have information on reporting precision and accuracy data available?	X			
Data Validation and Correction				
42. Is the validation criteria established and documented.	X			QAPP and SOP's
43. Does documentation exist on the identification and applicability of flags (i.e. identification of suspect values) within the data as recorded with the data in the computer files?	X			QAPP and SOP's
44. Is there documentation for the data validation criteria including limits for values such as flow rates, calibration results, or range tests for ambient measurements?	X			QAPP and SOP's
45. What actions are taken if data is found outside limits in the validation process (e.g., flags, modifications, deletions, etc.)?				Data are invalidated using the appropriate invalidation code for the situation.
46. Please provide an example of actions taken when limits were exceeded.				Ozone data from Grand Canyon were invalidated on 1/24/17 because the station temperature dropped below acceptable limits following the site operator visit this day.
47. Can data be changed after submission to AQS or AIRNow?	X			Validated values can be changed (raw data are never changed), but these changes are logged in 2 places so updates can be made in AQS. Data are submitted to AIRNow in real-time prior to the data validation process, so these values can change.
48. Please describe documentation procedures for changes made to data already submitted to AQS or AIRNow.				The database automatically tracks changes made to data after data have been marked as final. In addition, the person making changes logs the change in the data corrections spreadsheet.
49. Who has signature authority for approving corrections? Does the same personnel have authority for updating submitted data to AQS or AIRNow?				The data manager and the IMC team lead. The same personnel can update the data in AQS.
50. Are data points ever deleted? What criteria are used to determine if a data point should be deleted? When in the validation process is this determined?		X		Raw data are never deleted and/or altered.
51. Are data points ever reprocessed? What criteria are used to determine if a data point should be reprocessed? When in the validation process is this determined?		X		

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
52. Are changes to site information/coding/file structures/units documented in AQDBMS? Are there any records available for review?	X			Database report logs any changes to data that occur after final validation.
53. Who (ARS staff) is responsible for determining when the data review steps are within DQO goals and can be sent on to data validation processes?				The QA department reviews semi-annual calibration results. Results are provided to the IMC and used in conjunction with nightly precision checks to assess if data meet established DQO goals. Monthly validation is performed by IMC staff and reviewed by the IMC Team Leader and/or Data Manager during additional validation review.
54. How many data review steps are performed when reviewing ozone data?				5 in total; Level 0, preliminary, 3rd level, final review/plot review, and annual data review.
55. Is other data (meteorological) reviewed as well? Does it go through the same review steps?	X			
56. Who is responsible for each step of the data validation? Is there one person assigned to each of the three levels of validation, or is one person responsible for multiple levels?				The IMC shares responsibility for levels 0 through 3rd level (although the same person may not perform preliminary and 3rd level for any given site/month). The data manager is responsible for final review and annual data review.
57. Are any QC checks done to ensure that transferred data is accurate?	X			Automated programming routines verify that data in the database match values reported from the datalogger.
58. Are any components of the data other than the ASCII files reviewed regularly (i.e. strip charts, ZSP, calibrations)? Are these performed by software, staff or both?	X			Plots are automatically generated by software and reviewed daily and monthly by staff. These include hourly data, 1-minute data, and nightly calibrations.
59. Are there any typical post-processing calculations done to any of the data (STP corrections, modifications for humidity levels, etc.)?		X		
60. If a data correction is performed (e.g. raw data needs scaling; see SOP 3450 Section 4.2.2), how is this documented? Is there a table of the allowable times where this is correction is used? Who has authority to approve these corrections?				Adjustments to data are documented in the data validation log for that site/month and also are documented within the data record itself in the adjust field.
61. SOP's state 45 minutes of collected data are needed to report an hourly point. Are there any requirements excluding two back-to-back 45 minute collections?		X		There are no requirements excluding two back-to-back 45 minute periods.
62. Could a 30 minute block of missing time still produce no missed data points?	X			A missing 30 minute block of time could produce no missed data points if that 30 minute period was split evenly across 2 hours.

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
63. Examine a few recent examples of actions that were taken when data had to be flagged: • Please provide an example of software flagging and validation flagging (2 records - does not need to be for the same time period) • Identify the flagging criteria and SOP or other document where these are defined • RTI will examine the AQS and/or the AIRNow website database to verify that the data records were appropriately flagged.				Grand Canyon ozone data on 1/31/17, 0900 and 1000. The logger and software flagged these hours with <D. The validation process coded these hours as invalid with a ZS flag and a MT flag. GRSM Look Rock on 11/22/2015. Software applied an "X" screening flag from 0500-2000. The validation process coded these hours as invalid with a TL flag.
64. Are there any instances where a non-documented database or program would be used in the validation process?		X		
65. Is any original/raw data over-written if it is altered?		X		Data are overwritten on datalogger device only after it has been copied and stored elsewhere.
66. If a change to a data point needs to be made prior to submission to AQS (and other reporting databases), are any records of the original point maintained?	X			
67. What does "blank-filling" missing data entail? Are these values updated after Level 0 validation?	X			Blank-filling is a place holder to fill in a missing record. All values are updated during preliminary validation.
68. Does blank-filling entail entering a -999 value? At what point (if ever) is the value removed prior to reporting? What is it replaced with?	X			The value is removed if the missing record is later recovered.
69. Is there a list of validation codes?	X			
70. Are data flags (anomaly screening, datalogger, etc.) reported to AQS or AirNow?	X			Null data codes (invalidation codes) are reported to AQS.
71. Are comments from data stackplots incorporated into flags?	X			
72. Are these reported to AQS or AirNow?	X			
73. Is invalid data every changed to valid during final validation after stackplot review?	X			If it was determined the data should not have been invalidated it will be changed to valid during final validation review.
74. Are there copies of the monthly validation checklist available for review? Are the monthly validation checklists maintained electronically anywhere?	X			Stackplots, Site Station Log, DataView Log, Power Failure Log.
75. How are "expected" values/limits defined?				In tables.
76. Are there any additional data post-processing steps (after Level 3 validation) before reporting?	X			A final review of data occurs between 3rd level validation and data reporting.

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
77. If a request is received for high resolution data traces, is it QC checked prior to submission to the requestor? Does it go through the same review process, or is it presented as is with a disclaimer?	X			It depends on whether or not it's within our contract with the NPS to validate 1-minute data. If yes than it goes through the same review process, if no it's delivered as raw data.
Data Processing				
78. Are regular data summary reports issued by the organization? Please attach a list of reports routinely generated, including title, distribution, and period covered. Provide a citation to project documentation	X			Monthly and annual data reports are prepared and sent to site operators and park superintendents
79. How often are data submitted to AQS and the ARS website?				Data are submitted to AQS monthly. The NPS request web site is a live link to the database, so data are available there as soon as they are validated. Raw data are available hourly.
80. Has there been any recent difficulties in coding and submitting data following AQS guidelines?		X		
81. Are hard copy printouts requested after submission to AQS?		X		
82. Are at least three years of records kept? Are they orderly and accessible? Add additional comments, if three years of records are not kept.	X			
83. If records are kept, do they include raw data, calculation, QC data, and reports?	X			
84. Has data been submitted (along with the appropriate calibration equations used) to the processing center (IMC)?	X			Data are collected, uploaded and permanently stored within the database, of which IMC staff are all users.
85. Are concentrations of ozone corrected to EPA standard temperature and pressure before input into AQS?		X		This is done by the ozone analyzer.
86. Are audits (internal or external) on data reduction procedures performed on a routine basis?	X			
87. If audits on data reduction are performed, what is their frequency?				Annually or any time there is a systematic change.
88. Are data precision and accuracy checked each time they are calculated, recorded, or transcribed to ensure that incorrect values are not submitted to EPA?	X			
89. Are partial monthly reports ever submitted to AQS?	X			Data submissions for less than a month occur when changes are made to data after it's been submitted to AQS.
90. Does the AQS report come directly from AQDBMS?	X			

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
91. Does the AQDBMS directly supply any other place with data (CASTNET website, AirNow, etc.)?	X			The AQDBMS is the primary data source and therefore supplies the data for any and all data requests or routine data submittals.
Reporting (Internal & External)				
92. Are internal reports prepared and submitted as a result of the audits (NPAP and any TSA performed outside of ARS) required under 40 CFR 58, Appendix A? List Report Titles and Frequency.	X			The auditor provides the audit results in a report.
93. What internal reports are prepared and submitted as a result of precision checks required under 40 CFR 58, Appendix A? (List Report Titles and Frequency)				Precision check results are summarized in the Annual Data Summary Report as well as the Annual Performance Summary Report. These checks are also uploaded to AQS every quarter.
94. Do either the audit or precision check reports include a discussion of corrective actions initiated based on audit.				Corrective actions are documented in the database and in the calibration tracking spreadsheet (Validation Log).
95. Who has the responsibility for the calculation and preparation of data summaries? To whom are such summaries delivered? List Name, Title, Type of Report, and Recipient(s).				The data manager is responsible for the preparation and review of the annual data summary report. The report is delivered to the NPS ARD, who then delivers the report to site operators, park superintendents, and EPA regions.
96. Is the data reported to the AIRNow?	X			
97. When was the last annual data summary report submitted (40 CFR 58.15(b))?				It was last posted to the request web site in March of 2017.
98. Was precision and accuracy information included?	X			
99. Was location, date, pollution source and duration of all episodes reaching significant harm levels included?	X			Highest concentrations are listed by pollutant for each site.
100. Was Data Certification signed by a senior officer of your agency?	X			

Audit Questionnaire Part II – Detailed questions and data requests
Request to see raw data from the GRS420 site for April 24, 2017 (within a month), February 16, 2017 (prior quarter), and November 20, 2016 (within 6 months).

