



Air Pollution Control Division Technical Services Program

APPENDIX D2

Standard Operating Procedures for the
Processing and Verification of Gaseous and Meteorological Data

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Standard Operating Procedure for the Processing and Verification of Gaseous and Meteorological Data

1 SCOPE AND APPLICABILITY

1.1 Introduction

The data collected by the Air Pollution Control Division (APCD) Technical Services Program (TSP) will be used to make decisions that affect human and environmental health and may have economic impacts. High quality data increases the likelihood that these decisions will be well-informed and that the data will withstand scrutiny. Ultimately, consistently high quality data will enable the APCD to better serve the public's best interest and the Department's mission of improving and protecting the air for present and future generations.

This standard operating procedure (SOP) document describes the procedures used by members of the APCD to process and verify ambient gaseous and meteorological data collected at the State of Colorado, Department of Public Health and Environment's (CDPHE) air quality monitoring sites. This includes both standard and trace level analyzers at State and Local Air Monitoring Stations (SLAMS), special purpose monitoring (SPM), Near-Roadway, and National Core (NCore) monitoring stations. The procedures given in this SOP are a supplement to the APCD's Quality Assurance Project Plan (QAPP), and the latest information published in the Code of Federal Regulations. This SOP outlines the data processing and data verification procedures that will enable the APCD program to review analytical data for consistency, quality, and relevance before using it to evaluate compliance with the National Ambient Air Quality Standards (NAAQS) and in decision making processes.

The following procedure will ensure that the data collected by the APCD will be of a consistently high quality.

1.2 Format and Purpose

The sequence of topics covered in this data processing and data verification method follows 2007 EPA guidance on preparing SOPs. This method was also written to help technical staff understand how and why key procedures are performed (US EPA, 2007). Guidance for developing data verification procedures was attained from EPA's Guidance on Environmental Data Verification and Data Validation document (US EPA, 2002).

2 SUMMARY OF METHOD

The EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Section 3 states that data quality can be defined in terms of several key data quality indicators; precision, bias, detection limit, completeness, and comparability. Evaluation of these indicators is performed in the data validation process, as performed by APCD's Quality Assurance group (US EPA, 2013). In accordance with this rationale, the purpose of the data verification process, as performed by the Gaseous and Meteorological Monitoring (GMM) group, is to generate and provide high quality control data that can be used to evaluate these indicators.

In general, data verification is the process of evaluating the completeness, correctness, consistency, and compliance of a data package against a standard or against project-specific criteria. The data verification process will identify procedural and analytical errors that are associated with a data set. In addition, the data verification process may identify potential sampling errors, which are out of conformance with the standard network design and/or measurement quality objectives.

The APCD currently uses a system for data verification that consists of a daily review of quality control data to actively monitor and document network health; a monthly review of all data to identify, flag, correct, or null code all suspect data; and an annual review of data that is completed as part of the annual data certification process for the EPA. In addition to the internal (GMM group) review of ambient and quality control data, an external review of analytical and data processing systems are also performed by APCD's Quality Assurance Group and by the EPA. Findings identified by these groups are integrated into the data verification process.

Data that has been through the entire validation process is sent electronically to EPA's Air Quality System (AQS). Data upload files for ambient data are generated in either a pipe-delimited format or an XML format from within the AirVision software. Data upload files for precision data are generated in a pipe delimited format from within the ZSPTracking Access database.

3 DEFINITIONS

The CDPHE/APCD/TSP QAPP contains an appendix of acronyms and definitions. Any commonly used shorthand designations for items such as the sponsoring organization, monitoring site, and the geographical area will be defined and included in this SOP or in the QAPP Appendix P2. Of unique significance to this SOP are the definitions of verification and validation, as described below.

Verification: Data verification is a process for evaluating the completeness, correctness, consistency, and compliance of a data package against a standard. It also determines whether the data meet regulatory requirements.

Validation: Data validation attempts to assess if the data are appropriate and that the verified results will meet the data user's and/or project's needs.

Null Coding: Removing ambient data that does not meet QC criteria, or is otherwise unacceptable, in the final verified and validated monthly data package that is sent to the AQS. Each datum affected are manually null coded with overwritten letter codes indicating the cause of the out-of-specification event.

4 PERSONNEL QUALIFICATIONS

General Personnel Qualifications are discussed in the CDPHE/APCD/TSP QAPP.

5 SYSTEM DESIGN

5.1 Data Processing Overview

In its simplest form data is generated by the analyzer, collected by the data logger, assembled by the central polling system and subsequently the ZSPTracking QA system, verified by GMM staff, validated by QA staff, and sent to the AQS which is the final data repository operated by the EPA.

Figure 1 shows the complete overview of the data processing practice used by GMM. Section 5 concerns all items from the AVData and ZSPTracking databases upward to the top of the figure, and Sections 6, 7, and 8 address the remaining aspects of AVData, ZSPTracking, and all processes below.

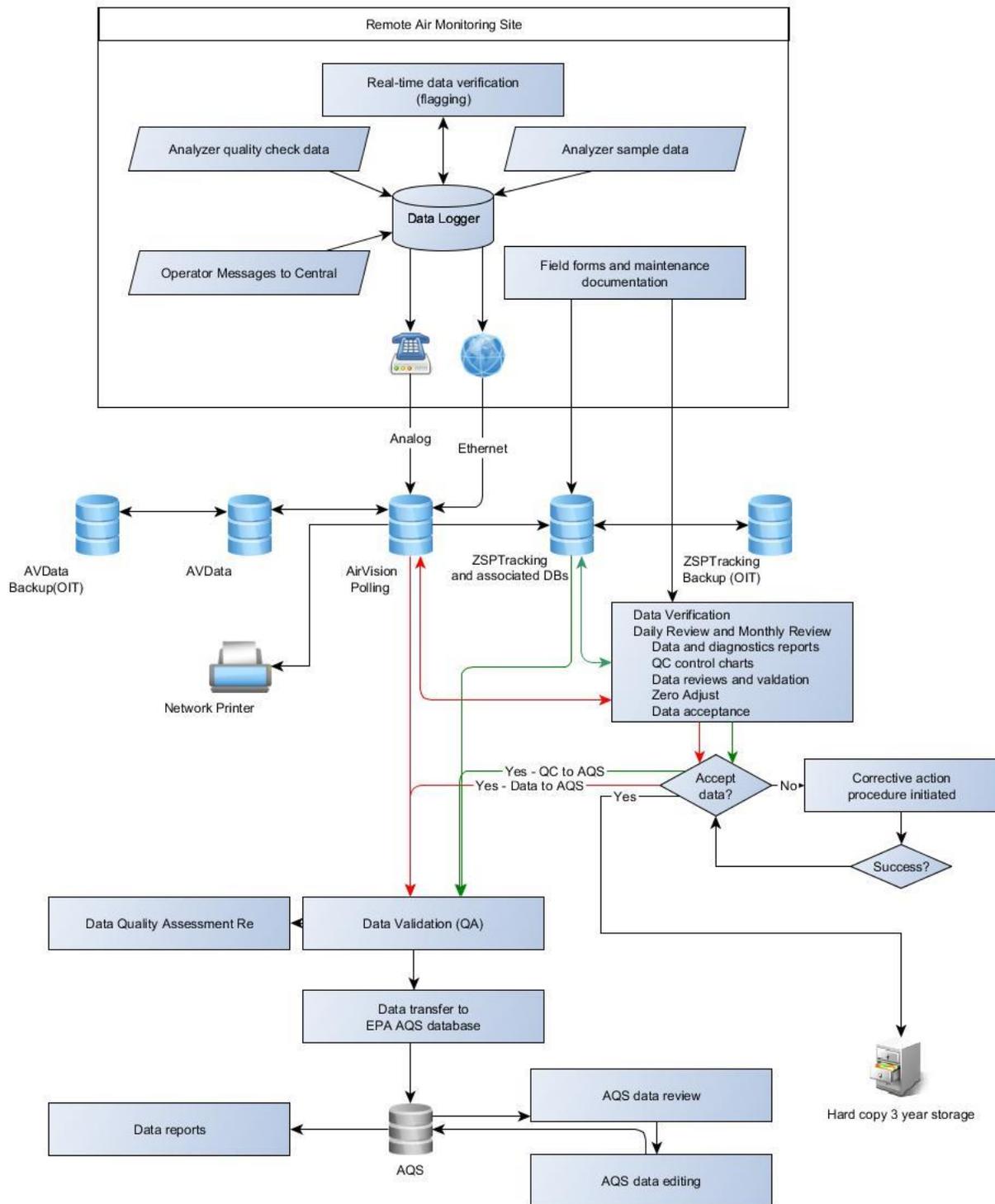


Figure 1. GMM Data Flow

5.1.1 Analyzer Data Generation

The GMM Unit operates several types of analyzers to monitor four of the six criteria pollutants (and associated pollutants such as NO, NO_x, and NO_y) and meteorology. The environment is sampled by the analyzer anywhere between once every three to every twenty seconds. The analyzers themselves are often not capable of determining whether the data is of high quality. The exception to this is the ability of analyzers to understand when they are not in normal sampling mode. The CO trace analyzers, for example, run occasional internal zero samples to readjust the baseline of the instrument. During such operations the data is flagged by the analyzer as invalid data in a way that is understood by the data logger.

Each analyzer has a number of internal operating measurements such as pressure and temperature. Should any of these parameters reach a level outside of optimal operating condition the analyzer will enter an alarm state. Currently the data loggers are not programmed to observe these alarm states and the responsibility to address them is left to the site operator. Consideration is underway to change this system to create a path by which the data loggers will be notified of critical alarms. While the alarm state is not observed, in cases where digital communication to the analyzer exists the operating measurements are also recorded and used later in the data validation process.

It should be noted that while analyzers are capable of understanding when they are in a state of internal calibration they are not capable of recognizing when they are being challenged externally. That information is generated and reported by the data logger. Meteorological instruments, from the perspective of the data logger, are all analog communication. They are not capable of any internal data storage or quality determination.

5.1.2 Data Logger Data Collection

The GMM Unit uses two generations of data loggers. The first is a proprietary DOS-style data logging system based on the ESC 8816 platform with a newer version, the 8832. The latter has the same software but has greater speed and memory. The second generation is a Windows-based fanless PC running Agilaire's AirVision software. Physically, connections between both data logger generations and the analyzers are the same, and the protocol to collect data from the analyzers is similar (though there are differences, for the purpose of this SOP the differences should be considered minimal).

Analyzers are connected to the data logger by Ethernet, serial RS-232, or analog physical wiring. Though Ethernet has been around for some time, older analyzers and ESC 8816 data loggers are not equipped with network interface cards. Further, though most analyzers are equipped with serial connection, older data loggers are limited to insufficient connection ports. While the TSP is putting effort into converting the entire system including each analyzer at each site to a form of digital communication between the analyzer and the data logger, such conversion is costly. Collection of diagnostic data from the analyzer such as cell temperature and sample pressure discussed in Section 5.1.1 is possible with both Ethernet and serial connections.

While different interfaces for communication are available, the underlying principle is the same. The data logger requests data periodically from the analyzer (There are analyzers that supply data at regular intervals and the data logger simply listens, such as the nephelometer). The data logger aggregates those responses into three time-bases. All data loggers are configured with one of two time-base scenarios. The first and predominant scenario is to aggregate to 1 minute, 15 minute, and 1 hour average. The second scenario, only used at sites monitoring for SO₂, is to aggregate to 1 minute, 5 minute, and 1 hour average. The 5 minute time-base is a requirement to submit the hourly maximum 5-minute average SO₂ concentration to the EPA. The 8872 data logger is capable of storing different time-bases for different channels and can therefore be a hybrid of the two scenarios.

The data logger is capable of near-real-time data validation based on a variety of factors configured by TSP. If there are fewer than 75% of valid data points for a particular time-base, the value is flagged as invalid (between 75% and 99% is flagged as potentially invalid). If the value received by the data logger is below a floor limit or above a ceiling limit, or if the values change beyond an allowable limit between samples, termed a rate of change error, the value is flagged as suspect. Other validation criteria are available on the data logger but are not currently configured by TSP.

The data logger collects data but also issues commands. At predetermined intervals the data loggers will send a command to a criteria gas source to generate a concentration of test gas as well as send commands to solenoids to create a path for the test gas to reach the desired analyzer. This is referred to as a performance check and generally meets the condition of either the biweekly EPA QC requirement or a high-level concentration check near the upper limit of the analyzer's designed concentration range. Though the analyzer is not made aware that a test is being performed, the data logger instructs a source to introduce the gas for a predetermined length of time and collects an average of the data points at the end of the time window. A five-minute average is collected at the end of each performance check phase and stored in the data logger as a calibration result.¹

In some cases the result of a performance check phase can be written to a numeric variable stored by the data logger (unfortunately referred to as a math constant in the technical manuals). These results can then be used to correct the readings from the analyzer. As an example, the result of the zero concentration during any performance check on an older Thermo 48C CO analyzer is stored as a math constant. A separate math channel on the data logger then subtracts the zero value from the observed CO value (called CO_RAW on the data logger) to provide real-time zero-adjusted CO concentrations. A more complex version of this can be found on the nephelometer data logger which stores both automatically generated offset values derived from zero readings and a manually entered span level value to generate a slope/offset equation adjusting raw nephelometer readings into backscatter in inverse kilometers.

The data logger also stores critical information that is maintained through the data process such as time of day and date of sample collection. The internal clocks are set by the central polling system (for the 8816/8832 generation) and by the site operator, data manager, or automatic sync with www.time.nist.gov (for the 8872). It is important to note that all times on all computers, data loggers and analyzers are to set to Mountain Standard Time and do not adjust for daylight savings. Clocks on these devices should appear to be running 1 hour behind from March to November (daylight savings time period, clocks move one hour forward). On site visits or during any maintenance, audit, or calibration, the operator enters a message to central which is stored by the data logger and later collected by the central polling system. The data logger also records when it revives from a power failure including information about how long the power has been out.

5.1.3 Central Polling Data Assembly

A central polling server is housed in a secured room under the purview of the GMM Unit, with shared access to other groups within the TSP. The central polling server, a Windows server with AirVision installed, is connected to multiple USB/analog modems, and to the internet through the Governor's Office of Information Technology (GOIT). It is also connected to a SQL Server operated and maintained by GOIT wherein the configuration of the network and the data from the network are physically stored.

The central polling server provides a number of functions including

- collecting data from sites
- providing user interfaces to review the data including results from performance checks, audits, and calibrations
- assembling data into formats appropriate for submission to regulatory agencies
- providing data to other servers for publication of data for internal and public consumption

¹ While the nomenclature in the data logger technical manual refers to precision checks as "calibrations" this is misleading. From the perspective of the data logger, any sequence of outgoing commands and averaging of subsequent results is deemed a calibration. A performance check does not alter the calibration settings of any analyzer.

Functions that the central polling server performs are discussed further in Sections 6 and 7. Before many of those functions can be performed (data validation and submission) the data must be collected.

On a regular interval which varies from every five minutes for high temporal resolution ozone data to every hour for sites relying on analog telephony, the central polling server connects with the data logger and retrieves all data available since its last successful connection and stores that data on the SQL Server. Since the data logger can store up to 33 days of hourly time-base, and as much as two weeks of one-minute time-base, if the network is impaired somehow it is possible to self-heal by back-polling data loggers for the duration of the impairment.

Polling is done in one of three ways. Many sites have digital cellular modems with static Internet Protocol addresses. These sites are connected to via two of the three ways. If the logger at the site has a network interface card, a direct IP connection can be established with the data logger (routed through the site modem). If the logger at the site does not have a network interface card, a proprietary software package specific to DIGI International is used to emulate an Internet Protocol connection over a serial RS-232 connection at the site. This proprietary package, called RealPort, must be configured at the central polling server and provide the server-side COM port and the static IP address of the DIGI modem at the site. In the AirVision software, these connections appear as directly connected data loggers (COM Routes). The third connection is via analog phone lines starting from the USB/analog modem connected to the server over one of many phone lines dedicated to it and ending at the USRobotics V.90 or equivalent analog modem at the site connected by serial RS-232 or -485 connection to the data logger.

Regardless of communication protocol, once connected the central polling server requests data by a proprietary command line and receives data in ASCII text. The AirVision software is capable of digesting the coded strings returned by the data logger into data points stored in the SQL Server. The AirVision software also monitors the success of each communication and on each attempt to communicate will attempt to collect data back to the previous successful communication. In this way, in the event of an outage the system can self-heal because the data logger can store a certain amount of data that will be automatically requested when the system is back online.

The central polling server requests the following data streams:

- Time-base average data regardless of use or destination
- Central messages
- Power failures
- Calibration results (please see footnote 1 earlier)

The central polling server also stores configurations for each data logger in the field and can store configurations for up to 99 data loggers, whether they are deployed or not. The central storage of these configurations makes homogenization of their configuration simple by allowing copy/paste between them, and provides for a backup. In the event a data logger fails or gets erased, a new data logger can be programmed and quickly deployed.

5.1.3.1 ZSPTracking QA System

The GMM Unit has designed a database in Microsoft Access that is primarily intended to store and track performance checks, manual precisions destined for AQS, and notes about zero correction and performance results (reasons for failure, for example), as well as instrument calibrations and source certifications.

The ZSPTracking database allows for entry of performance checks and QC precisions checks by either manual entry or by a coded algorithm connected to the AVData SQL Server. The latter is the preferred method because it reduces transposition and other errors common to manual entry. Additionally the coded algorithm, called the Get Method, and its loop control, Get Everything, allows for review of the results before storing them into the database. See Section 6.1 for more information on the Get Method, Get Everything, and entry of results.

The ZSPTracking database is also a useful tool in data review with charts designed to quickly spot trends in performance checks. These Control Charts are included in the monthly data validation package, Section 7.1, and are often referenced during daily data review particularly in the event of a failure of a performance check.

5.2 Documentation

This SOP serves as documentation for the overall structure of the system design, including data flow and repositories, as well as communication, collection, and dissemination methodologies. System design documentation can be found in vendor manuals for specific analyzers, data loggers, and the central polling software.

Documentation for the processes coded into the ZSPTracking and associated databases are in the form of commented documentation within the Visual Basic coding as is the industry standard.

Within the system, documentation for activities conducted includes site and analyzer forms, Messages to Central, and monthly data validation package forms.

5.3 Description of Software

Conceptual information about software supplied from vendors and developed in-house is in Section 5.1. This section gives more detail about the use of the software itself. Specific activities carried out within each software package can be found in the respective activity section in this SOP (for example, manual entry of performance checks into the ZSPTracking database can be found in Section 6.1).

5.3.1 AirVision

AirVision is a proprietary software package produced and supported by Agilaire LLC. There are two versions of AirVision. The first is a central polling system which is the complete and robust version, and the second is a data logger version found on the 8872 that has limited capabilities, called AVTrend.

This section of this SOP is not intended to be an exhaustive explanation of each interface in the AirVision software. For activity-specific functionality see the appropriate section in this SOP. For a full explanation of how to interface with any data logger or Central, see Appendix D1 of this QAPP.

5.3.1.1 AirVision Central

AirVision is installed on both central polling servers. While not discussed in detail here, the second polling server is a repository for non-CDPHE agency data that may or may not enter the GMM Unit data stream. To access AirVision you must have credentials to the polling server (at a minimum as a remote desktop user), to the AirVision software (at a minimum as a data reader user), and to the AVData SQL server which must be granted by GOIT. Access to the SQL Server is only necessary if connections are made to the SQL server outside the AirVision environment, such as the Get Method described in Section 6.1. Use of the AirVision software itself assumes the machine level access granted to the polling server.

There are four main menus most frequently used in AirVision; Configuration Editors, Data Editors, Reports, and Utilities.

Configuration Editors holds interfaces to alter Site/Parameter settings such as reported resolution and AQS ID numbers, as well as Data Source Details where configuration can be altered concerning communication routes to data loggers and configuration of specific channels. Server settings can also be configured here including settings for modems, COM routes, and Internet Protocol addresses.

Data Editors allow for zero-adjustment, annotation, flagging, and null coding of data and are commonly used as a graphing engine to view trends in data streams. Data can be altered in the data editors and care should be taken not to alter data unwillingly or without proper documentation. A raw state of the data is maintained so that at any time

the outward-facing data can be restored to its original state, but this can only be actively done. Changes to the data can only be performed by members of the data editor group as discussed in SOP Appendix D1.

Reports abound in AirVision. The Reports menu is where many of the monthly data validation reports are found including power failure logs, central message reports, and output to AQS text files used for null coding completeness checks. Raw data reports can be used to supply data to interested investigators.

Status Displays include the invaluable Scheduled Task Status that shows which sites failed to poll, and when the last successful poll occurred, as well as provide the ability to manually execute a task. The log viewer can be used by advanced users to determine causes of faults. The link-to-logger utility is used to monitor data loggers remotely as well as execute manual QC checks. The logger download utility is used to program data loggers from Central.

There are many other capabilities in the AirVision Central installation that are covered in the AirVision manual and will not be further discussed here.

5.3.1.2 AirVision 8872

The newest generation of data loggers deployed by GMM Unit is a fanless PC running Windows. AirVision is installed on the 8872 as any other software package would be. To gain access to the 8872 you need only the Administrator password since the data loggers are not connected to the GOIT Active Directory Forest (the same is true of the 8816/8832 where one password gives access to any data logger).

There are three menus that are predominantly used in day-to-day operation of the 8872; Data Editors, Reports, and Utilities.

The Data Editors menu holds the interface for the Logbook Entry Editor where messages to central are recorded. Note that no other data editor should be used since Central is the in-perpetuity data repository and data is only stored on the 8872 for approximately one month. As well, any data alteration falls under the responsibility of a chain of reviewers and should not be conducted by a site operator alone. However, there is an Annotate Data user interface that should be used to demark any data with any occurrence that may assist data managers in understanding the activities being conducted at the site.

The Reports menu has an interface to generate results from performance checks with a report called Calibration Results (unfortunately named, see footnote 1). This report is effective in determining the quality of the precision check. A site operator can also instance a logger report about messages left from that logger for central to view any work history that may affect their decision making process.

The Utilities menu holds the heart of the 8872 functionality, the Site Node Logger (SNL) Toolbox. Once open, the SNL Toolbox has five tabs; Channels, Calibrations, Digital Inputs, Digital Outputs, and Diagnostics.

The Channels tab provides real-time readouts from all connected analyzers and provides the ability to put a channel into maintenance or disabled mode which attaches an M or D flag to the data. Do not turn the collection Boolean off ever. The Calibrations tab provides information on whether a performance check is underway, and provides the option to manually start or stop a check. The Digital Inputs tab is not generally used by the site operator but can relay information about control input responses. The Digital Outputs tab is used to control external contact closures such as solenoids and control contacts for criteria gas sources. The Diagnostics tab is largely for advanced users and troubleshooting.