Audit Questions	Response			Comments and References (provided by ARS personnel unless otherwise indicated)
	Y	N	NA	
101. Download or print hourly data from Ozone instrument. Include time and O_3 ppb data at a minimum, plus other information such as ambient temperature, BP, RH, shelter temperature, flow rate, etc., if available. Include a zero-span check if available. Auditor will compare the data obtained at the site vs. the data reported in the CASTNET website and AQS. Identify any discrepancies and follow-up with ARS staff.				RTI: Three dates of data were collected (November 20, 2016, February 16, 2017, and April 24, 2017. Data for November 20 and February 16 were reported to CASTNET and AQS.
102. While on site, for the TSA, the auditor will record (if possible) several hours of raw ozone data directly from the front panel or instrument outputs and compares it versus raw data obtained from ARS. • Are there any discrepancies in ozone concentration between the monitor readout and downloaded or printed data? • If any data flags are appended to the data by the instrument, later trace them to records on AQS and on the CASTNET website.		X		
103. Obtain 1-minute data directly from the instrument or from ARS. Do recalculated hourly averages agree with the reported hourly data? (The auditor will calculate data completeness for hourly data that contains one or more invalidated 5-minute values, and verify any completeness flags that should have been applied.)	X			RTI: Checked 1-min values to hourly values reported. The 1-min values were averaged for the hourly and evaluated. No data was flagged for any of the three days. The result was that all 60 1-min values for each hour were the average hourly value reported.
104. While on site, the auditor performing the TSA should note the time of any interruption in monitoring data that occur during the TSA. If any were observed: • Check that the raw data records reflect the data gap at the correct time. • Do the correct flags appear in the hourly data records?	X			No data was evaluated requiring flags. Other datasets were reviewed to located flagged data, this data was compared to reported hourly data and the data was flagged. No issues.

105. Have any recent PE audits resulted in data revisions or reflagging? List site IDs, dates and times. RTI will compare corresponding data records on the CASTNET website and in AQS and will determine if the appropriate changes or flags were applied.	**X**			The ozone analyzer failed the audit at Sequoia Ash Mountain on October 14, 2015. The problem was due to a kink in the pump tubing inside the ozone analyzer. The kink was fixed by the site operator on 10/20/15. Ozone data were invalidated from the last good precision check on 10/7/15 until the kink was fixed on 10/20/15. The site was re-audited on 10/30/15 and the analyzer passed with good results.
106. Auditor will observe the data validation process with the datalogger and Data View software and will follow the steps in the SOP. Were any deviations from the data processing and validation SOPs observed? Note any significant deviations that should be reflected in a revised SOP.		**X**		
107. Auditor will ask the data management staff to identify a few examples where they had to add data flags or change/invalidate data, as a result of higher level data validation. Record the reasons for the changes, site IDs, dates and times of the data affected. (Example data need not come from the two sites that were audited for the field TSA.) Answer the following questions: • When higher-level validation identifies new data flags or other data changes, how are these sent to the ARS website to replace data already posted? • Have data already in AQS ever had to be changed or updated? Is the process for making changes to AQS data documented?				Yellowstone ozone data from 1/18/17 – 1/20/17 were changed from valid to invalid following higher level review. A new ozone analyzer was installed by the site operator on 1/18 and originally we decided to leave data valid from 1/18 – 1/20 because the precision checks were within limits during this time (data after this were invalid because the checks were outside of tolerance). However, further review of the data revealed a shift up in the ambient data as well as the analyzer response to calibrations during this time, so it was decided it would be best to invalidate all data from when the analyzer was installed on 1/18 until it was re-calibrated later in the month. RH at Denali on 5/23/16, 2000 was changed from valid to invalid during higher level review. ARS was on site performing semi-annual maintenance during this time and higher level review noted that there was a suspect dip in temperature and RH data during this time. Changes to data don't need to be sent to the GPMP request web site because the site is a live link to the database. As soon as changes are made in the database these changes are available on the web site. Data are re-uploaded to AQS when changes are made to data after the initial upload has been completed.
108. Based on the three data sources (ARS raw data; AQS; CASTNET web site) determine the following: • Do all identifiers and flags from the three sources agree? If not, prepare a table or crosswalk of discrepancies or apparent correspondences. • Do hourly concentration averages computed from 1-minute data sources agree? • Do hourly averages posted on AQS and the CASTNET website agrees as to both concentration and time?	 **X** **X** **X**			

109. Review ARS's validation records for a past issue. How are outliers identified and marked invalid by the validation process? - Was the outlier correctly identified? - Was the correct data flag applied?	X			The data group noticed low ozone values at Yosemite between site visits on 12/13/16 and 12/20/16. The low values were identified by reviewing stackplots. ARS contacted the site operator to determine what happened during this time and discovered there was an issue with a saturated filter and low flow. Data were invalidated with IM during this time.
110. Was anyone contacted (site operator, auditor, and network service person) to ask about the outlier? Discuss the general process of investigating unexplained outliers in the data.			X	
111. For the observed issue, did enough valid observations remain to compute a valid hourly average? (RTI will re-compute the hourly average and compare it to the hourly averages posted in AQS and on the CASTNET website)	X			
In the following questions RTI will download previous data from AQS and the ARS web site and compare hourly data over several months and sites.				
Audit Questions	**Response**			**Comments and References** (provided by ARS personnel unless otherwise indicated)
	Y	**N**	**NA**	
112. Do the hourly data received directly from ARS agree with the corresponding data downloaded from the EPA data sources (AQS and the CASTNET website operated by EPA/CAMD)?	X			
113. Do time stamps agree?	X			
Additional Comments:				

APPENDIX D

6-Month Calibration Audit of the Great Smoky Mountains National Park (GRS420) Site

Semiannual Maintenance and Calibration Report
Prepared by Air Resource Specialists, Inc.

Client:	National Park Service	**Field Personnel:**	Mike Slate
Site:	Great Smokey Mtns N.P. (Look Rock)	**Service Date(s):**	10/30/2016
Site Operator:	Jim Renfro/Ethan McClure	**Subject:**	Semiannual Maintenance

All site visit and calibration forms are attached, detailing the pre- and post-maintenance calibrations and test results.

SUMMARY OF FINDINGS

GASEOUS POLLUTANT SUPPORT EQUIPMENT

Zero-Air System (Werther / Panther Compressor PC70/4E):

Maintenance - No maintenance for the pump or compressor was required at this time. The media for the zero-air system was replaced.

Station Temperature:

Pre-Maintenance Testing - The sensor was compared against a certified temperature transfer standard. The sensor was found to be responding within calibration acceptance criteria.

Maintenance - No other maintenance was performed.

Post-Maintenance Testing - No post-maintenance checks were performed.

GASEOUS POLLUTANT ANALYZERS

Ozone Analyzer (Thermo 49i):

Pre-Maintenance Testing - The ozone analyzer was compared against a Level 2 ozone transfer standard. The ozone analyzer was found to be responding outside of calibration acceptance criteria.

Maintenance - The analyzer on site was replaced with a park-owned analyzer, which was recently repaired.

Post-Maintenance Testing - The ozone analyzer was compared against a Level 2 ozone transfer standard. The ozone analyzer was found to be responding within calibration acceptance criteria.

Ozone Station Reference (Thermo 49i):

Pre-Maintenance Testing - The ozone station reference was compared against a Level 2 ozone transfer standard. The ozone station reference was found to be responding within calibration acceptance criteria.

Maintenance - A new 1x6 multi-point calibration was performed to certify the instrument.

Post-Maintenance Testing - The ozone station reference was compared against a Level 2 ozone transfer standard. The ozone station reference was found to be responding within calibration acceptance criteria.

METEOROLOGICAL SENSORS

Ambient Temperature and Vertical Temperature Difference (RM Young 41342VC):

Pre-Maintenance Testing - The sensor was compared against a certified temperature transfer standard in three water baths controlled at temperatures between 0 and 50 degrees Celsius. The sensor was confirmed to be responding within calibration acceptance criteria.

Maintenance - No other post maintenance was performed.

Post-Maintenance Testing - No post-maintenance checks were performed.

Relative Humidity (Vaisala HMP45AC):

Pre-Maintenance Testing - The sensor was collocated with a certified relative humidity transfer standard. The sensor was confirmed to be responding within calibration acceptance criteria. The aspirator fan was functioning correctly.

Maintenance - A newly serviced sensor was installed.

Post-Maintenance Testing - The sensor was collocated with a certified relative humidity transfer standard. The sensor was confirmed to be responding within calibration acceptance criteria.

Wind Speed (RM Young 05305):

Pre-Maintenance Testing - The sensor was challenged with a certified anemometer drive. The sensor was confirmed to be responding within calibration acceptance criteria. The starting threshold test for the sensor was within acceptance criteria.

Maintenance - A new nose cone with new bearings was installed.

Post-Maintenance Testing - The sensor was challenged with a certified anemometer drive. The sensor was confirmed to be responding within calibration acceptance criteria. The starting threshold test for the sensor was within acceptance criteria.

Wind Direction (RM Young 05305):

Pre-Maintenance Testing - The reference alignment for the sensor was checked using a compass. The reference alignment for the sensor was confirmed to be within acceptable limits. The accuracy of the sensor was tested by comparison to a reference. The sensor was confirmed to be responding outside of calibration acceptance criteria. The linearity of the sensor was outside of acceptable limits.The starting threshold test results were within acceptance criteria.

Maintenance - A newly serviced sensor was installed.

Post-Maintenance Testing - The reference alignment for the sensor was checked using a compass. The reference alignment for the sensor was confirmed to be within acceptable limits. The accuracy of the sensor was tested by comparison to a reference. The sensor was confirmed to be responding within calibration acceptance criteria. The linearity of the sensor was within acceptable limits. The starting threshold test for the sensor was within acceptance criteria.

Solar Radiation (Li-Cor Pyranometer):

Pre-Maintenance Testing - The sensor was collocated with a certified solar radiation transfer standard. The sensor was confirmed to be responding outside of calibration acceptance criteria. The sensor was found to be level, but was not clean.