5.3.2 ZSPTracking

Conceptual inclusion of the ZSPTracking database in the system design is illustrated in Figure 1 and briefly discussed in Section 5.1.3.1, and more completely discussed in Section 6.1 and other sections.

ZSPTracking serves a vital role in assessing the overall health of the network, and allows for focused investigation into specific analyzer performance. After entry of the automatic and manual precision checks are complete, the ZSPTracking database is beneficial in seeing which analyzers failed (or were close), which did not communicate, and which had zeros outside of an acceptable range with a single report, the ZSP Failure Report. Once this information is at hand, further investigation can be assisted by the Control Chart available from within the ZSP Entry Form.

As mentioned, ZSPTracking is an internally developed database built in Microsoft Access with heavy reliance on Visual Basic for Applications, and documentation can be found in the appropriate coding. Data is now stored on a SQL back-end under GMM purview.

5.3.3 AVData Monthly Review Pivot Tables

Two Microsoft Excel pivot table spreadsheets have been developed to allow for multi-stream data visualization during monthly data validation (the queries behind the pivot table have the month hard-coded into them). Both are found in the [\\dphe.local\apc\Programs\Monthly Review Tools\](#) folder. They are AVDataMonthlyDiagParams.xlsx and AVDataMonthlyGraphCriteria.xlsx. They are separated to clear the clutter of the filter criteria within the pivot table, and to allow for two ways to view the data.

The AVDataMonthlyDiagParams pivot table is designed to view diagnostic parameters such as temperature and pressure readings taken internally by the analyzers. It is designed to view all analyzers by parameter, showing, for example, sample flow for each ozone analyzer on one graph. This is beneficial by allowing comparison across analyzers that should, in theory, operate the same way.

The AVDATAMonthlyGraphCriteria pivot table is used to view criteria and meteorological data streams in a visual environment. In this case, every criteria and meteorological parameter at a site is shown on the same graph. While this can be problematic for sites that have many parameters, reduction of the number of parameters shown at one time is possible. The benefit to viewing each parameter at one site (rather than each site for one parameter) is that inter-species relationships become evident and assist in invalidating poor data. For example, ozone is generally diurnal and can fluctuate directly with NO₂. If a non-diurnal pattern is noticed, or an inverse relationship with NO₂, the data becomes suspect.

While graphing these parameters is a possibility within AirVision, the local copy storage method used by the Excel Pivot Table provides fast and easily manipulated visual representations.

6 DAILY - DATA EVALUATIONS AND DATA PROCESSING PROCEDURES

6.1 Entry of Quality Control Data into ZPSTracking Database Procedure

Values that are used to evaluate the performance of individual analyzers and overall network health are generated from the nightly automated performance tests. Data loggers for all continuous monitors in the field are programmed to generate a precision or span on alternate nights. Shortly before midnight (actual time determined by the length of time required to perform a full span or precision completely before midnight for a particular pollutant) of a given day, the data logger will begin a precision or a span test and record the results which are then polled by APCD's Central computer. At the beginning of the following workday, GMM staff will retrieve the data from the Central computer and enter them into the ZSPTracking System. The ZSP Tracking System serves as an archive for the automated Performance test data as well as manually generated QC Precision test data, calibration data, and source/bottle data. Flags are automatically generated for these data that separate them from the raw ambient air data. Monthly, data from the ZSPTracking System is entered into the EPA's Air Quality System (AQS) with AQS-type text strings created by the ZSPTracking System and uploaded to the AQS using the same methodology as the uploading of raw ambient air data.

6.1.1 Entry of Automated Performance Tests into the ZSPTracking System

1. The ZSP Tracking System is accessed from the operator's computer at:

J:\ZSFILES\ZSP Tracking

Double clicking on this ZSP database file will open the program on the operator's computer (A shortcut can also be created, placing an Icon on the computer screen that can also serve as a direct connection to the ZSP Tracking system).

- Double clicking the aforementioned file on the J: drive or the ZSP Tracking icon on the operator's computer results in the following screen, the Start Menu is displayed:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
Air Pollution Control Division - Technical Services Program
Start Menu
10/10/2014

Data Tracking Forms	
Enter Z/S/P Readings	Enter Z/S/P
Enter Calibration Data	Enter Calibration
Enter Source or Bottle Data	Enter Source Info
Notes	Enter Notes
Enter Manual Precision	Enter Manual

Site Information Form	
Site Information	Site Information
Update QA Site Table	Update

Reports	
Start Date: 10/9/2014	End Date: 10/10/2014
Z/S/P Failure Report	Generate Report
Z/S/P Summary Report	Generate Report
Bottle Expiration Report	Generate Report
Calibration Report by Site	Generate Report
Calibration Report by Due Date	Generate Report

Zero Adjust Reports	
Ozone Zero Adjust Report	Generate Report
Ozone Absolute Zero Adjust Report	Generate Report

QC Data Processing	
View Missing Manual Precision Report	Generate Report
View Pre-Upload Report	Generate Report
Generate AQS Textstring File	Generate File
Set AQS Textstring Flags	All Flags Off All Flags On

- The operator will click on the "Enter Z/S/P" button located under *Data Tracking Forms*, resulting in the following screen (ZSPEntry):

The screenshot shows the ZSPEntry software interface. At the top, it displays the Colorado Department of Public Health and Environment logo and the title 'Air Pollution Control Division - Technical Services Program Z/S/P Tracking - Data Entry'. The site name is 'CAMP' and the AQS ID is '080310002'. The date is set to '12/8/2014'. The main data table has columns for dates from 12/7/2014 to 12/22/2014. The table includes fields for 'Span or Prec.', 'A / M / NP / SDay', 'Actual (Zero)', 'Actual (Raw)', 'Actual (ZC)', 'Indicated Zero', 'Indicated Raw', 'Indicated ZC', '% Diff.', 'Notes', 'Zero Adjust', 'AQS', 'Invalid Record?', and 'Delete Record?'. Below the table, there are sections for 'Expanded Notes', 'Recent Calibrations', and 'S/P/Bottle Source Information'.

- For instructional purposes, the following example will demonstrate how an automated performance test generated from the carbon monoxide (CO) monitor at the CAMP site (AQS i.d. = 08-031-0002) on 12-07-2014 is entered into the ZSP Tracking System. From the ZSPEntry screen shown in step 3 above, CAMP (ID 06) is selected from the drop down menu that appears when the arrow next to Site Name is clicked, resulting in the screen below:

The screenshot shows the ZSPEntry software interface with the site name 'CAMP' selected. The AQS ID is '080310002' and the date is '12/8/2014'. The main data table has columns for dates from 12/7/2014 to 12/22/2014. The table includes fields for 'Span or Prec.', 'A / M / NP / SDay', 'Actual (Zero)', 'Actual (Raw)', 'Actual (ZC)', 'Indicated Zero', 'Indicated Raw', 'Indicated ZC', '% Diff.', 'Notes', 'Zero Adjust', 'AQS', 'Invalid Record?', and 'Delete Record?'. Below the table, there are sections for 'Expanded Notes', 'Recent Calibrations', and 'S/P/Bottle Source Information'.

The fields to be populated with the automatically generated span data are to the left side of the form underneath the date field (the current date, 12/08/2014, less one day, because the span was initiated before midnight on 12/07/2014). Directly to the right of these blank fields are descriptions of each field: Span or Prec., A/M/NP/SDay, Actual (Zero), Actual (Raw), etc. Note that the previous overnight's automated performance test results appear to the right of the fields that are to be entered.

- The operator clicks the “Get” button on the left side of the screen, and the formerly blank fields below the date field become populated with the results of the overnight span:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
Air Pollution Control Division - Technical Services Program
Z/S/P Tracking - Data Entry

Site Name: 06 AQS ID: 080310002 Date (mm/dd/yy): 12/8/2014

CO CAMP - 42101 - 2 - Z/S/P Tracking - 283

Date	Span	Prec														
12/7/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/6/2014	4.04	9.2	4.04	9.2	4.04	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04
12/5/2014	4.04	9.2	4.04	9.2	4.04	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04
12/4/2014	0.1	0	0.1	0	0	0	0	0.1	0	-0.1	-0.1	0	-0.1	0	0	-
12/3/2014	9.4	4.1	9.3	4.1	9.3	4.1	4.1	9.3	4.1	9.2	4	9.2	4.1	9.3	4.1	9.3
12/2/2014	9.4	4	9.3	4	9.3	4.1	4.1	9.2	4.1	9.3	4.1	9.3	4.1	9.400001	4.1	9.3
12/1/2014	2.2%	-1.0%	1.1%	-1.0%	1.1%	1.5%	1.5%	0.0%	1.5%	1.1%	1.5%	1.1%	1.5%	2.2%	1.5%	1.1%
Actual Z	Actual Zero															
Zero Adjust:	<input checked="" type="checkbox"/>															
AQS:	<input type="checkbox"/>															
Invalid Record?:	<input type="checkbox"/>															
Delete Record?:	<input type="checkbox"/>															

Expanded Notes (double click note field of interest)

Note Date: Overwrite

Note Record ID:

Recent Calibrations (not editable)

Date	Initials	Zero	Span	Prec
11/14/2014	VRS	0	9.39	4.07
8/12/2014	VRS	0	9.1	4.02
6/19/2014	VRS	0.01	9.08	4.04
3/14/2014	VRS	0	9.08	4.04
12/10/2013	VRS	0	9.27	4.03
10/8/2013	VRS	0	9.3	4.1
7/18/2013	VRS	0.04	9.12	4.06

S/P/Bottle Source Information (not editable)

Type	SN	Conc
42101	CC403235	9.20
42101	CC176167	4.04
42101	CC51903	4.0
42101	CC259603	9.118
42101	XCO284268	9.136
42101	CC331454	4.016
42101	CC402770	39.47

(NOTE: If this is the first precision or span to be entered for a given day, the date field will be populated with ##### symbols; clicking on the arrow beside the date field and selecting the appropriate date, 12/07/2014, will populate the date field with a readable date and eliminate the ##### symbols from appearing for the rest of the entry period.)