Maintenance - The sensor was cleaned.

Post-Maintenance Testing - No post-maintenance checks were performed.

Precipitation (Climatronics 100508):

Pre-Maintenance Testing - The sensor was challenged using a known volume of water. The sensor was found responding within calibration acceptance criteria. The sensor was found to be level and clean. The heater was found to be functional.

Maintenance - The tipping mechanism was cleaned.

Post-Maintenance Testing - The sensor was challenged using a known volume of water. The sensor was found responding within calibration acceptance criteria.

PARTICULATE MONITORS AND SAMPLERS

CASTNET Filter Pack Flow:

Pre-Maintenance Testing - A leak check on the system was performed and results were within acceptable limits. The flow was checked using a certified flow standard measuring flow in standard conditions. The measured flow was found to be outside of calibration acceptance criteria.

Maintenance – The pump was rebuilt and the filter was replaced. The unit was then calibrated.

Post-Maintenance Testing - The flow was checked using a certified flow standard measuring flow in standard conditions. The measured flow was confirmed to be within calibration acceptance criteria.

ADDITIONAL COMMENTS

Jim and Ethan take excellent care of the station and are prompt to take action when necessary.

Air Resource SPECIALISTS

TEMPERATURE / VERTICAL TEMPERATURE DIFFERENCE SYSTEM VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
Temperature Reference	Eutechnics	4400	304019	1/27/2017

AS FOUND

2m Temperature Sensor	
Manufacturer	RM Young
Model	TS 02797
Serial Number	7297

List sensors according to height on tower, from highest to lowest.

Temp. Deltas

AS LEFT

2m Temperature Sensor	
Manufacturer	RM Young
Model	TS 02797
Serial Number	7297

CALIBRATION ACCEPTANCE CRITERIA (<=)	
Ambient Temperature Difference (°C)	0.5
Vertical Temperature Difference (°C)	N/A

AS FOUND	2m Temperature		
Bath Temp (°C)	DAS	Difference	
0.10	0.05	-0.05	PASS
22.49	22.47	-0.02	PASS
55.57	55.45	-0.12	PASS
MAX ABS Difference		0.12	PASS

MAX ABS Difference		

Aspirator fan functional 2m?	☑ Yes	☐ No	☐ N/A
	☐ Yes	☐ No	☐ N/A
	☐ Yes	☐ No	☐ N/A
	☐ Yes	☐ No	☐ N/A

Each sensor was verified against its data channel ?			
	☑ Yes	☐ No	☐ N/A
Each Temperature Difference = Upper - Lower ?			
	☐ Yes	☐ No	☑ N/A

AS LEFT	2m Temperature		
Bath Temp (°C)			
MAX ABS Difference			

MAX ABS Difference		

NOTES:

Air Resource SPECIALISTS

STATION TEMPERATURE SENSOR VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
Temperature Reference	Eutechnics	4400	304019	1/27/2017

CALIBRATION ACCEPTANCE CRITERIA (<=)	
Temperature Difference (°C)	1.0

AS FOUND	Temperature		
Reference (°C)	DAS (°C)	Difference	
22.22	21.84	-0.4	PASS
22.24	21.88	-0.4	PASS
22.27	21.90	-0.4	PASS

AS LEFT	Temperature		
Reference (°C)	DAS (°C)	Difference	

NOTES:

Air Resource SPECIALISTS

RELATIVE HUMIDITY SENSOR VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
RH SENSOR REFERENCE	Rotronic	hygroclip	20039863	9/14/2017

AS FOUND

Manufacturer	Vaisala
Model	HMP-45ASP
Serial Number	A1040015

AS LEFT

Manufacturer	Vaisala
Model	HMP-45ASP
Serial Number	Z1730047

FIELD CALIBRATION ACCEPT. CRITERIA (<=)	
Relative Humidity Difference (%)	5%

AS FOUND	Relative Humidity (%)				V
Hour	STD	DAS	Difference		
1300	45.1%	47.2%	2.1%	PASS	
1400	43.4%	45.2%	1.8%	PASS	
1500	43.7%	43.5%	-0.2%	PASS	
1600	46.5%	46.2%	-0.3%	PASS	
	Average				

AS LEFT	Relative Humidity (%)				V
Hour	STD	DAS	Difference		
300	57.4%	57.7%	0.3%	PASS	
400	58.2%	58.6%	0.4%	PASS	
500	58.9%	59.2%	0.3%	PASS	
600	60.8%	61.0%	0.2%	PASS	
700	62.5%	62.8%	0.3%	PASS	
	Average		0.3%	PASS	

Aspirator fan functional?	☑ Yes ☐ No ☐ N/A

NOTES:	RH replaced at 15:25 logger time on 10/30/16

Air Resource SPECIALISTS

WIND SPEED SENSOR VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
Wind Speed Reference	RM Young	18220	CA03807	3/2/2017
Wind Speed Torque Gauge	RM Young	18310		

AS FOUND	
Manufacturer and Model	RM Young - 05305 / 08254 PSD
Sensor Serial #	55389
Cups Serial #	68492

AS LEFT	
Manufacturer and Model	RM Young - 05305 / 08254 PSD
Sensor Serial #	44099
Cups Serial #	68492

CALIBRATION ACCEPTANCE CRITERIA (<=)		
Wind Speed Difference (m/s)	0.25	if wind speed <= 5 m/s
Wind Speed Difference (%)	5.0%	if wind speed > 2 m/s

Select UNITS	m/s

AS FOUND

		Wind Speed			
Motor Speed (rpm)	Target Speed	DAS	Difference		
0	0.000	0.000	N/A	N/A	N/A
600	3.072	3.070	0.00	-0.1%	PASS
1200	6.144	6.150		0.1%	PASS
4000	20.480	20.500		0.1%	PASS
7000	35.840	35.900		0.2%	PASS
9000	46.080	46.100		0.0%	PASS
				PASS	

Starting Threshold	TORQUE
Torque <= 0.3 g-cm	0.3
	NO ACTION REQUIRED

Heater sleeve functional? ☐ Yes ☐ No ☐ N/A

AS LEFT

		Wind Speed			
Motor Speed (rpm)	Target Speed	DAS	Difference		
0	0.000	0.000	N/A	N/A	N/A
600	3.072	3.070	0.00	-0.1%	PASS
1200	6.144	6.150		0.1%	PASS
4000	20.480	20.500		0.1%	PASS
7000	35.840	35.900		0.2%	PASS
9000	46.080	46.000		-0.2%	PASS
				PASS	

Starting Threshold	TORQUE
Torque <= 0.3 g-cm	0.3
	NO ACTION REQUIRED

NOTES:

Air Resource SPECIALISTS

WIND DIRECTION SENSOR VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
Direction Alignment Reference	Brunton	5006LM	5060405265	[redacted]
Direction Linearity Reference	RM Young	18212	NA	
Direction Torque Gauge	RM Young	18331	NA	

AS FOUND	
Manufacturer & Model	RM Young - 05305
Sensor Serial #	55389
Vane Serial #	NA

AS LEFT	
Manufacturer & Model	RM Young - 05305
Sensor Serial #	44099
Vane Serial #	NA

Local Magnetic Declination (degrees)	10.0
Method	Solar

Mag. Dec. from NOAA (deg/min/sec)	10			10.00

http://www.ngdc.noaa.gov/geomag-web/#declination

CALIBRATION ACCEPTANCE CRITERIA (<=)	
Cross-arm Alignment Error (degrees)	2
Total Align. Diff (degrees)	5
Sensor Linearity (degrees)	5

Landmarks	Degrees
From the North	0
From the South	180
From the East	90
From the West	270

Is the Reference Alignment intended to be N-S?	YES

Is the Reference Alignment intended to be N-S?	YES

AS FOUND

Reference Alignment (degrees)	0.0	PASS

SENSOR ALIGNMENT			
N-S Reference	Degrees	DAS	Difference
From the North	0	356.0	-4.0
From the South	180	176.0	-4.0
From the East	90	89.8	-0.2
From the West	270	271.0	1.0
Total Alignment MAX ABS Diff		4.0	PASS

OR

SENSOR ALIGNMENT			
Landmark	Degrees	DAS	Difference
From the North	0		
From the South	180		
From the East	90		
From the West	270		
Total Alignment MAX ABS Diff			

OR

SENSOR ALIGNMENT			
X Reference	Degrees	DAS	Difference
	0		
	180		
	90		
	270		
Total Alignment MAX ABS Diff			

SENSOR LINEARITY			
Point	DAS	Difference	
1	9.1	N/A	
2	54.6	1	PASS
3	100.0	0	PASS
4	146.0	1	PASS
5	191.0	0	PASS
6	237.0	1	PASS
7	280.0	-2	PASS
8	324.0	-1	PASS
1	8.6	0	PASS
MAX Difference		2	
		NO ACTION REQUIRED	

Starting Threshold	TORQUE
Torque <= 9.0 g-cm	5.0
	NO ACTION REQUIRED

AS LEFT

Reference Alignment (degrees)	0.0	PASS

SENSOR ALIGNMENT			
N-S Reference	Degrees	DAS	Difference
From the North	0	356.0	-4.0
From the South	180	180.0	0.0
From the East	90	87.6	-2.4
From the West	270	268.0	-2.0
Total Alignment MAX ABS Diff		4.0	PASS

OR

SENSOR ALIGNMENT			
Landmark	Degrees	DAS	Difference
From the North	0		
From the South	180		
From the East	90		
From the West	270		
Total Alignment MAX ABS Diff			

OR

SENSOR ALIGNMENT			
X Reference	Degrees	DAS	Difference
Align with Ref (N)	0		
Align with Ref (S)	180		
Perp with Ref (E)	90		
Perp with Ref (W)	270		
Total Alignment MAX ABS Diff			

SENSOR LINEARITY			
Point	DAS	Difference	
1	39.5	N/A	
2	83.6	-1	PASS
3	129.0	0	PASS
4	176.0	2	PASS
5	221.0	0	PASS
6	267.0	1	PASS
7	312.0	0	PASS
8	355.0	-2	PASS
1	38.7	-1	PASS
MAX Difference		2	
		NO ACTION REQUIRED	

Starting Threshold	TORQUE
Torque <= 9.0 g-cm	5.0
	NO ACTION REQUIRED

Heater sleeve functional?		Yes		No		N/A

Air Resource SPECIALISTS

SOLAR RADIATION SENSOR VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE	MULTIPLIER
Solar Radiation Reference	LICOR	LI-200	PY 7972 / PY 60977	8/4/2017	200.00

AS FOUND

Manufacturer	LICOR	
Model	LI-200	
Serial Number	NPS 91046	
Translator	NA	
Logger Type	High Input (V)	1.0000
ESC	Low Input (V)	0.0000
	High Output	1000.0000
	Low Output	-0.6000

AS LEFT

Manufacturer	LICOR	
Model	LI-200	
Serial Number	NPS 91046	
Translator	NA	
Logger Type	High Input (V)	1.0000
ESC	Low Input (V)	0.0000
	High Output	1000.0000
	Low Output	-0.6000

CALIBRATION ACCEPTANCE CRITERIA (<=)	
Difference from CTS (%)	10%

AS FOUND

Hour	Solar Radiation CTS (W/m^2)	DAS (W/m^2)	Difference	V
1300	565	563	-0.4%	
1400	528.3	501	-5.2%	
1500	342.8	324	-5.5%	
1600	64.2	63	-1.9%	
	MEAN ABS % DIFF	3.2%	PASS	

	DAS (W/m^2)
DARK RESPONSE	0

Sensor found clean? ☐ Yes ☐ No

Sensor found level? ☐ Yes ☐ No

AS LEFT

Hour	Solar Radiation CTS (W/m^2)	DAS (W/m^2)	Difference	V
	MEAN ABS % DIFF			

	DAS (W/m^2)
DARK RESPONSE	

NOTES:

Air Resource SPECIALISTS

PRECIPITATION SENSOR VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
Precipitation Reference	Novalynx	drip bottle	NA	

AS FOUND	
Manufacturer	Climatronics
Model	100508
Serial Number	EPA 02149

AS LEFT	
Manufacturer	Climatronics
Model	100508
Serial Number	EPA 02149

CALIBRATION ACCEPTANCE CRITERIA (<=)	
Difference from Input Volume (%)	5%

	Reference Chart			Input Volume (mL)		946
	Manufacturer	Model	Diameter (in.)	mm/tip	mL/tip	DAS target
	Climatronics	100097-1-G0-H0	8	0.254	8.24	29.17
X	Climatronics	100508	9.66	0.100	4.73	20.01
	Met One	370	8	0.254	8.24	29.17
	Met One	385	12	0.254	18.53	12.96
	RM Young	52202	6.2825	0.100	2.00	47.30
	Texas Electronics	TR-525I-HT	6.06	0.254	4.73	50.84

Conversions			
Value	Units	Value	Units
1.000	inch	25.400	mm
25.40	mm	1.000	inch

AS FOUND		Precipitation		
Reference (mL)	Target (mm)	DAS (mm)	Difference	
946	20.01	20.50	2.5%	PASS

Heater functional?	☑ Yes ☐ No ☐ N/A
Sensor found level?	☑ Yes ☐ No
Sensor found clean?	☑ Yes ☐ No

AS LEFT		Precipitation		
Reference (mL)	Target (mm)	DAS (mm)	Difference	
946	20.01	20.10	0.4%	PASS

NOTES: Cleaned buckets.

Air Resource SPECIALISTS

CASTNET FLOW SYSTEM VERIFICATION & CALIBRATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
MFC High Flow Reference	BIOS	Definer 220	1120797	11/3/2016

AS FOUND

MFC	
Manufacturer	Tylan
Model	FC-280S
Serial Number	AW9706012

Pump	
Manufacturer	Thomas
Model	107CA18
Serial Number	0191007233

Flow Target	3.00

ENTER FLOWS IN SLPM

AS LEFT

MFC	
Manufacturer	Tylan
Model	FC-280S
Serial Number	AW9706012

Pump	
Manufacturer	Thomas
Model	107CA18
Serial Number	0191007233

AS FOUND

MFC Display Linear Regression		MFC VDC Linear Regression		ESC Logger Scaling	
Date	4/18/2016			High Input (V)	5.000
Setpoint	2.550	Setpoint		Low Input (V)	0.000
Slope	1.017	Slope		High Output (LPM)	5.486
Intercept	0.400	Intercept		Low Output (LPM)	0.400

Operational Checks	
Vacuum	-19 " Hg
DAS Flow	3.0
MFC Flow	2.6
Flow Standard	3.1

AS FOUND	Target	Flow Standard	Rotometer	MFC Display	MFC Volts DC	DAS Display	Difference Value	Difference %	
Pump Off	0.00 SLPM		0.00	-0.35	-0.320	0.070			
Leak Test	0.00 SLPM		0.00	-0.35	-0.316	0.070			
1	2.00 SLPM	2.147	2.20	1.67	1.676	2.105	-0.042	-2.0%	
2 (low)	2.50 SLPM	2.795	2.80	2.28	2.291	2.730	-0.065	-2.3%	PASS
3 (target)	3.00 SLPM	3.065	3.10	2.55	2.558	3.002	-0.063	-2.1%	FAIL
4 (high)	3.50 SLPM	3.296	3.30	2.77	2.775	3.221	-0.075	-2.3%	PASS
5	4.00 SLPM	3.583	3.60	3.04	3.044	3.496	-0.087	-2.4%	
MAX	> 4.00 SLPM	3.911	3.80	3.37	3.372	3.835	-0.076	-1.9%	

Leak Test Results		
Flow (SLPM)	0.00	PASS

*Note: A leak is present if the difference between the zero and leak test value is greater than 0.10 lpm

Recalibration	REQUIRED

*Note: A calibration is required if the difference between the transfer standard and the DAS value is greater than +/- 2.0% at the target setting or greater than +/- 2.5% at either the low or high point

NEW CALIBRATION FACTORS

MFC Display Linear Regression		MFC VDC Linear Regression		ESC Logger Scaling	
Setpoint	2.484	Setpoint	2.491	High Input (V)	5.000
Slope	1.045	Slope	1.047	Low Input (V)	0.000
Intercept	0.404	Intercept	0.392	High Output (LPM)	5.628
Correlation	1.000	Correlation	1.000	Low Output (LPM)	0.392

AS LEFT	Target	Flow Standard	Rotometer	MFC Display	MFC Volts DC	DAS Display	Difference Value	Difference %	
Pump Off	0.00 SLPM		0.00	-0.33	-0.300	0.078			
Leak Test	0.00 SLPM		0.00	-0.34	-0.300	0.080			
1	2.00 SLPM	2.340	2.40	1.87	1.875	2.357	0.017	0.7%	
2 (low)	2.50 SLPM	2.595	2.60	2.11	2.115	2.607	0.012	0.5%	PASS
3 (target)	3.00 SLPM	2.980	3.00	2.48	2.491	3.001	0.021	0.7%	PASS
4 (high)	3.50 SLPM	3.305	3.40	2.78	2.793	3.321	0.016	0.5%	PASS
5	4.00 SLPM	3.629	3.80	3.09	3.102	3.645	0.016	0.4%	
MAX	> 4.00 SLPM	3.897	4.00	3.37	3.370	3.926	0.029	0.7%	

Leak Test Results		
Flow (SLPM)	-0.01	PASS

*Note: A leak is present if the difference between the zero and leak test value is greater than 0.10 lpm

Operational Checks	
Vacuum	-19 " Hg.
DAS Flow	3.0
MFC Flow	2.5
Flow Standard	3.0

Air Resource SPECIALISTS

OZONE ANALYZER VERIFICATION & CALIBRATION
(AS FOUND)

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

AS FOUND

Logger Slope Correction	0.9994
Logger Intercept Correction	-0.0419

TRANSFER STANDARD		AMBIENT ANALYZER		STATION REFERENCE	
Manufacturer	Thermo	Manufacturer	Thermo	Manufacturer	Thermo
Model	49i	Model	49C	Model	49i
Serial Number	1130450195	Serial Number	61985-333	Serial Number	1130450193
Coefficient	1.000	Coefficient	1.028	Coefficient	1.000
Background	0.000	Background	0.0	Background	0.000
Cell A Intensity (Hz)	108154	Cell A Intensity (Hz)	73290	Cell A Intensity (Hz)	86551
Cell B Intensity (Hz)	107479	Cell B Intensity (Hz)	83402	Cell B Intensity (Hz)	127879
Flow A (lpm)	0.706	Flow A (lpm)	0.679	Flow A (lpm)	0.681
Flow B (lpm)	0.714	Flow B (lpm)	0.697	Flow B (lpm)	0.679
Pressure (mmHg)	700.4	Pressure (mmHg)	684.9	Pressure (mmHg)	700.0
Bench Temp (°C)	30.2	Bench Temp (°C)	32.9	Bench Temp (°C)	31.3
Bench Lamp Temp (°C)	53.8	Bench Lamp Temp (°C)	56.0	Bench Lamp Temp (°C)	53.5
Ozone Lamp Temp (°C)	68.6	Ozone Lamp Temp (°C)	70.8	Ozone Lamp Temp (°C)	NA
		Ozone Source	Yes	Ozone Source	
Transfer Standard Level	LEVEL 2			Transfer Standard Level	LEVEL 3