- Once it is determined that all of the fields are populated, the Capture Data button (below the Delete, Overwrite and Get buttons on the left of the screen) is clicked. This causes the data to be shifted to the right, next to the previous day's performance test entries:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
Air Pollution Control Division - Technical Services Program
Z/S/P Tracking - Data Entry

Site Name: 06 AQS ID: 080310002 Date (mm/dd/yy): 12/8/2014

CO CAMP - 42101 - 2 - Z/S/P Tracking - 283

Date	Span	Prec														
12/7/2014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/6/2014	4.04	9.2	4.04	9.2	4.04	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04
12/5/2014	4.04	9.2	4.04	9.2	4.04	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04	9.2	4.04
12/4/2014	0.1	0	0.1	0	0	0	0	0.1	0	-0.1	-0.1	0	-0.1	0	0	-
12/3/2014	9.4	4.1	9.3	4.1	9.3	4.1	4.1	9.3	4.1	9.2	4	9.2	4.1	9.3	4.1	9.3
12/2/2014	9.4	4	9.3	4	9.3	4.1	4.1	9.2	4.1	9.3	4.1	9.3	4.1	9.400001	4.1	9.3
12/1/2014	2.2%	-1.0%	1.1%	-1.0%	1.1%	1.5%	1.5%	0.0%	1.5%	1.1%	1.5%	1.1%	1.5%	2.2%	1.5%	1.1%
Actual Z	Actual Zero															
Zero Adjust:	<input checked="" type="checkbox"/>															
AQS:	<input type="checkbox"/>															
Invalid Record?:	<input type="checkbox"/>															
Delete Record?:	<input type="checkbox"/>															

Expanded Notes (double click note field of interest)

Note Date: Overwrite

Note Record ID:

Recent Calibrations (not editable)

Date	Initials	Zero	Span	Prec
11/14/2014	VRS	0	9.39	4.07
8/12/2014	VRS	0	9.1	4.02
6/19/2014	VRS	0.01	9.08	4.04
3/14/2014	VRS	0	9.08	4.04
12/10/2013	VRS	0	9.27	4.03
10/8/2013	VRS	0	9.3	4.1
7/18/2013	VRS	0.04	9.12	4.06

S/P/Bottle Source Information (not editable)

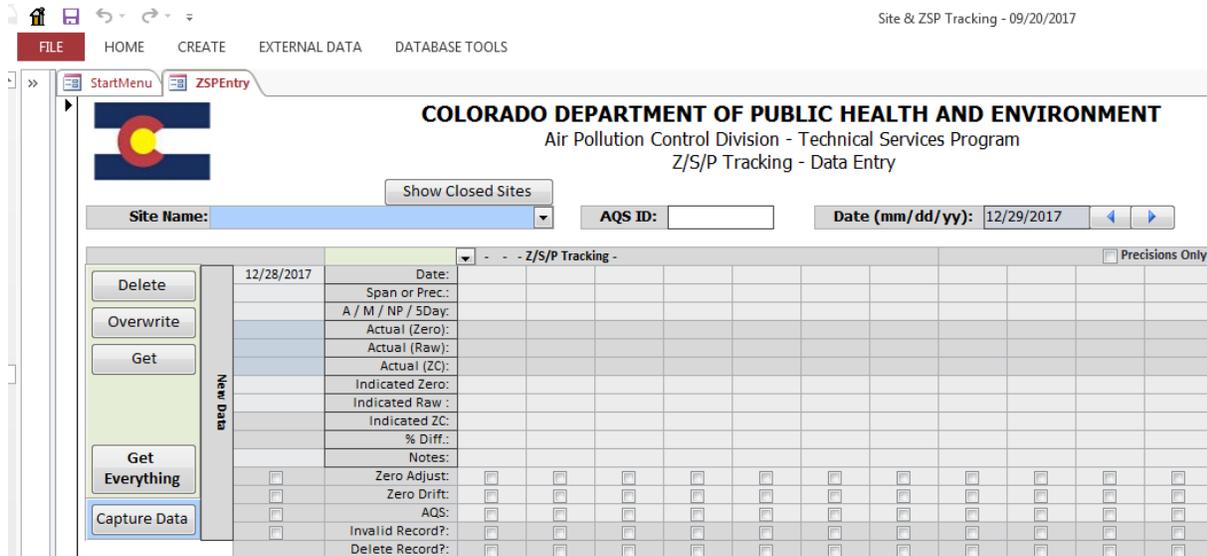
Type	SN	Conc
42101	CC403235	9.20
42101	CC176167	4.04
42101	CC51903	4.0
42101	CC259603	9.118
42101	XCO284268	9.136
42101	CC331454	4.016
42101	CC402770	39.47

(Note: Clicking “Get” also triggers an automatic calculation of % Diff occurring in that formerly blank field ((Indicated Raw - Actual Raw)/Actual Raw)*100=% Diff; ((9.4-9.2)/9.2)x100=2.2%. Note: In this example, the % Diff field is NOT highlighted with any shading after calculation. Besides this “no color” highlighting this particular cell, two other highlighting possibilities exist after calculation of % Diff: Yellow indicates a “Warning” and occurs when the calculated % Diff is between 7.5% and 10% (5%-7.5% for ozone). A % Diff calculation of >10% (>7.5% for ozone) would result in a red highlighted field, indicating a “Fail”. A “Warning” % Diff requires no immediate action on the part of the operator—overnight precisions will be closely monitored to see if the % Diff calculation worsens or resolves on its own. A “Fail” will require intervention to determine the cause of the failure, and the operator will perform trouble shooting as necessary to alleviate the problem(s) that are causing a failure.)

7. These daily entered records may also be deleted and recaptured or overwritten as needed. Clicking on the “Delete Record?” box beneath the daily precision/span data and then clicking the Delete button (above the Get button to the left of the screen) will remove the previously captured record. Changing values or Notes within a previously captured record is accomplished by making any needed changes within a given cell, then clicking the “Overwrite” button on the left of the screen (between the Delete and Get buttons).
8. The procedures described above are repeated for each continuous parameter at a given continuous monitoring site each morning.

6.1.2 Batch Entry of Automated Performance Tests into the ZSP Tracking System

Each business day at the beginning of the day, Section 6.1.1 is carried out for each analyte for each site. The data analyst would start by selecting the first site in the Site Name list, and rotate through each of the analytes in the species list. This redundancy is handled by the Get Everything button, located above the Capture Data button on the left of the screen in the figure below.



Click the Get Everything and agree, if appropriate, to the subsequent warning. Code now guides the database through each site, and then through each analyte, and records the results between the most recent date to the right in the form and the date in the Date (mm/dd/yy): field.

Note that two warnings are possible. The first is an indication that one or more performance tests are missing out of the last five tests. Take note of the site name and analyte from the title bar of the warning box and click OK, and the process will continue. The second is an error created by an absent Actual NO₂ concentration developed by the

reduction in NO during a titration sequence. This most likely happens because of an aborted performance check or a manual performance check on a true NO₂ analyzer and not on a converted NO₂ analyzer within ±60 minutes. Take note of the error and delete the errant record after the Get Everything process is completed using the method that follows, and Section 6.2.1.

On completion the process will simply stop on the last site/analyte. Return to any noted site/analyte records and add a NP record, or remove the faulty NO₂ record as appropriate. From the StartMenu page, click Generate Report next to Z/S/P Failure Report, which will open a report with all failures from the dates in the Start Date: to End Date: range just above that button. Review this report for obvious errors, including any -999 values that are generated by aborted sequences and can be removed in the ZSP Entry tab (Enter Z/S/P).

6.1.3 Entry of Calibration Information into the ZSP Tracking System

In an effort to assure quality data retrieval, most continuous monitoring instruments are calibrated on a quarterly basis. The instruments are challenged with known NIST traceable concentrations of the gas of interest and the response by the instrument being calibrated is recorded. The measured results recorded by the instrument being calibrated are entered into the AirVision system (previously referred to in this section as the “Central” computer) so that they may be retrieved and entered by GMM staff into the ZSP Tracking System on the next business day.

1. AirVision is accessed by clicking on a desktop icon on one’s computer. After entering all of the appropriate logon information perform the following.
 - a. Select the home tab on the top tab bar.
 - b. From the Report dropdown menu select “Logger Reports” to open up a second dropdown menu.
 - c. Select the “Central Messages” option. This will open up the report selection window.
 - d. In the Start Date field enter the beginning date and time for the time period of interest. Typically, this will be the 00:00 hrs for the previous day.
 - e. In the End Date field enter the ending date and time for the time period of interest. Typically, this will be the current time on the current day.
 - f. In the Source Selection section select the sites you wish to view messages for. Typically, all active sites will be selected. Note: multiple sites can be selected by holding down the Ctl key. Note: This report and along with static selection criteria can be saved as a favorite. See the operator’s manual for instructions.
 - g. Select the “Generate Report” button on the command ribbon.
2. The daily Logger Central Message Report:

Logger Central Message Report

Site Name CAMP	Site Description CAMP
Logger Identifier ⁰⁶	Logger Name CAMP_72
Message Time	Message Text
11/19/2014 1:16:12 PM	On site for air toxics sample pick up. -AF
Site Name MANITOU	Site Description Manitou Springs Public Works
Logger Identifier ⁶⁴	Logger Name MANITOU
Message Time	Message Text
11/19/2014 11:28:54 AM	O3, Z=-0.001, S=241, P=060, 401 READ, VRS.

In the above example, all activities performed by monitoring staff in the field on 11/19/2014 (Wednesday) have been entered into AirVision and appear on this default report run on 11/20/2014 (Thursday). A longer

time period can be selected by adjusting the Start Date and End Date using the drop down calendars, accessed by the outermost “down arrows” next to the Start Date and End Date cells in the upper left portion of the screen. Clicking on these arrows results in the appearance of the current month calendar and enables the user to highlight a specific date or create an interval with multiple days spanning any time period. Once the date or interval has been selected, click the Generate Report in the upper left portion of the screen to generate a new Logger Central Message Report for the specific date or interval of interest, e.g., the previous Friday through the weekend.

- The individual looking for any calibrations performed on a specific date or during a period of days will scan the report seeking a line (or lines) within the body of the report that contains the chemical abbreviation of the gaseous pollutant (CO, SO₂, NO₂, NO, NO_x, or O₃) followed by Z=(value), S=(value), P=(value). In the above example, such a line is discovered and is associated with a “Logger Name” of MANITOU (Manitou Springs Ozone site; logger i.d.=64). A calibration of the O₃ monitor at Manitou Springs was completed and entered into the AirVision system at 11:28:54 AM on 11/19/2014. The results were Z(zero)=-0.001, S(span)=241, P(precision)=060. Other notes entered by the operator performing the calibration indicate that the source instrument at the site used to generate test gas concentrations is a “401” (Teledyne O₃ monitor, model #401). The operator has included his initials as well (VRS). The Logger Central Messages Report may now be printed, or the pertinent values written down for later entry into the ZSP Tracking System.
- Entry of calibration data begins by opening the ZSPTracking System (again, double clicking the file J:\ZSFILES\SP Tracking or clicking on desktop icon if shortcut has been created. From the Start Menu, in the box titled “Data Tracking Forms”, clicking the button “Enter Calibration” results in the appearance of the following Calibration Information screen:

The screenshot shows the 'Calibration Information' form within the 'COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT' interface. The form includes the following fields and values:

Calibration Information	
Site:	[Dropdown Menu]
AQS ID	[Text Field]
Parameter Type:	[Dropdown Menu]
Calibration Date:	12/9/2014
Initials:	VRS
PreCal - Span %:	-0.001
PreCal - Prec %:	241
Zero - Tag:	060
Span - Tag:	241
Precision - Tag:	060
Notes	[Text Area]

Buttons: Go To Archive, Capture New Record

- Clicking on the arrow next to the “Site” cell elicits a drop down menu with all continuous sites listed. In this instance, site i.d.=64 (CO Springs-Manitou) is selected and the Site field and AQS ID field are populated with the appropriate information associated with the site.