CALIBRATION ACCEPTANCE CRITERIA (<=)	
Mean Absolute Difference (%)	3%
Maximum Absolute Difference (%)	3%
Linearity % of Fullscale	1%
DATA ACCEPTANCE CRITERIA (<=)	
Mean Absolute Difference (%)	10%
Maximum Absolute Difference (%)	10%
Linearity % of Fullscale	2%

	SLOPE	INT
Transfer Standard Correction Factors	1.0110	-0.1193

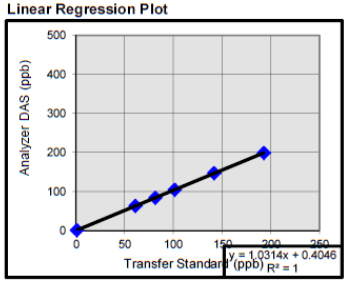
Full Scale (ppb)	250

	O3 LAMP	TRANSFER STANDARD		AMBIENT ANALYZER					STATION REFERENCE				
POINT	TARGET	% or mV	Display	Corrected	DAS	Diff	%Diff	Linearity %		DAS	Diff	%Diff	Linearity %	
ZERO	0	0	0.6	0.7	1.1	0.4	N/A	0.0%	PASS	-0.1	-0.8	N/A	0.0%	PASS
1	225	33.9	194.7	192.7	198.9	6.2	3.2%	0.1%	PASS	196.7	4.0	2.1%	0.2%	PASS
2	150	31	143.2	141.8	146.9	5.1	3.6%	-0.1%	PASS	145.1	3.3	2.4%	-0.1%	PASS
3	100	28	102.1	101.1	105.0	3.9	3.9%	-0.1%	PASS	103.9	2.8	2.8%	-0.3%	PASS
4	80	26	82.1	81.3	84.0	2.7	3.3%	0.1%	PASS	82.8	1.5	1.8%	0.0%	PASS
5	60	23.3	61.3	60.8	63.0	2.2	3.7%	0.0%	PASS	61.4	0.6	1.1%	0.1%	PASS
ZERO	0	0	0.4	0.5	1.1	0.6	N/A	0.0%	PASS	-0.3	-0.9	N/A	0.1%	PASS
					Mean ABS % Diff			3.5%	ACTION	Mean ABS % Diff			2.0%	PASS
					Max ABS % Difference			3.9%	ACTION	Max ABS % Difference			2.8%	PASS
					Slope			1.031		Slope			1.027	
					Y-Intercept			0.47		Y-Intercept			-0.72	
					Correlation			1.0000		Correlation			1.0000	

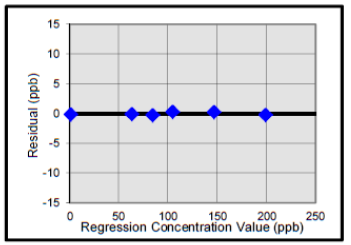
Analog Test	Analyzer DAS	Reference DAS
Zero	0.51	-0.12
Full Scale	250.5	249.9

Line Loss Test	Analyzer Display		
Span (site tubing)	202	%	P/F
Span (bypass tubing)	205	-1.5%	PASS

Linear Regression Plot



Residuals Plot



NOTES: Replaced analyzer with original 49i that was previously used here and is back after repair.

Air Resource SPECIALISTS

OZONE ANALYZER VERIFICATION & CALIBRATION
(AS LEFT)

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

AS LEFT

Logger Slope Correction	1.0015
Logger Intercept Correction	-0.2547

TRANSFER STANDARD		AMBIENT ANALYZER		STATION REFERENCE	
Manufacturer	Thermo	Manufacturer	Thermo	Manufacturer	Thermo
Model	49i	Model	49i	Model	49i
Serial Number	1130450195	Serial Number	1023943903	Serial Number	1130450193
Coefficient	1.000	Coefficient	1.010	Coefficient	1.000
Background	0.000	Background	0.00	Background	0.000
Cell A Intensity (Hz)	106008	Cell A Intensity (Hz)	109117	Cell A Intensity (Hz)	86557
Cell B Intensity (Hz)	107231	Cell B Intensity (Hz)	111812	Cell B Intensity (Hz)	127929
Flow A (lpm)	0.698	Flow A (lpm)	0.686	Flow A (lpm)	0.682
Flow B (lpm)	0.707	Flow B (lpm)	0.711	Flow B (lpm)	0.683
Pressure (mmHg)	706.8	Pressure (mmHg)	684.9	Pressure (mmHg)	703.3
Bench Temp (°C)	34.3	Bench Temp (°C)	30.4	Bench Temp (°C)	29.0
Bench Lamp Temp (°C)	53.8	Bench Lamp Temp (°C)	53.8	Bench Lamp Temp (°C)	53.5
Ozone Lamp Temp (°C)	68.8	Ozone Lamp Temp (°C)	68.1	Ozone Lamp Temp (°C)	NA
		Ozone Source	Yes	Ozone Source	No
Transfer Standard Level	LEVEL 2			Transfer Standard Level	LEVEL 3

CALIBRATION ACCEPTANCE CRITERIA (<=)	
Mean Absolute Difference (%)	3%
Maximum Absolute Difference (%)	3%
Linearity % of Fullscale	1%
DATA ACCEPTANCE CRITERIA (<=)	
Mean Absolute Difference (%)	10%
Maximum Absolute Difference (%)	10%
Linearity % of Fullscale	2%

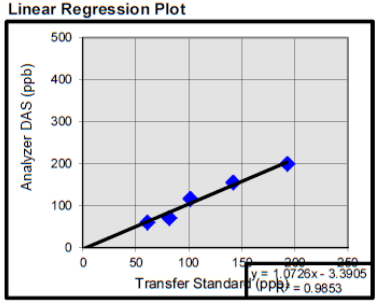
	SLOPE	INT
Transfer Standard Correction Factors	1.0110	-0.1193

Full Scale (ppb)	250

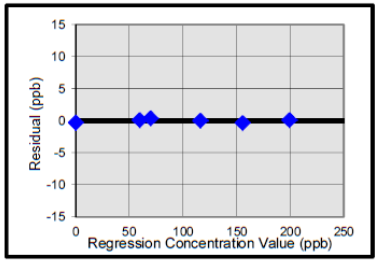
		O3 LAMP	TRANSFER STANDARD		AMBIENT ANALYZER					STATION REFERENCE				
POINT	TARGET	% or mV	Display	Corrected	DAS	Diff	%Diff	Linearity %		DAS	Diff	%Diff	Linearity %	
ZERO	0	0	0.3	0.4	-0.2	-0.6	N/A	0.1%	PASS	-0.5	-1.0	N/A	0.2%	PASS
1	200	31.1	196.9	194.9	199.2	4.3	2.2%	0.0%	PASS	199.7	4.8	2.5%	-0.4%	PASS
2	150	28.5	153.8	152.2	155.1	2.9	1.9%	0.1%	PASS	154.2	2.0	1.3%	0.4%	PASS
3	100	26.3	114.9	113.8	116.1	2.3	2.0%	0.0%	PASS	115.3	1.5	1.3%	0.2%	PASS
4	80	23.4	69.2	68.6	70.2	1.6	2.4%	-0.1%	PASS	69.9	1.3	1.9%	-0.1%	PASS
5	60	22.6	59	58.5	59.6	1.1	1.9%	0.0%	PASS	59.7	1.2	2.1%	-0.1%	PASS
ZERO	0	0	0.1	0.2	0.0	-0.2	N/A	0.0%	PASS	0.3	0.1	N/A	-0.2%	PASS
					Mean ABS % Diff			2.1%	PASS	Mean ABS % Diff			1.8%	PASS
					Max ABS % Difference			2.4%	PASS	Max ABS % Difference			2.5%	PASS
					Slope			1.023		Slope			1.022	
					Y-Intercept			-0.32		Y-Intercept			-0.46	
					Correlation			1.0000		Correlation			1.0000	

Analog Test	Analyzer DAS	Reference DAS
Zero	0.03	-0.1
Full Scale	250	249.9

Linear Regression Plot



Residuals Plot



NOTES:

Air Resource SPECIALISTS

TEOM 1400ab VERIFICATION & CALIBRATION (PM_{10})
(PAGE 1)

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL NUMBER	EXPIRATION DATE
PM Flow Standard #1	BIOS	Definer 220	120797	11/3/2016
PM Temperature Standard #1	Eutechnics	4400	304019	1/27/2017
PM Barometric Pressure Standard #1	Druck	DPI705	70565570	4/21/2017
MTC Verification Reference	Thermo	weighted filter	CVK5505-1	4th use

AS FOUND

MANUFACTURER	Thermo
MODEL	1400a
SERIAL NUMBER	140AB240260203

SETTINGS	Average	Standard
Temperature (°C)	99	25.0
Pressure (atm)	9	1.000
	Setpoint	
Main Flow	3.00	
Auxiliary Flow	13.67	

AS LEFT

MANUFACTURER	Thermo
MODEL	1400a
SERIAL NUMBER	140AB240260203

SETTINGS	Average	Standard
Temperature (°C)	99	25.0
Pressure (atm)	9	1.000
	Setpoint	
Main Flow	3.00	
Auxiliary Flow	13.67	

Date and Time correct?
☑ Yes ☐ No
If no, time off by:
0 min
Corrected? ☐ Yes ☑ No

LEAK CHECK	Pump off	Stopcock Closed	
Main Flow	0.13	0.14	PASS
Auxiliary Flow	0.24	0.29	PASS

ACCEPTANCE CRITERIA (<=)	Data
Leak Check Main Flow (LPM)	0.15
Leak Check Aux. Flow (LPM)	0.60

	FLOW VERIFICATION					
AS FOUND	Reference	Instrument	Actual Diff	Design Diff		Flow Coefficient
Main Flow	3.00	3.00	0.0%	0.0%	PASS	1.023
Total Flow	16.71	16.66	-0.3%	0.2%	PASS	N/A
Auxiliary Flow	13.71	13.66	-0.4%	0.3%	PASS	0.997

ACCEPTANCE CRITERIA (<=)	Field	Data
Actual Flow % Diff	4%	7%
Design Flow % Diff	4%	10%

	TEMPERATURE SENSOR (°C)			
	Reference	Instrument	Difference	
AS FOUND	24.1	23.8	-0.3	PASS
AS LEFT	24.1	23.8	-0.3	PASS

ACCEPTANCE CRITERIA (<=)	Field
Temperature Difference (°C)	2.0

NOTES: This site measure PM 2.5 not PM 10. There is no TEOM 1400 2.5 page.

Air Resource SPECIALISTS

TEOM 1400ab VERIFICATION & CALIBRATION (PM_{10})
(PAGE 2)

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	PRESSURE SENSOR (atm)			
	Reference	Instrument	Difference	
AS FOUND	0.917	0.917	0.000	PASS
AS LEFT	0.917	0.917	0.000	PASS

ACCEPTANCE CRITERIA (<=)	Field
Pressure Difference (mmHg)	10
Pressure Difference (atm)	0.013

In-line MFC filters replaced?	☐ Yes ☑ No

PM_{10} inlet cleaned?	☑ Yes ☐ No

Pump?	☐ Replaced ☐ Rebuilt ☑ N/A

LEAK CHECK			
	Pump off	Stopcock Closed	
Main Flow	0.13	0.14	PASS
Auxiliary Flow	0.24	0.29	PASS

ACCEPTANCE CRITERIA (<=)	Data
Leak Check Main Flow (LPM)	0.15
Leak Check Aux. Flow (LPM)	0.60

Flow recalibrated?	☐ Yes ☑ No

	FLOW VERIFICATION					
AS LEFT	Reference	Instrument	Actual Diff	Design Diff		Flow Coefficient
Main Flow	3.02	3.00	-0.7%	0.7%	PASS	1.023
Total Flow	16.72	16.67	-0.3%	0.3%	PASS	N/A
Auxiliary Flow	13.7	13.67	-0.2%	0.2%	PASS	0.997

ACCEPTANCE CRITERIA (<=)	Field	Data
Actual Flow % Diff	4%	7%
Design Flow % Diff	4%	10%

MASS TRANSDUCER CALIBRATION CHECK		
Filter Serial No.	CVK5505-1	
Filter Weight	0.09629	
Frequency w/o filter	324.99768	
Frequency w/ filter	245.95159	
Audit K_o	13632	13632
Instrument K_o	13399	
ABS % Difference	-1.7%	PASS

ACCEPTANCE CRITERIA (<=)	Field
MTC Check ABS Difference (%)	2.5%

NOTES:	

Air Resource SPECIALISTS

SITE INFORMATION

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
NETWORK TYPE		NPS					

		Deg	Min	Sec		Decimal
LATITUDE	North				--CALCULATE->	
LONGITUDE	West					

Decimal		Deg	Min	Sec
	--CALCULATE->			

	Meters		Feet
ELEVATION		--CALCULATE->	

Feet		Meters
	--CALCULATE->	

Photo Documentation Completed?	☑ Yes	☐ No	☐ N/A

	Protocol?	Carrier?	# of Bars?	Signal Strength?
Cellular Phone Coverage				-X dBm
Cellular Phone Coverage				-X dBm

DAY	TIME IN	TIME OUT
10/30/2016	800	1700

Please verify site standards used by the site operator

SITE STANDARDS	MANUFACTURER	MODEL	SERIAL #	Calibration Expiration Date
PM Flow Reference				

NOTES:

Air Resource SPECIALISTS

CALIBRATION AND VERIFICATION STANDARDS

ABBR.	GRSM-LR	CLIENT	NPS	FIELD SPECIALIST	M. Slate/ W. Yahr	DATE	10/30/2016
SITE NAME		Look Rock				DATE OF LAST VISIT	4/18/2016
Network type		NPS					

	MANUFACTURER	MODEL	SERIAL #	Calibration Expiration Date
Ozone Transfer Standard	Thermo	49i	1130450195	1/29/2017
MFC High Flow Reference	BIOS	Definer 220	1120797	11/3/2016
MFC Low Flow Reference				
Temperature Reference	Eutechnics	4400	304019	1/27/2017
AT/RH Sensor Reference	Rotronic	hygroclip	20039863	9/14/2017
Barometric Pressure Reference				
Wind Speed Reference (high rpm)	RM Young	18220	CA03807	3/2/2017
Wind Speed Reference (low rpm)				
Wind Speed Torque Gauge	RM Young	18310	NA	
Wind Direction Alignment Reference	Brunton	5006LM	5060405265	
Wind Direction Linearity Reference	RM Young	18212	NA	
Wind Direction Torque Gauge	RM Young	18331	NA	
Solar Radiation Reference				
Multiplier 200.00	LICOR	LI-200	PY 7972 / PY 60977	8/4/2017
UV Radiation Reference				
Multiplier				
Precipitation Reference				
Volume 946 mL	Novalynx	drip bottle	NA	
Voltage Measurement Reference				
Voltage Source				

PM Flow Standard #1	BIOS	Definer 220	120797	11/3/2016
PM Flow Standard #2				
PM Flow Standard #3				
PM Flow Standard #4				

PM Temperature Standard #1	Eutechnics	4400	304019	1/27/2017
PM Temperature Standard #2				
PM Temperature Standard #3				
PM Temperature Standard #4				

PM Barometric Pressure Standard #1	Druck	DPI705	70565570	4/21/2017
PM Barometric Pressure Standard #2				
PM Barometric Pressure Standard #3				
PM Barometric Pressure Standard #4				

TEOM MTV Standard	Thermo	weighted filter	CVK5505-1	4th use

HiVol Direct Flow Standard				
HiVol Orifice Plate				
Orifice Manometer				
Stagnation Manometer				

Ozone Transfer Standard Verification Summary Report

U. S. Environmental Protection Agency
Region 4 Science and Ecosystem Support Division
Enforcement and Investigations Branch
Superfund and Air Section
980 College Station Rd.
Athens, GA 30605

	EPA Standard	GUEST Instrument
Agency:	EPA Region 4	ARS
Contact:	Keith Harris	Christian Kirk
Make:	NIST	Thermo
Model:	SRP-10	49i
S/N:	10	1130450195
Guest Test Status:		**PASS**
Guest Known Offset:		0

SESD Project #:
Test #: # "as found"

Level 2	Slope	Intercept	R^2	High O_3	Lower O_3
Averages:	1.0011	-0.1193	0.9999977	481	0
Upper Tolerance:	1.0300	3.0000			
LowerTolerance:	0.9700	-3.0000			

Date Start	Time Start	Date End	Time End	File	Slope	Intercept	R^2	Upper Range (ppb O_3)	Lower Range (ppb O_3)
01/29/16	9:25 AM	01/29/16	11:10 AM	c0129001.xls	1.0001	-0.0881	0.9999972	480	0.08
01/29/16	11:10 AM	01/29/16	12:55 PM	c0129002.xls	1.0017	-0.1519	0.9999974	481	-0.21
01/29/16	12:55 PM	01/29/16	2:50 PM	c0129003.xls	1.0015	-0.1181	0.9999984	481	-0.14

Comments:

Instrument tested as found.
Ozone calibration factors at time of test: O3 BKG: 0.0 ppb O3 COEF: 1.000

Verification Expires on: **January 29, 2017**

Keith Harris _____ Date 01/29/16

MesaLabs

NVLAP Lab Code 200661-0

Calibration Certificate

CertificateNo.	55257	**Sold To:**	Air Resource Specialists, Inc.
Product	200-220H Definer 220 High Flow		1901 Sharp Point Drive
Serial No.	120797		Fort Collins, CO 80525
Cal. Date	03-Nov-2015		US

All calibrations are performed at Mesa Laboratories, Inc., 10 Park Place, Butler, NJ, 07405, an ISO 17025:2005 accredited laboratory through NVLAP of NIST. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

As Received Calibration Data

Technician	Lilianna Malinowska	**Lab. Pressure**	753 mmHg
		Lab. Temperature	22.6 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
25478 sccm	25096 sccm	1.52%	1.00%	Out of Tolerance
5095.1 sccm	5001.25 sccm	1.88%	1.00%	Out of Tolerance
1526.2 sccm	1500.8 sccm	1.69%	1.00%	Out of Tolerance
22.1 °C	22.6 °C	-	± 0.8°C	In Tolerance
765 mmHg	753 mmHg	-	± 3.5 mmHg	In Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	103521	23-Jun-2015	22-Jun-2016
Percision Thermometer	305460	21-Sep-2015	20-Sep-2016
Precision Barometer	2981392	28-Jun-2015	27-Jun-2016

MesaLabs

NVLAP Lab Code 200661-0

As Shipped Calibration Data

Certificate No	55257	**Lab. Pressure**	762 mmHg
Technician	Lilianna Malinowska	**Lab. Temperature**	22.6 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
25077 sccm	25024.5sccm	0.21%	1.00%	In Tolerance
5000.1 sccm	5001.5 sccm	-0.03%	1.00%	In Tolerance
1502.2 sccm	1501.6 sccm	0.04%	1.00%	In Tolerance
22.6 °C	22.6 °C	-	± 0.8°C	In Tolerance
762 mmHg	762 mmHg	-	± 3.5 mmHg	In Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-44	103521	22-Jun-2015	21-Jun-2016
Percision Thermometer	305460	21-Sep-2015	20-Sep-2016
Precision Barometer	2981392	23-Jun-2015	22-Jun-2016

Calibration Notes

The expanded uncertainty of flow, temperature, and pressure measurements all have a coverage factor of k = 2 for a confidence interval of approximately 95%.