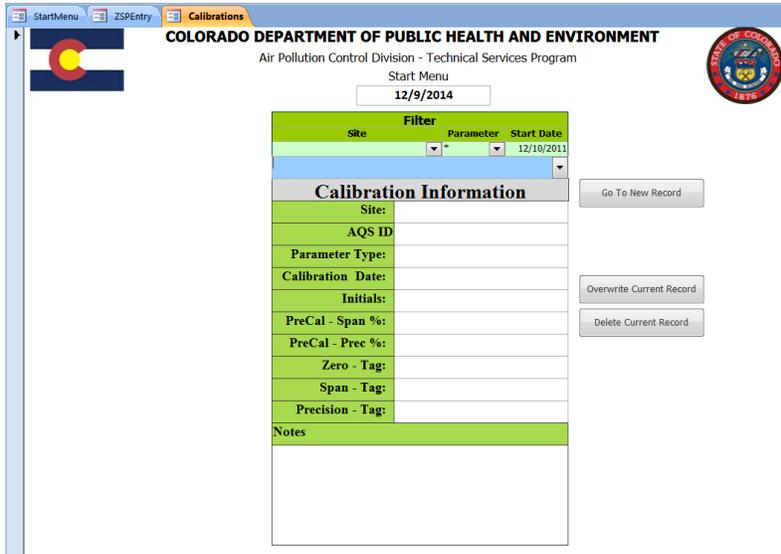
6. Clicking on the arrow next to the Parameter Type cell elicits another drop down menu listing all continuous parameters monitored at the site of interest. In this case, O₃ (the only continuous parameter monitored at Manitou Springs) is selected.
7. Using whatever methods were utilized to record the calibration information in step 2. above, the remaining cells in the Calibration Information screen (with the exception of the “PreCal-Span & Prec %’s cells) can be filled in—the date can be entered manually, e.g., 11/19/2014, or selected from a calendar which is generated when clicking on the Calibration Date cell. The field operator’s initials are entered, and the Zero, Span, and Precision cells have the Z, S, and P values from the calibration (-0.001, 241, and 60) entered into them, respectively. The only “Notes” in this example are “401 READ”, which is entered into the large cell at the bottom of the form. The completed form is below:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
Air Pollution Control Division - Technical Services Program
Start Menu
12/9/2014

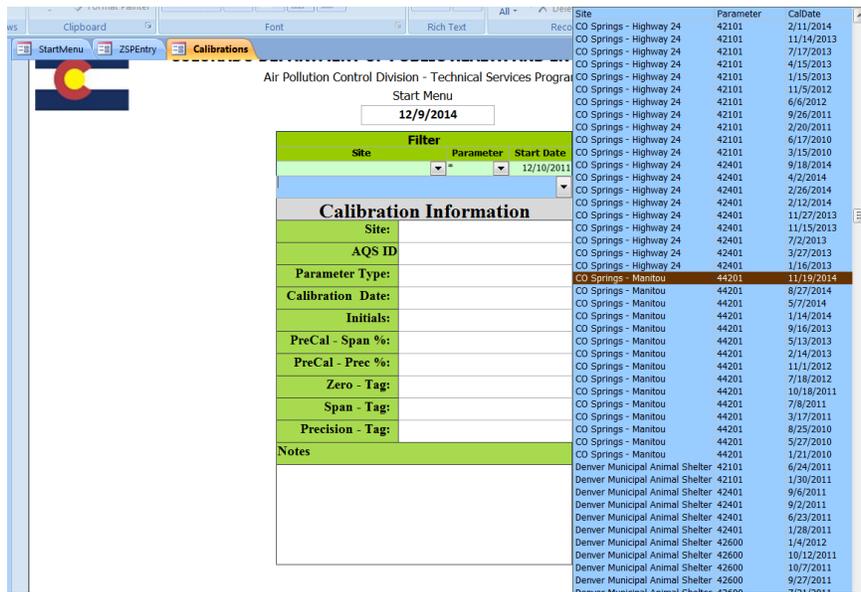
Calibration Information	
Site:	64
AQS ID:	080410016
Parameter Type:	O ₃
Calibration Date:	12/9/2014
Initials:	VRS
PreCal - Span %:	
PreCal - Prec %:	
Zero - Tag:	-0.001
Span - Tag:	241
Precision - Tag:	60
Notes	
401 READ	

Go To Archive
Capture New Record

8. Once all the necessary information has been entered into the Calibration Information form, it needs to be archived and this is accomplished by clicking the “Capture New Record” button to the right of the form. A popup window will appear, acknowledging the capture of the record. Click the “OK” button in this window.
9. Archived calibration records can be accessed for modification or deletion by clicking on the button “Go To Archive” to the right of the Calibration Information form. The following screen appears:



- Clicking on the arrow next to the blue cell in this form will generate the following screen, and show a scrollable list of every calibration of every continuous monitor at every continuous site, from 2010 to the present:



- For Example, the Manitou O3 calibration on 11/19/2014 is scrolled to and selected, resulting in the following screen:

Air Pollution Control Division - Technical Services Program
Start Menu
12/9/2014

Site	Parameter	Start Date
CO Springs - Manitou	44201	12/10/2011
CO Springs - Manitou		

Calibration Information

Site: CO Springs - Manitou
 AQS ID: 080410016
 Parameter Type: 44201
 Calibration Date: 11/19/2014
 Initials: VRS
 PreCal - Span %:
 PreCal - Prec %:
 Zero - Tag: -0.001
 Span - Tag: 241
 Precision - Tag: 60

Notes
401 READ

Buttons: Go To New Record, Overwrite Current Record, Delete Current Record

6.1.4 Entry of Bottle Information into the ZSP Tracking System

Tracking the precision and accuracy of the monitors requires overnight Performance tests using NIST traceable gasses for each gaseous monitor, with the exception of ozone. Ozone is not “available in a bottle”, so to speak, so sites with an O₃ monitor have instruments (ozonators) that generate ozone via photolysis resulting in a precise concentration of O₃ that can be used to challenge the O₃ monitor, just as the specific span and precision gasses (CO, SO₂, and NO₂) are used for assessing the performance of monitoring instrumentation nightly. Only some of the CO monitors have a direct source for a precision gas. The concentration for the CO precision gas is generally around 4 ppm; the concentration for CO span gas is generally around 9 ppm. NO₂ and SO₂ precision and span gas concentrations are achieved by dilution of the concentration from a single NIST traceable source bottle. The methods used for these dilutions are approved by EPA to achieve the proper span and precision concentrations used in the overnight tests. These source gasses are tracked in the ZSP Tracking System. Tracking ozone sources in ZSP Tracking is being developed.

1. The first step in tracking the initial placement of a source gas is to open the ZSP Tracking System (again, double clicking the file J:\ZSFILES\SP Tracking or clicking on desktop icon if shortcut has been created). This will bring up the Start Menu. Locate and click on the Enter Bottle Info button next to the “Enter Bottle Data” banner, part of the Data Tracking Forms area of the Start Menu. The form below is generated:

Site & ZSP Tracking - 09/20/2017
Mattson, Erick J.

**Zero/Span/Precision Database
Bottle Management Menu**

Data Entry Forms

Manage Bottle Inventory	Bottles
Assign Bottles to Sites	Site Assignment
Perform an Action on a Bottle	Actions
Enter Bottle Pressures	Pressure

Records: 14 of 1 of 1 | No Filter | Search

Form View

- a. The Bottle Management form allows for full management of the bottle inventory. When bottles arrive from the vendor, a GMM data manager will enter that information into the form opened by clicking Bottles.
 - b. Following the example below, a bottle in the inventory can be assigned to a site by clicking the Site Assignment button.
 - c. Returns and recertifications, or any other actions performed on bottles can be logged by clicking on the Actions button.
 - d. Starting in the middle of 2017, pressures read from site log forms are entered into the form opened by clicking Pressure in order to attempt to trend bottle pressures to preemptively replace bottles.
2. Click the Site Assignment button to get to this form, which has had the Site and Parameter drop-downs selected in order to fit the example below:

Site & ZSP Tracking - 09/20/2017
Mattson, Erick J.

HOME CREATE EXTERNAL DATA DATABASE TOOLS

StartMenu BottleManagement BottleSiteAssignment

COLORADO
Air Pollution Control Division
Department of Public Health & Environment

Manage Bottle Locations

Site: 080013001
Parameter: 42101
Show old bottles

Assign this bottle:

AQSID	Parameter	ID	SerialNumber	StartDate	EndDate
080013001	42101	397	SG9167851BAL	10/5/2012	3/26/2013
080013001	42101	398	CC129002	12/19/2011	3/26/2013
080013001	42101	405	CC181781	3/26/2013	6/11/2013
080013001	42101	406	CC213284	3/26/2013	6/11/2013
080013001	42101	441	CC420371	6/11/2013	7/29/2014
080013001	42101	445	CC72424	6/11/2013	3/13/2014
080013001	42101	446	CC235243	3/13/2014	12/30/2014
080013001	42101	467	SG9166747BAL	7/29/2014	2/9/2016
080013001	42101	468	SG9132356BAL	2/9/2016	12/8/2016
080013001	42101	469	CC400359	12/30/2014	2/9/2016
080013001	42101	301	CC213284	3/26/2013	6/11/2013
080013001	42101	310	SG9200021	1/1/2010	3/14/2011
080013001	42101	311	FF38999	3/14/2011	3/23/2011
080013001	42101	334	CC169116	1/1/2010	12/19/2011
080013001	42101	340	CC57122	3/23/2011	3/5/2012
080013001	42101	355	CC187423	3/5/2012	10/5/2012
080013001	42101	503	CC311384	12/8/2016	

Records: 17 of 17 Filtered Search

Form View NUM LOCK FILTERED

3. As an example, we will use the following scenario. A site operator doing a weekly check at the Welby station on 7/28/2014 noticed that the CO span bottle pressure was approaching 250 psi. This is a value low enough to warrant a “bottle change”—a new CO span bottle needs to replace the CO span bottle currently on site.
4. The site operator notes the current bottle information: bottle serial# (traceable to the bottle supplier/manufacturer), expiration date, bottle concentration, and psi. This information will be entered into the AirVision System along with the bottle information for the new source which will be sited the following day.
5. The following day, 7/29/2014, the site operator returns to Welby with a new CO span source bottle. Once replaced, the following message is entered into the AirVision System: “remove span bottle (old) cc420371 (manufacturer’s serial number), 4/13/21 (expiration date), 8.739 (concentration), 250 psi. replaced with (new bottle) sg9166747bal (serial number), 1/14/21 (expiration date), 9.224 (concentration), 2000 psi.

6. The following day, 7/30/2014, the GMM staff member responsible for looking at messages from field operators on the previous day's logs on to AirVision and reads through the Logger Central Message Report (See Step 1 in Section 6.1.2 for information how to select and view a Logger Central Message Report). It contains the following message:

Logger Central Message Report

Site Name I25-DENVER **Site Description** Near Roadway site at Yuma Street near I-25 and 9th Avenue

Logger Identifier 20 **Logger Name** I25-DENVER

Message Time	Message Text
7/29/2014 9:33:51 AM	Monthly complete. - KH
Site Name WELBY	Site Description Welby

Logger Identifier 01 **Logger Name** WELBY

Message Time	Message Text
7/29/2014 11:32:39 AM	remove span bottle cc420371, 4/13/21, 8.739, 250psi. replaced with sg9166747ba, 1/14/21, 9.224, 2000psi. reset power on 700 and

Thursday, December 11, 2014 2:49 PM

Page 1 of 1

7. The "ZSP Bottle Information" form generated in Step 2 above may now be filled out with all the pertinent information. The two cells with dropdown menus (Site and Parameter Type) will enable the user to select from multiple choices, Welby from the Site menu and CO from Parameter Type. All cells will be populated with the information from the site operator with the exception of "End Date":

Site & ZSP Tracking - 09/20/2017

FILE HOME CREATE EXTERNAL DATA DATABASE TOOLS Mattson, Erick J.

StartMenu BottleManagement BottleSiteAssignment

COLORADO
Air Pollution Control Division
Department of Public Health & Environment

Site: 080013001
Parameter: 42101
[Show old bottles](#)

Assign this bottle:

AQSID	Parameter	ID	SerialNumber	StartDate	EndDate
080013001	42101	397	SG9167851BAL	10/5/2012	3/26/2013
080013001	42101	398	CC129002	12/19/2011	3/26/2013
080013001	42101	405	CC181781	3/26/2013	6/11/2013
080013001	42101	406	CC213284	3/26/2013	6/11/2013
080013001	42101	441	CC420371	6/11/2013	7/29/2014
080013001	42101	445	CC72424	6/11/2013	3/13/2014
080013001	42101	446	CC235243	3/13/2014	12/30/2014
080013001	42101	467	SG9166747BAL	7/29/2014	2/9/2016
080013001	42101	468	SG9132356BAL	2/9/2016	12/8/2016
080013001	42101	469	CC400359	12/30/2014	2/9/2016
080013001	42101	301	CC213284	3/26/2013	6/11/2013
080013001	42101	310	SG9200021	1/1/2010	3/14/2011
080013001	42101	311	FF38999	3/14/2011	3/23/2011
080013001	42101	334	CC169116	1/1/2010	12/19/2011
080013001	42101	340	CC57122	3/23/2011	3/5/2012
080013001	42101	355	CC187423	3/5/2012	10/5/2012
080013001	42101	503	CC311384	12/8/2016	

Records: 1 of 17 Filtered Search

Form View NUM LOCK FILTERED

Select a bottle from available inventory from the Assign this bottle: drop-down list. This action will assign the selected bottle to the site. If a bottle that is currently entered at another site is selected, the current date will be used to close out that bottle at the previous site, and to open the bottle at the now assigned site.

Note that the EndDate must be entered for the existing bottle that was removed from the shelter in order to inform the system it is no longer there. It may be necessary to click the Show old bottles toggle to reveal the bottle removed from the shelter.

6.2 Review of Ambient Data and Quality Control Parameters

6.2.1 Review of Performance Checks and Quality Control Events

Each business morning at least one but as many as three separate GMM staff review both the ambient and the quality control data back to the last review (on Monday morning the review would stretch back to Friday morning, for example).

Review of the QC data happens in two forms. First, in the ZSPTracking database from the opening page, click on the "Generate Report" button next to "Z/S/P Failure Report".

The screenshot displays the 'COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT' Air Pollution Control Division - Technical Services Program. The 'Start Menu' includes sections for 'Data Tracking Forms', 'Site Information Form', 'Reports', 'Zero Reports', and 'QC Data Processing'. The 'Reports' section lists several report types, each with a 'Generate Report' button. The 'End Date' field is set to 2/27/2015 and is circled in red.

This report shows all warnings, failures, and non-polling stations including their relative percent error, and provides a quick look at the overall health of the QC portion of the network. Warnings and failures should be noted here for the second form of QC review, and should be brought to the attention of site operators. Non-polling sites should be brought to the attention of the communications manager.

In a sense, this form of QC review relies on memory, in that trends of failures will not be visible unless date parameters for the report (available on the opening page) are widened, and even then can be difficult to see. If practice has not supplied information about trends, each warning or failure can be further investigated by clicking the “Enter Z/S/P” button on the opening page of “ZSP Tracking”, changing the site and

the parameter to that in question, and reviewing the data in the table to the right. See Section 6.1.1 for more details. There are frequently warnings and failures that occur once and only once within a two-week period that can be somewhat ignored, particularly in cases of inclement weather. Ozone sources will on occasion and apparently at random start providing very noisy levels of ozone, which can often be resolved by power-cycling the ozone source.

The second form of QC review occurs in AirVision. While graphing options are available through reports (Home>Reports>Average Data Graph Report) a more useful way is to use an Average Data Editor interface (Home>Data Editors>Average Data Editor). To review overnight performance checks or QC

- open the data editor,
- enter the timeframe of the check/QC,
- select the appropriate Site/Parameter list.
- Change the Average Interval to 001m and click Average Data Editor>Retrieve Data.

Once the data is retrieved it can be viewed as a list, as a cross-tab, and most usefully as a time-series graph. Each performance check should conform to the programmatic construct of the check, respond quickly (within three minutes), and have a stable response. The resultant plot of a zero/precision level/zero sequence would be a box, for example. Other considerations to give the shape of the response curves are noisy signal (which may indicate the need to recycle power on an ozone source, for example), retarded analyzer response (which may indicate a leak or a contaminant), and flat line or ambient response during the check which could represent a host of problems.

The time frames for overnight performance check reviews are shown in Table 1

Table 1. Automated Performance Check Time Windows

Analyte	Time (O ₃ and SO ₂ run over midnight)
CO	22:30 – 23:30
NO ₂ (including all NO _x /NO _y counterparts)	20:45 – 23:00

NO_y (Converter efficiency, Sunday only)	02:46 – 03:47
O₃ (review should include source and analyzer)	23:40 – 00:15
SO₂	23:30 – 01:00

The times above are inclusive of ambient data outside of the performance check windows to illustrate normal performance before, and return to normal performance after. This assessment is qualitative and comes with experience.

6.2.2 Review of Ambient Data

Each business morning a review of the ambient data back to the previous review is carried out by at least two GMM staff. Generally the review follows a path of increasing temporal resolution until perceived problems are vetted, starting with a review of hourly data (most importantly, since hourly data is reported to AQS) and moving to an investigation of minute data when hourly data is suspect. Note that a review of minute data should be carried out in a random way on approximately 20% of the hourly data set.

The best vehicle to review ambient data is through the Average Data Editor in AirVision (Home>Data Editors>Average Data Editor). In the interface, select the time window, the appropriate site/parameter list, and (default) 001h. Then on the Average Data Editor ribbon, click Retrieve Data.

The ambient data can be viewed in a list, as a cross-tab, or most usefully (for all but wind direction) as a time series graph. In this view it is easy to look for correlation between sites, cause and effect of weather fronts moving through an area, and so on. It is also visible when a data stream is acting suspiciously because it is different in some way from the other streams. While this subjective assessment improves with exposure to typical data conditions, any appearance (or failure of a “stink test” as the GMM likes to say) of suspect data should be investigated.

If an hourly average (or several) are found to be in question, highlight them in the average data editor, right click, and from the context menu choose Drill Down Interval. A new data editor window will open with the one-minute averages which can then be viewed in the same modes.

If data is found to be suspect it should be flagged by right-clicking and selecting Batch Edit from the context menu.

Use extreme caution here, the default window is the value adjustment screen, and if the Enabled box is checked here by mistake and the OK button is clicked, even after using some other function, the data will all be set to 0. See Appendix D1 of this QAPP.

Select Set Flags from the column at the left, then click Enabled. The flagging dialog will colorize, click on “<” and “D”. Select Set Annotations from the column at the left, and click Enabled. Type a brief synopsis of the reason for invalidating the data.

Bring all invalidated data to the attention of the data manager, the GMM Lead, and the site operator.

6.3 Entry of Manual QC Precision Test Records into ZSPTracking Database Procedure

Values that are used to demonstrate compliance with EPA precision criteria are generated from the QC Precision tests. In the case where one manual test is missing, a nightly automated Performance test may be substituted. Manual QC Precision tests are performed randomly once every two weeks. A member of the GMM staff manually triggers these tests remotely or on site, the length of the test is dependent on pollutant type. Flags are automatically generated for these data that identify this data from raw ambient air data. This data is manually entered onto the *Precision Test Tracking & Results* form and entered into the ZSPTracking System. Entry into the ZSPTracking System can be either performed manually or via an automated algorithm utilizing the “Get” button. The ZSPTracking System serves as an archive for both the automated Performance tests data and the manual QC Precision test data. Monthly,

data from the ZSPTracking System is entered into the EPA's Air Quality System (AQS) with AQS-type text strings created by the ZSPTracking System and uploaded to AQS using the same methodology as the uploading of raw ambient air data.

Entry of QC Precision tests into ZSPTracking System

- Operator enters the values of manual QC Precision test onto the *Precision Test Tracking & Results* field sheet. This form is an Excel spreadsheet and is available to print at J:\ZSfiles\FORMS\Manual Precision 2013.xls (form is shown below, Figure 1, with CAMP CO as an example). More information regarding the running of manual QC precision test can be found in the individual parameter SOPs.
- Information logged on the *Precision Test Tracking & Results* field sheet is to be entered into the ZSP Tracking System. This system is accessed via from the operators computer on the J: drive at:

J:\ZSFILES\SP Tracking

Double clicking on this ZSP database file will open the program on the operator's computer (A shortcut can also be created, placing an icon on the computer screen that can also serve as a direct connection to the ZSPTracking system).

DATE: 12/15/14 PRECISION TEST TRACKING & RESULTS

STATION AIRS ID	PARAM ETER	LOG GER	CALIBRATOR / CYLINDER SOURCE			ANALYZE R		LOG GER	RECO RD
		STA RT TIME	MODEL & S/N or BOTTLE #	CO,O3,N Ox,SO2 ACTUAL CONC	ZERO ACTUAL CONC	PRECISIO N INDICATE D CONC	ZERO INDICATE D CONC	END TIME	ENTER ED IN DATAB ASE
CAMP (06) 08 031 0002	CO	0649	C403235	4.04	0	4.10	0.0	0730	no
	NO ₂				0				
	O3								
	SO2				0				

Figure 1: Precision Test Tracking and Results

- Double clicking the aforementioned file on the J: drive or the ZSTracking icon on the operator's computer results in the following screen; the Start Menu is displayed:

- The operator will click on the “Enter Manual Precision” button located under *Data Tracking Forms*, resulting in the following screen (Manual Precision Entry):

- For instructional purposes, the following example will demonstrate how a manual QC Precision test for carbon monoxide (CO) at the CAMP site (AQIS i.d. = 08-031-0002) on 12-15-2014 is entered into the ZSPTracking System. From the Manual Precision Entry screen shown in Step 4. above, CAMP (ID 06) is

selected from the drop down menu that appears when the arrow next to Site Name is clicked, resulting in the screen below:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
Air Pollution Control Division - Technical Services Program
Z/S/P Tracking - Data Entry

AQS ID: 080310002 Date (mm/dd/yy): 12/19/2014

CAMP - 42101 - 2 - Z/S/P Tracking - 283

Date	Span or Prec.	A / M / NP / 5Day	Actual (Zero)	Actual (Raw)	Actual (ZC)	Indicated Zero	Indicated Raw	Indicated ZC	% Diff.
12/18/2014	M		0	4.04	4.04	0	4.1	4.1	1.5%
12/1/2014	M		0	4.04	4.04	-0.1	4.1	4.2	4.0%
11/18/2014	M		0	4.04	4.04	0.1	4.2	4.1	1.5%
11/6/2014	M		0	4.04	4.04	0	4	4	-1.0%
10/20/2014	M		0	4.04	4.04	0	3.9	4	-1.0%
10/6/2014	M		0	4.04	4.04	0	4	4	1.5%
9/22/2014	M		0	4.04	4.04	0	4.1	4.1	1.5%

Notes: Actual Zero Actual Zero Actual Zero Actual Zero Actual Zero Actual Zero

Zero Adjust:

AQS:

Invalid Record?:

Delete Record?:

Recent Calibrations (not editable)

Date	11/14/2014	11/14/2014	8/12/2014	6/19/2014	3/14/2014	12/10/2013	10/8/2013
Initials:	VRS	VRS	VRS	VRS	VRS	VRS	VRS
Zero:	0	0	0	0.01	0	0	0
Span:	9.39	9.32	9.1	9.08	9.08	9.27	9.3
Prec:	4.07	4.07	4.02	4.04	4.04	4.03	4.1