Flow testing is in accordance with our test number PR18-13 with an expanded uncertainty of 0.18% using high-purity nitrogen or filtered laboratory air. Flow readings in sccm are performed at STP of 21.1°C and 760 mmHg.

Pressure testing is in accordance with our test number PR18-11 with an expanded uncertainty of 0.16 mmHg.

Temperature testing is in accordance with our test number PR18-12 with an expanded uncertainty of 0.04 °C.

Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

Louis Guido, Chief Metrologist

MICRO PRECISION CALIBRATION INC.

MICRO PRECISION CALIBRATION
22835 INDUSTRIAL PLACE
GRASS VALLEY CA 95949
530-278-9135

Certificate of Calibration

Date: Jan 27, 2016 **Cert No. 222008122819559**

Customer:
AIR RESOURCE SPECIALIST, INC
1901 SHARP POINT DR, STE E
FORT COLLINS CO 80525

		Work Order #:	SAC-70076487
		Purchase Order #:	A30271
MPC Control #:	AW5409	Serial Number:	304019
Asset ID:	N/A	Department:	N/A
Gage Type:	DIGITAL THERMOMETER	Performed By:	TODD MORRIS
Manufacturer:	EUTECHNICS	Received Condition:	IN TOLERANCE
Model Number:	4400	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	January 27, 2016
Temp/RH:	68.0°F / 38.0%	Cal. Interval:	12 MONTHS
		Cal. Due Date:	January 27, 2017

Calibration Notes:

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
CL7456	STANDARD PLATINUM RESISTANCE THERMOMETER PROBE	5681	1595	FLUKE	Dec 4, 2016	A7B16006
CR6700	DOUBLE WELL BATH	7013	79006	HART	Oct 14, 2016	222008122697272

Procedures Used in this Event

Procedure Name	Description
MPC-00125	Temperature Devices, General, 12-7-2015 rev01

Calibrating Technician: Todd Morris — TODD MORRIS

QC Approval: B. Gold — BRIAN GOLD

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO 17025:2005, ANSI/NCSL Z540-1, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

CERTIFICATE OF CALIBRATION AND TESTING

MODEL: **18802** (Comprised of Models 18820A Control Unit & 18830A Motor Assembly)
SERIAL NUMBER: CA03807

R. M. Young Company certifies that the above equipment was inspected and calibrated prior to shipment in accordance with established manufacturing and testing procedures. Standards established by R.M. Young Company for calibrating the measuring and test equipment used in controlling product quality are traceable to the National Institute of Standards and Technology.

Nominal Motor Rpm	27106D Output Frequency Hz (1)	Calculated Rpm (1)	Indicated Rpm (2)
300	50	300	300
2700	450	2700	2700
5100	850	5100	5100
7500	1250	7500	7500
10,200	1700	10,200	10,200
12,600	2100	12,600	12,600
15,000	2500	15,000	15,000
☒ Clockwise and Counterclockwise rotation verified			

(1) Measured frequency output of RM Young Model 27106D standard anemometer attached to motor shaft 27106D produces 10 pulses per revolution of the anemometer shaft
(2) Indicated on the Control Unit LCD display

* Indicates out of tolerance

☐ New Unit	☒ Service / Repair Unit	☐ As Found
	☒ No Calibration Adjustments Required	☐ As Left

Traceable frequency meter used in calibration Model: 34405A SN: 53020093

Date of inspection 3/2/2016
Inspection Interval One Year

Tested By 

apogee
INSTRUMENTS
721 West 1800 North
Logan, UT 84321

Certificate of Calibration
LI-COR Pyranometer
Model LI-200X

Customer Name	:	Genevieve Lariviere
Serial Number	:	PY60977
Calibration Date	:	04-Aug-2016
Previous Calibration Date	:	19-Aug-2015
Recommended Recalibration Date	:	04-Aug-2018
Calibration Factor	:	202.27 **W m^{-2} per mV**
Output	:	94.0 **µA per 1000 W m^{-2}**
Calibration Factor as Received	:	193.25 **W m^{-2} per mV**
Output as Received	:	95.3 **µA per 1000 W m^{-2}**
Resistance (Measured)	:	52.6 **Ω**
Change in Output	:	-1.4 **%**
Change in Output per Year	:	-1.4 **%**

Calibration Procedure

Calibration is based on a side-by-side comparison under high intensity discharge metal halide lamps using the mean of (4) LI-COR transfer standard pyranometers. LI-COR transfer standards are calibrated to the mean of at least (2) ISO-classified reference pyranometers under sunlight (clear sky conditions) in Logan, Utah. Each of the four ISO-classified reference pyranometers are recalibrated on an alternating year schedule (two instruments per year) at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL reference standards are calibrated to the World Radiometric Reference (WRR) in Davos, Switzerland.

Traceability

Instrument (Serial #)	ISO Classification	Calibration Date	Calibration Due Date
Kipp & Zonen CM21 (041269)	Secondary Standard	20-Jun-2015	20-Jun-2017
Kipp & Zonen CM11 (060089)	Secondary Standard	29-Jun-2014	29-Jun-2016
Kipp & Zonen CMP11 (101625)	Secondary Standard	29-Jun-2014	29-Jun-2016
Hukseflux SR20 (2497)	Secondary Standard	20-Jun-2015	20-Jun-2017
LICOR (PY68846)	Photodiode Transfer Standard	13-Jun-2015	13-Jun-2016
LICOR (PY68847)	Photodiode Transfer Standard	13-Jun-2015	13-Jun-2016
LICOR (PY68895)	Photodiode Transfer Standard	13-Jun-2015	13-Jun-2016
LICOR (PY68896)	Photodiode Transfer Standard	13-Jun-2015	13-Jun-2016

Technical Manager : Jacob Bingham Date : 04-Aug-2016

Please keep this document for your records

Website: www.apogeeinstruments.com E-mail: techsupport@apogeeinstruments.com Ph: (435)792-4700 Fax: (435)787-8268

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

RECALIBRATION OF LICOR LI200 PYRANOMETER

This unit has been repaired (if needed) and recalibrated. Sensors fitted with connectors and LI200X sensors have been adjusted to reflect the new calibration. LI200S Sensors require entry of the new calibration coefficient in the datalogger program. A copy of the recalibration sheet is enclosed; information pertaining to your sensor is summarized below.

User/Address

GENEVIEVE LARIVIERE
AIR RESOURCE SPECIALISTS INC
1901 SHARP POINT DR STE E
FORT COLLINS CO 80525
970-484-7941

Serial Number

PY60977

Last Known Calib. Date	Recalib. Date	Time (Months)
8/15	8/16	12

Original Calib. (uA/kW/m^2)	New Calib. (uA/kW/m^2)	F (New/Old)	Calib. Drift (%)
95.3	94.0	.99	-1.4

Past measurements may be corrected using the following formulas:

$$Rc = F'Rm$$
$$F' = Ko/Kn'$$

Rc corrected radiation value
Rm value measured using the original calibration
Ko original calibration
Kn' is the calibration at the time of the measurement computed by assuming a linear drift with time between Ko and Kn

MICRO PRECISION CALIBRATION INC.

MICRO PRECISION CALIBRATION
22835 INDUSTRIAL PLACE
GRASS VALLEY CA 95949
530-268-1860

Certificate of Calibration

Date: April 21, 2016 **Cert No. 222200812317175**

Customer:
AIR RESOURCE SPECIALIST, INC
1901 SHARP POINT DR, STE E
FORT COLLINS CO 80525

		Work Order #:	SAC-70078353
		Purchase Order #:	A30502
MPC Control #:	DB6200	Serial Number:	70565570
Asset ID:	N/A	Department:	N/A
Gage Type:	DIGITAL PRESSURE INDICATOR	Performed By:	ERICK CONKLIN
Manufacturer:	DRUCK LIMITED	Received Condition:	IN TOLERANCE
Model Number:	DPI 705	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	April 21, 2016
Temp/RH:	68°F / 43 %	Cal. Interval:	12 MONTHS
		Cal. Due Date:	April 21, 2017

Calibration Notes:

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
CS1000	PRIMARY PRESSURE STANDARD	2465A-754	47761	RUSKA	Jun 24, 2016	10062547776

Procedures Used in this Event

Procedure Name	Description
MPC-00033	Digital Pressure Gages, General, 8-20-2015 rev.01

Calibrating Technician: Erick Conklin
ERICK CONKLIN

QC Approval: B. Gold
BRIAN GOLD

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. .The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO 17025:2005, ANSI/NCSL Z540-1, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

APPENDIX E

EE&MS PE Audit of the
Great Smoky Mountains National Park (GRS420) Site

PRELIMINARY NPAP THROUGH-THE-PROBE AUDIT REPORT
EEMS Van-1

OZONE REPORT

Site Name:	GRS420	Airs ID:	470090101
Auditor:	Eric Hebert (EEMS)	Audit Date:	10/27/16
Station Manager:	Mike Slate (ARS) / Ethan McClure (operator)		

MOBILE PE LAB INSTRUMENTS

	Ozone	CO
Instrument:	Ozone	CO
Manufacturer:	Thermo	0
Model:	49C-PS	0
Serial Number:	0517112167	0
Calibration Date:	09/14/16	1/0/1900
Slope:	1.00261	0
Intercept (PPM):	-0.00015202	0

STATION INSTRUMENT INFORMATION

Instrument:	Ozone	
Manufacturer/Model #:	Thermo	49-C
Property Number:	49C-61985-333	
Calibration Date:	08/05/16	
Slope/Intercept (PPB):	0.0000	0.0000
Indicated Flow (LPM):	0.68 / 0.69	
In-Line Filter Change:	10/25/16	
Manifold Type:	1/4" Teflon	

PRELIMINARY OZONE AUDIT RESULTS

NPAP O3 Concentration (ppm)	Site Response (ppm)	Percent Difference
0.10235	0.10200	-0.3
0.07526	0.07533	0.1
0.04785	0.04796	0.2
0.02733	0.02755	0.8
0.01287	0.01363	5.9
0.00024	0.00088	

	Pass/Fail	Warning
O3 Audit Level 6	Pass	
O3 Audit Level 5	Pass	
O3 Audit Level 4	Pass	
O3 Audit Level 3	Pass	
O3 Audit Level 2	Pass	

Auditor: Eric Hebert (EEMS)
Print
Eric Hebert
Signature
Tim Sharac
EPA person notified in case of audit failure

Audit Limits

Pass	Bias < ±10% OR difference from actual concentration < 24 hour allowable drift (0.003 ppm)
Fail	Bias > ±10% AND difference from actual concentration > 24 hour allowable drift (0.003 ppm)
Warning	Bias > ±7% AND difference from actual concentration > 0.0015 ppm

Comments:
The station monitor was installed recently and has not been verified onsite. The level 3 standard photometer was verified on 4/22/16, however the results of that verification are not yet available onsite. The inlet filter is changed and the sample train is leak tested each week.