Pre Cal 5/P: SBOT=9.20; PB (9.2 bottle) SBOT=9.20; PB ***** SBOT=9.118; P SBOT=9.118; P *****

5/P/Bottle Source Information (not editable)

Type	42101	42101	42101	42101	42101	42101	42101
SN:	CC403235	CC176167	CC51903	CC259603	XCO28426B	CC331454	CC402770
Conc:	9.20	4.04	4.0	9.118	9.136	4.016	39.47
Exp. Date:	1/14/2021	4/13/2021	1/14/2021	1/14/2021	1/13/2013	12/8/2010	6/26/2020
Start Date:	7/18/2014	12/17/2013	2/13/2013	2/13/2013	10/30/2012	10/30/2012	9/5/2012
End Date:			12/17/2013	7/18/2014	2/13/2013	2/13/2013	10/30/2012

Notes: WAS FORMER NEW PRECISIO

Precision Status

Sunday	Saturday
12/14/2014 - 12/27/2014	X
11/30/2014 - 12/13/2014	✓
11/16/2014 - 11/29/2014	✓
11/2/2014 - 11/15/2014	✓
10/19/2014 - 11/1/2014	✓
10/5/2014 - 10/18/2014	✓

The fields to be populated with the manually generated QC Precision data are to the left side of the form underneath the date field. Directly to the right of these blank fields are descriptions each field: Span or Prec., A/M/NP/5Day, Actual (Zero), Actual (Raw), etc. Note that the six most recent Manual Precisions appear to the right of the fields that are to be entered and next to these fields is a window entitled *Precision Status*, a box with two week date ranges, Sunday to Saturday, corresponding to the required two week date ranges required by the EPA for random Manual Precision tests to be conducted. Note that at this point, a “red X” appears next to the date range 12/14/2014-12/27/2014. This is an indicator that no manual QC Precision record has been entered into the ZSPTracking System that corresponding pollutant and date range.

6. Data can be entered in the ZSPTracking system one of two ways; manually or by automatic import. (see below Steps a & b, respectively) .
 - a. Data can manually be transposed from the *Precision Test Tracking & Results* form into the Manual Precision entry form within the ZSPTracking system. For example, the QC Precision results for the CO monitor at CAMP, entered onto the *Precision Test Tracking & Results* sheet (Figure 1, above), can be entered as follows.
 - i. Clicking on the *Date* field results in the appearance of a “calendar” and the appropriate date (December 15, 2014) is selected. Maneuvering between the other entry fields is by Tab key and/or mouse/cursor. The CO manual QC Precision entry would continue as follows:
 - ii. After date entry, tab to *Actual (Zero)* field and enter 0 (round all measurement values to one decimal point.)
 - iii. Tab to *Actual (Raw)* and enter 4.04 (with rounding = 4.0); tabbing to next field, *Actual (ZC)* will see this field automatically calculate the actual zero corrected value, 4 (4.04-0=4.04)

- iv. Tabbing to the next cell, *Indicated Zero*, enter 0.1
- v. Tab to *Indicated Raw* and enter 4.2
- vi. Tab to *Indicated ZC* to see the automatic calculation of the zero corrected actual values, 4.2 (4.2-0.1=4.1)
- vii. Once all fields are populated the tab “Capture Data” (on the left, bottom of the form) is clicked, resulting in an automatic calculation of % Diff occurring in that formerly blank field $((\text{Indicated Raw} - \text{Actual Raw})/\text{Actual Raw}) \times 100 = \% \text{ Diff}$; $((4.2-4)/4) \times 100 = 1.5\%$. NOTE: In this example, the % Diff field is highlighted in yellow after calculation. “Yellow” indicates a “Warning” and occurs when the calculated % Diff is between 7.5% and 10% (5%-7.5% for ozone). A % Diff calculation of >10% (>7.5% for ozone) would result in a “red” highlighted field, indicating a “Fail”. A “Warning” % Diff requires no immediate action on the part of the operator—overnight precisions will be closely monitored to see if the % Diff calculation worsens or resolves on its own. A “Fail” will require intervention to determine the cause of the failure, and the operator will perform trouble shooting as necessary to alleviate the problem(s) that are causing a failure.

NOTE: Capturing this particular record has resulted in the conversion of the “red X” next to the date range 12/14/2014-12/27/2014 to a “green X”; this indicates that a Manual Precision record has been entered into the required date range (even if that Manual Precision test was a “Fail”).

- b. Data can be automatically imported into the Manual QC Precision Entry Form by use of a user selected routine (“Get” button). This was developed to limit transposition errors when entering Manual Precision data into the ZSP Tracking System. Using the same example record as above, the carbon monoxide (CO) at the CAMP site (AQS i.d. = 08-031-0002) on 12-15-2014 is entered into the ZSPTracking System using a more automated method.
 - i. After completion of the operator triggered precision test on 12/15/2014, the results of that test are automatically stored in the AirVision (“central” computer) System. Clicking the “Get” Button to the left of the screen will cause the ZSPTracking System to retrieve the results of the manually triggered precision test, and populate the fields below the date field with the values of the most recent manually generated precision test. This is demonstrated with the following screen.

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
 Air Pollution Control Division - Technical Services Program
 Z/S/P Tracking - Data Entry

Site Name: 06 AQS ID: 080310002 Date (mm/dd/yy): 12/17/2014

12/15/2014 8:11:18 AM CO₂ CAMP - 42101 - 2 - Z/S/P Tracking - 283

Date	Span or Prec.	Prec	Prec	Prec	Prec	Prec	Prec
12/15/2014							
	A / M / NP / 5Day:	M	M	M	M	M	M
	Actual (Zero):	0	0	0	0	0	0
4.04	Actual (Raw):	4.04	4.04	4.04	4.04	4.04	4.04
4.04	Actual (ZC):	4.04	4.04	4.04	4.04	4.04	4.04
0.1	Indicated Raw:	0	-0.1	0.1	0	-0.1	0
4.2	Indicated Raw:	4.1	4.1	4.2	4	3.9	4.1
4.1	Indicated ZC:	4.1	4.2	4.1	4	4	4.1
1.5%	% Diff:	1.5%	-4.0%	1.5%	-1.0%	-1.0%	1.5%
	Actual Z	Actual Zero					
	Zero Adjust:	<input checked="" type="checkbox"/>					
	AOS:	<input checked="" type="checkbox"/>					
	Invalid Record?:	<input type="checkbox"/>					
	Delete Record?:	<input type="checkbox"/>					

Precision Status

Sunday - Saturday

12/14/2014 - 12/27/2014 ✘

11/30/2014 - 12/13/2014 ✔

11/16/2014 - 11/29/2014 ✔

11/2/2014 - 11/15/2014 ✔

10/19/2014 - 11/1/2014 ✔

10/5/2014 - 10/18/2014 ✔

Recent Calibrations (not editable)

Date	11/14/2014	8/12/2014	6/19/2014	3/14/2014	12/10/2013	10/8/2013	7/18/2013
Initials:	VRS	VRS	VRS	VRS	VRS	VRS	VRS
Zero:	0	0	0.01	0	0	0	0.04
Span:	9.39	9.1	9.08	9.08	9.27	9.3	9.12
Prec:	4.07	4.02	4.04	4.04	4.03	4.1	4.06

Pre Cal S/P:
 Notes: SBOT=9.20; PBO SBOT=9.20; PBO bottle 4.041, 9.##### SBOT=9.118; PB SBOT=9.118; PB#####

S/P/Bottle Source Information (not editable)

Type:	42101	42101	42101	42101	42101	42101	42101
SN:	CC403235	CC176167	CC51903	CC259603	XCO284268	CC331454	CC402770
Conc:	9.20	4.04	4.0	9.118	9.136	4.016	39.47
Exp. Date:	1/14/2021	4/13/2021	1/14/2021	1/14/2021	1/13/2013	12/8/2010	6/26/2020

Record: 1 of 1 No Filter Search

(NOTE: this may not be obvious as the date field will be populated with “#####” characters if this is the first manual precision record to be entered for a given session. Clicking on the down arrow above the date field and selecting the appropriate date, 12/15/2014, will populate the date field with a readable date and eliminate the ##### symbols from appearing for the rest of the entry session.)

- ii. At this point the operator may want to compare the values that have automatically populated the cells underneath the appropriate date with values that he has either written down on the *Precision Test Tracking & Results* form or printed from the AirVision System once the precision test was complete. It is possible that there might be minor variations at the one decimal point level due to variability in the “rounding” functions of the AirVision System versus the ZSPTracking System.
- iii. Once the operator is satisfied that the values of the precision test are accurate with what was generated, the “Capture Data” may be clicked. This will archive the manually generated precision record within the ZSPTracking System. The following screen is generated, and note that the “red circle with an X” has been replaced with a “green circle with a check mark:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
 Air Pollution Control Division - Technical Services Program
 Z/S/P Tracking - Data Entry

Site Name: 06 AQS ID: 080310002 Date (mm/dd/yy): 12/17/2014

12/15/2014 8:11:18 AM CO CAMP - 42101 - 2 - Z/S/P Tracking - 283

Span or Prec.:	Prec	Prec	Prec	Prec	Prec	Prec
A / M / NP / SDay:	M	M	M	M	M	M
Actual (Zero):	0	0	0	0	0	0
Actual (Raw):	4.04	4.04	4.04	4.04	4.04	4.04
Actual (ZC):	4.04	4.04	4.04	4.04	4.04	4.04
Indicated Zero:	0.1	0	-0.1	0.1	0	-0.1
Indicated Raw:	4.2	4.1	4.1	4.2	4	3.9
Indicated ZC:	4.1	4.1	4.2	4.1	4	4
% Diff.:	1.5%	1.5%	4.0%	1.5%	-1.0%	-1.0%

Notes: Actual Zero Actual Zero Actual Zero Actual Zero Actual Zero Actual Zero

Zero Adjust:

AQS:

Invalid Record?:

Delete Record?:

Recent Calibrations (not editable)

Date:	11/14/2014	8/12/2014	6/19/2014	3/14/2014	12/10/2013	10/8/2013	7/18/2013
Initials:	VRS	VRS	VRS	VRS	VRS	VRS	VRS
Zero:	0	0	0.01	0	0	0	0.04
Span:	9.39	9.1	9.08	9.08	9.27	9.3	9.12
Prec:	4.07	4.02	4.04	4.04	4.03	4.1	4.06

Pre Cal S/P: SBOT=9.20; PBO SBOT=9.20; PBO bottel 4.041, 9.##### SBOT=9.118; PBI/SBOT=9.118; PBI(#####

S/P/Bottle Source Information (not editable)

Type:	42101	42101	42101	42101	42101	42101
SN:	CC403235	CC176167	CC51903	CC259603	XCO284268	CC331454
Conc:	9.20	4.04	4.0	9.118	9.136	4.016
Exp. Date:	1/14/2021	4/13/2021	1/14/2021	1/14/2021	1/13/2013	12/8/2010
						6/26/2020

Record: 1 of 1

c. In this particular example, there is an appropriately generated and entered manual precision test for each of the six, two-week time periods. The possibility exists, however, that for whatever reason, there might be a two-week block where a manual QC Precision test was unable to be generated.

7. Once the Manual Precision record is successfully entered into the ZSPTracking System, a hardcopy of the *Precision Test Tracking & Results* sheet or other hand written record of this activity is archived in the monthly data packet folder or in the operator's personal filing system.

Note that manual precisions are also gathered by the Get Everything button, see Section 6.1.2.