APPENDIX F

Fourth Quarter State Audit (NPAP) of the
Great Smoky Mountains National Park (GRS420) Site

TN Department of Environment & Conservation

November 21, 2016

Jim Renfro
Air Resource Specialist
Great Smoky Mountains National Park
1316 Cherokee Orchard Rd
Gatlinburg, TN 37738
Phone (865) 436-1708

Reference: Fourth Quarter 2016 Performance Audit

Mr. Renfro:
Attached are the performance audits conducted in October of this year by personal from Tennessee's Air Quality Assurance Section. The air monitoring stations audited are located in and around The Great Smoky Mountains National Park. The sites are maintained by personal from the National Park Services and Air Resources Specialist, Inc. Fort Collins, Colorado. There are five reports, four ozone sites and one NCORE site.

To try and achieve the new standards presented by the EPA, four audit points were used to challenge the ozone analyzers this quarter. Those points fall into audit levels 3-5 and the last level 2. Audit level 2 ranges between .006-.019ppm. The acceptable limits for level two concentrations are ±15% or ± 1.5 ppb. Two sites, Look Rock and Cove MTN. did not meet the acceptable limits at level 2. The EPA stated that data in AQS would **NOT** be invalidated if a monitor unsuccessfully meets the acceptable limits at the lower audit levels 1&2.

As you probably know, the EPA is directing that zero correcting of test concentrations be discontinued. Thus, new audit procedures will need to be addressed in order to accurately audit CO analyzers in the future. More information is present pertaining to CO auditing in the NCORE site report.

All other measured parameters were within acceptable limits. The results were entered in the digital site logs as well as the data loggers. There are no recommendations in conjunction with this audit. I will contact Mr. Renfro early next year to schedule the first quarter audits for 2017.

If we can be of any further assistance or should there be questions regarding this audit, please email at Lance.Allen@tn.gov or call (615)687-7040.
Sincerely,

D. Lance Allen

D. Lance Allen
Environmental Consultant
Quality Assurance Section

CC: R .Brawner APC, B. Pugh APC, Jason Stephens APC

TN Department of Environment & Conservation

Site: Look Rock 47-009-0101
Date: November 21, 2016
To: Jim Renfro
From: Lance Allen
Subject: TDEC Quality Assurance Performance Audit

On October 19, 2016, personnel from the TDEC Quality Assurance section conducted performance audits on selected ambient air monitors. The following is a summary of the parameters and values measured.

Site &Instrument 47-009-0101	Measured Parameter	Audit Value	Monitor Response	Difference	Acceptable Range
Look Rock	Ozone (O3)	.080ppm	.082ppm	2.5%	±15%
Thermo 49c		.050	.052	4.0%	±15%
S#1130450193		.030	.032	6.7%	±15%
		.010	***.012***	***2 ppb***	*±15% or ± 1.5ppb*
Data Logger ESC	Lab Temp	21.9°C	21.8°C	-0.1°C	±2°C
8832 S#A4115K	Station Time	12:01:30	12:01:06	-24 sec	
Teom 1400a	Sample Flow	3.08 lpm	3.00 lpm	-2.6%	±4%
serial # 24026	Bypass Flow	----- lpm	13.67 lpm	-----%	±4%
	Total Flow	16.58 lpm	16.67 lpm	0.5%	±%
	Bar. press.	694 mm	697 mm	3 mm	±10mm
	Amb. temp.	25.4°C	24.7°C	-0.7°C	±2°C
	Current time	11:29:44	11:30:00	16 sec	±5 min

Remarks:

1. The ozone monitor audited showed satisfactory correlation with our audit standard at audit levels 3-5. At level 2, it did not meet the acceptable range. EPA region 4 stated if a monitor failed to meet the acceptable range at the lower audit levels1-2 that it would **NOT** invalidate the data in AQS.
2. *Per 40 CFR Part 50 58, App. A, Sec 3.2.2: the percent difference of any ozone Audit Level is to be ± 15%; whereas, Audit Levels 1 and 2 may also be measured by difference in ppb.*
   - *This instrument was challenged at Audit Level 2, which reflected a difference of 2 pbb. Discussions with Region 4 EPA personnel in June 2016 indicated data will not be invalidated because of failing lower-level audits (Audit Levels 1 and 2). Furthermore, according to Region 4 personnel, the lower-level audits are being evaluated for information only at this time.*
3. All the measured parameters on the TEOM were within acceptable ranges.
4. The TEOM PM 10 cyclone and PM 2.5 impactor were clean.
5. The bypass flow was not measured during this audit.

Recommendations:

1. None.

If we can be of any further assistance or should there be questions regarding this audit, please email or call.

Lance.Allen@tn.gov
(615)687-7040

Ref: LR101916
cc: R .Brawner APC, B. Pugh APC, Jason Stephens APC

***Teledyne T750U (#70), Streamline Pro (S#M060504) and website www.time.gov were used by Quality Assurance personnel to conduct this audit.**

Department of Environment & Conservation

Site: NCORE Lock Rock 47-009-0101
Date: November 21, 2016
To: Jim Renfro
From: Lance Allen
Subject: TDEC Quality Assurance Performance Audit

On October 21, 2016, personnel from the TDEC Quality Assurance section conducted performance audits on selected ambient air monitors. The following is a summary of the parameters and values measured.

Site & Instrument 47-009-0101	Measured Parameter	Audit Value	Monitor Response	Difference	Acceptable Range
NCORE Look Rock/Thermo 43i-TLE S#612516918	Sulfur Dioxide (SO2)	.130ppm	.130ppm	0.0%	±15%
		.066	.065	-1.5%	±15%
		.026	.026	0.0%	±15%
		.014	.014	0.0%	±15%
		zero	.000	.000ppm	0-0.1ppb
Teledyne T500u S#96	Nitrogen Dioxide (NO2)	.126ppm	.135ppm	3.8%	±15%
		.067	.070	0.0%	±15%
		.028	.033	-5.7%	±15%
		zero	.000	.000ppm	<0.01ppm
Thermo 42c S#427408897	Nitrogen Oxides (NO)	.179ppm	.181ppm	1.1%	±15%
		.100	.102	2.0%	±15%
		.050	.052	4.0%	±15%
		.020	.021	5.0%	±15%
		.011	.012	9.0	±15%
		zero	.000	.000ppm	
	(NOy)	.185ppm	.191ppm	3.4%	±15%
		.104	.128	4.0%	±15%
		.053	.064	6.0%	±15%
		.021	.015	5.0%	±15%
		.012	.011	9.1%	±15%
		zero	.000	.000ppm	<0.10ppb
	(NO2)	.136ppm	.136ppm	3.2%	±15%
		.067	.070	3.0%	±15%
		.028	.033	3.6%	±15%
		zero	.000	.000ppm	<0.01ppm
	Convertor efficiency	Total		99.74%	≥96%
Thermo 48i-TLE S#621417079	Carbon monoxide (CO)	1.008ppm	1.009/**.962**ppm	0.1%/**-4.6%**	±15%
		.404	**.417/.370**	3.2%/**-8.4%**	±15%
		.221	**.184/.231**	4.5% /**-16.7%**	±15%
		zero	-.047ave	**-.047ppm**	0-0.010ppm
Data Logger ESC 8832 S#A4115K	Lab Temp	26.0°C	24.3°C	-1.5°C	±2°C
	Time	12:15:58	12:15:00	-58sec	

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Department of Environment & Conservation

Remarks:

1. The monitors audited showed satisfactory correlation with our audit standards.
2. All measured parameters were within acceptable limits.
3. The conversion efficiency of the Thermo 42c was 99.74% which was above the acceptable limit of greater than 96%.
4. The bold numbers in the CO column are the actual concentrations and percentages without zero correction. The zero concentration indicated by the CO analyzer is also in bold. The EPA is directing that zero correcting of test concentrations be discontinued. Thus, new audit procedures will need to be addressed in ordered to accurately audit CO analyzers in the future. The CO analyzers may need to be audited independently to avoid the high flow rates needed to achieve the lower audit level concentrations injected into the other analyzers. The high flow rates of our audit equipment, sometimes up to 16LPM, I feel is correlated to the high zero readings of the CO analyzer. Because with the site CO calibrator, operating at3or 5LPM, it doesn't duplicate the same high zero readings indicated during our audit procedures. I have also witnessed the same results from CO analyzers across the State.

Recommendations:

1. None.

If we can be of any further assistance or should there be questions regarding this audit, please email or call.
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Ref: LRNCORE4Q2016

cc: R .Brawner APC, B. Pugh APC, Jason Stephens APC

***Teledyne T750U S# 70, Gas Cylinder S# FF21045 and Streamline Pro (S#M060504) were used by Quality Assurance personal to conduct this audit.**