7 MONTHLY – DATA EVALUATIONS AND DATA PROCESSING PROCEDURES

7.1 Development of Monthly Data Packet Procedure

A monthly data packet consists of all reportable and some non-reportable data collected and reviewed during a calendar month. It also includes several ancillary data collections like ZSPTracking and QC, and maintenance reports, among others, the content of which is illustrated in Figure 2. Development of the monthly data packet primarily comprises of printing and collating paperwork. The development may start any time after the first of the month but should generally wait until the second week of the month to ensure all paperwork has been returned to the office from the field and to ensure all data has been completely polled from the data loggers.

Obtain a 5” Letter accordion folder and label it with the 3-letter abbreviation for the month and the last two numbers of the year, MAR '03 for example.

7.1.1 Ambient Data Monthly Printouts

In AirVision (see Appendix D1 of this QAPP) go to Reports > Monthly Reports. In the site and parameter selection choose all parameters active during the month of data being developed. Select the month to review by choosing the first and last day of the month in the date picker dialog on the left of the criteria selection panel, and choose hourly data from the interval selection window. Then click Monthly Reports > Generate Report. This may take some time, possibly longer than 15 minutes. When generated, a report will be displayed. Currently this report ranges between

290 and 310 pages. Print the report in color, ensuring that the printer will not print on both sides, as later organization of the data packet may not follow the alphabetical (and controllable, see Appendix D1) order inherent in AirVision. Bind the printout together with a large clip and place it in the accordion folder.

7.1.2 Site and Analyzer Log Sheets

The site and analyzer log sheets are usually returned after the monthly site visit but that may not occur until the second week. When site operators return the log sheets they are placed in a box in the data manager's office along with maintenance forms. During assembly of the monthly data verification packet the only requirement is to assemble and organize the log sheets. To organize, the log sheets should be in alphabetical order by site, but within sites should be ordered by AQS Parameter Code followed by ancillary sheets. Against this, the order should be:

CO (42101)
SO₂ (42401)
NO_x Family (42600, 42601, 42602, 42603)
O₃ (44201)
O₃ Calibrator
700
Site Met Log

A review of the log sheets will be used in both Section 7.2 and 7.4 below. While later review may reorganize the log sheets, this order has served well for initial data review in Section 7.2. Place them into the accordion folder.

7.1.3 Power Failure Reports

In AirVision (see Appendix D1 of this QAPP) select Reports > Logger Reports > Power Failure Reports. Select all sites in the site selection list and select the first and last day of the month being assembled in the date picker dialog in the criteria selection pane. Click on Power Failure Report > Generate Report. Usually this report will be 1 to 2 pages long. Print the report in monochrome on both sides to save paper. Highlight any power outages equal to or longer than 15 minutes ($\geq 0:15$ on the far right column) in green. Place them into the accordion folder.

7.1.4 Central Messages Report

The central messages (commonly referred to as "messages to central") are reviewed on most work days. However they may not be printed during that review and are not printed in a concise way fitting this assembly. In AirVision (see Appendix D1 of this QAPP) select Reports > Logger Reports > Central Messages. Select all sites in the site selection list and select the first and last day of the month being assembled in the date picker dialog in the criteria selection pane. Click on Central Messages > Generate Report. This report ranges from no (which would be incredibly uncommon) to 10s of pages. Print this report in monochrome on both sides to save paper. Place them into the accordion folder.

7.1.5 Maintenance Forms

Maintenance forms will have been placed in the same box as the site log sheets. Assemble them (if any) and clip them together. Place them into the accordion folder.

7.1.6 Zero Correct Documentation

See Section 7.1.6 for a thorough discussion of the zero correction procedure and resulting documentation. It is common for the zero correction procedure to be carried out after the data package has been assembled. It must be carried out before the Ambient Data Verification Procedure discussed in Section 7.4. Once completed, place the documentation into the accordion folder.

7.1.7 QC Control Charts

See Section 6.2 for a discussion about entry of daily QC into the ZSPTracking database. The QC Control Charts have been developed to visually display trending of the daily QC entries. These charts are used on a regular basis for troubleshooting and review. In ZSPTracking from the opening page, click “Enter Z/S/P”. On the ZSP Entry form, change the Start Date: and End Date: to the first and last month being assembled. These dates are on the bottom left of the form next to the green box labeled Control Chart. Click Print out Monthly Control Charts. Click “Yes” in the verification dialog. These will be printed by macro to the default printer on your computer. Place them into the accordion folder.

7.1.8 Supporting ZSPTracking Database Documentation

Other forms need to be printed from the ZSPTracking database and included in the accordion folder. These reports are all found from the StartMenu tab in ZSPTracking.

Use the “Last Month” or “Two Months Ago” as appropriate button to change the Start Date: and End Date: to the appropriate period. Click on Generate Report beside the following, print the generated report, and return to the StartMenu tab to continue:

- Z/S/P Precision Failure Report
- Z/S/P Span Failure Report
- Ozone Absolute Zero Correction Report
- Zero Drift Report
- Monthly Calibration Data Report

A description of each of these reports follows.

The Z/S/P Precision Failure report and Z/S/P Span Failure report lists all failed precisions and spans respectively during the period selected on StartMenu. It is organized by parameter, then by site, then by date. It includes information about whether the precision has been marked as invalid and notes concerning any activity at the time.

The Ozone Absolute Zero Correction Report determines whether three or more adjacent ozone quality check zero values are outside of acceptance criteria for three consecutive days or more in a row. This is a valuable form for determining longer trend zero problems with ozone analyzers and may be commonly used outside of this context for troubleshooting. Note that the form must be in Datasheet View to be useful. It may be best to copy and paste the table into excel for better control over printing.

The Zero Drift Report displays all quality checks that have been determined (automatically or manually) to be invalid against zero drift criteria. Though this is currently under review, zero drift is seen in two ways: 1) as an absolute distance of the zero value against 0 and 2) as a comparison of the difference between subsequent quality check zero values. This report often has excess data in it since invalid data and aborted quality checks inherently end up qualifying for zero drift failure.

The Monthly Calibration Data Report is a wholesale listing of all quality checks for the period selected in StartMenu. Later data validation processes use this report which may be dozens of pages long.

7.1.9 Manual Precision Summary Report

The Manual Precision Summary Report is to be printed only after completion of the Verification Procedure for Quality Control Precision Tests and Nightly Performance Tests (Section 7.7).

- 1) Open J:\ZSFILES\SP Tracking\ZPSTTracking.accdb.

- 2) From the StartMenu form under the Reports heading, enter the start date and end date that brackets the time period of interest into the Start Date and End Date fields, respectively (Figure 21).
- 3) Under the QC Data Processing heading, select the Generate Report button next to the View Missing Manual Precision Report label. This will open up a report that shows all Quality Control Precision Checks that have been selected to be uploaded to EPA's AQS database.
- 4) Print this report and place it into the accordion folder.

7.1.10 Chain of Custody Tracking

Open <\\dphe.local\apc\Programs\ZSFiles\Forms.xlsx>. Select the C&C Tracking sheet. Change the MONTH: value to the month and year being reviewed and print the sheet. Date and initial in the DATE and BY column for the first six items (if they are complete). Place the sheet in the accordion folder.

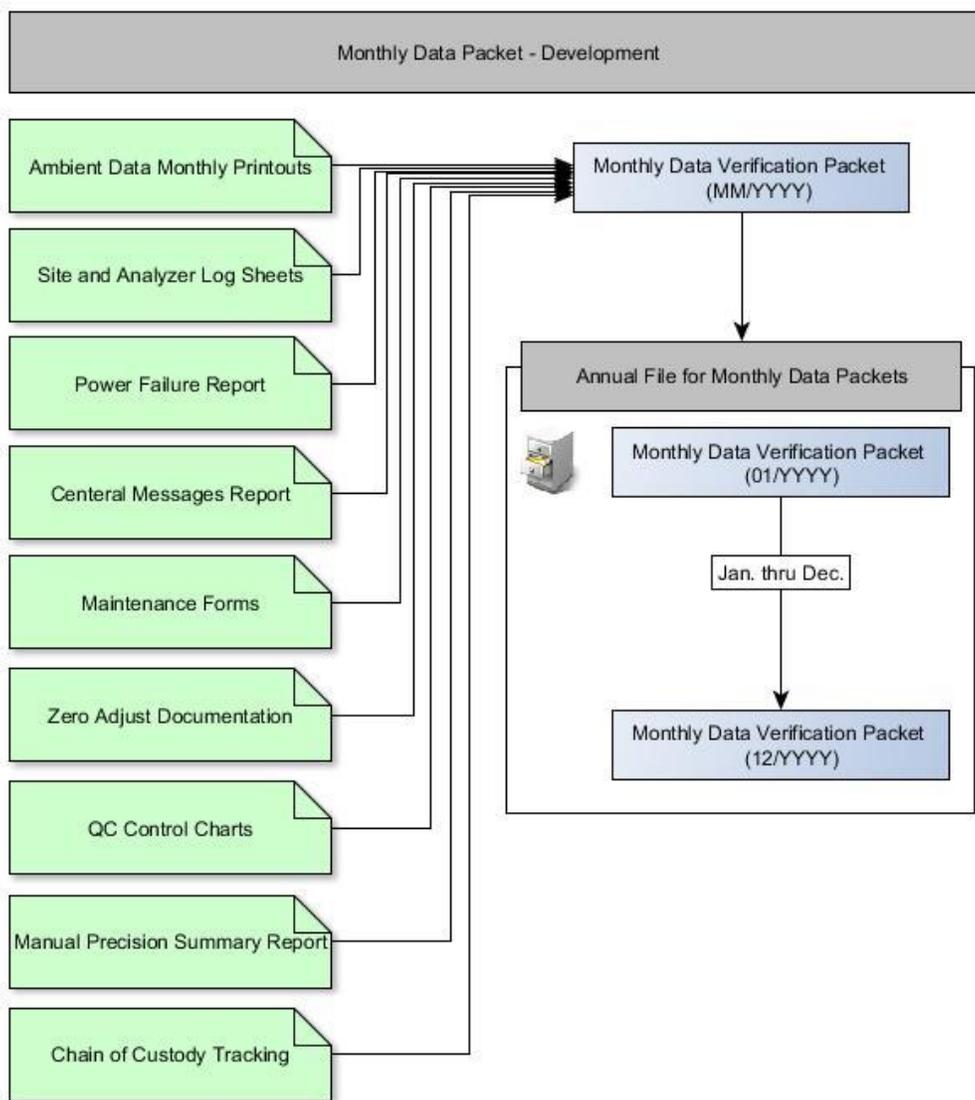


Figure 2. Monthly Data Packet Development

7.2 Initial Data Review Procedure

The initial data review begins in a foundation of the daily review discussed in Section 6.2 but is more thorough and reviews a greater scope of data. Much of the review here is based on practical knowledge of the system and of the analyzers and as such should only be carried out by personnel well versed in the air quality monitoring system as a whole.

7.2.1 Excel Pivot Tables

There are two pivot table Excel spreadsheets in <\\dphe.local\apc\Programs\ZSFILES\Monthly Review Tools> called AVDataMonthlyDiagParams.xlsx (hereafter Diag) and AVDataMonthlyGraphCriteria.xlsx. (hereafter Criteria). Open both of these files. If necessary, click on the warning dialog at the top of the window and click Enable Content. In each, on Sheet1, select a cell within the pivot table. Then click the Data ribbon and in the Connections group click Properties. In the Connection Properties dialog, click the Definition tab. Figure 3 shows the Connection Properties dialog.

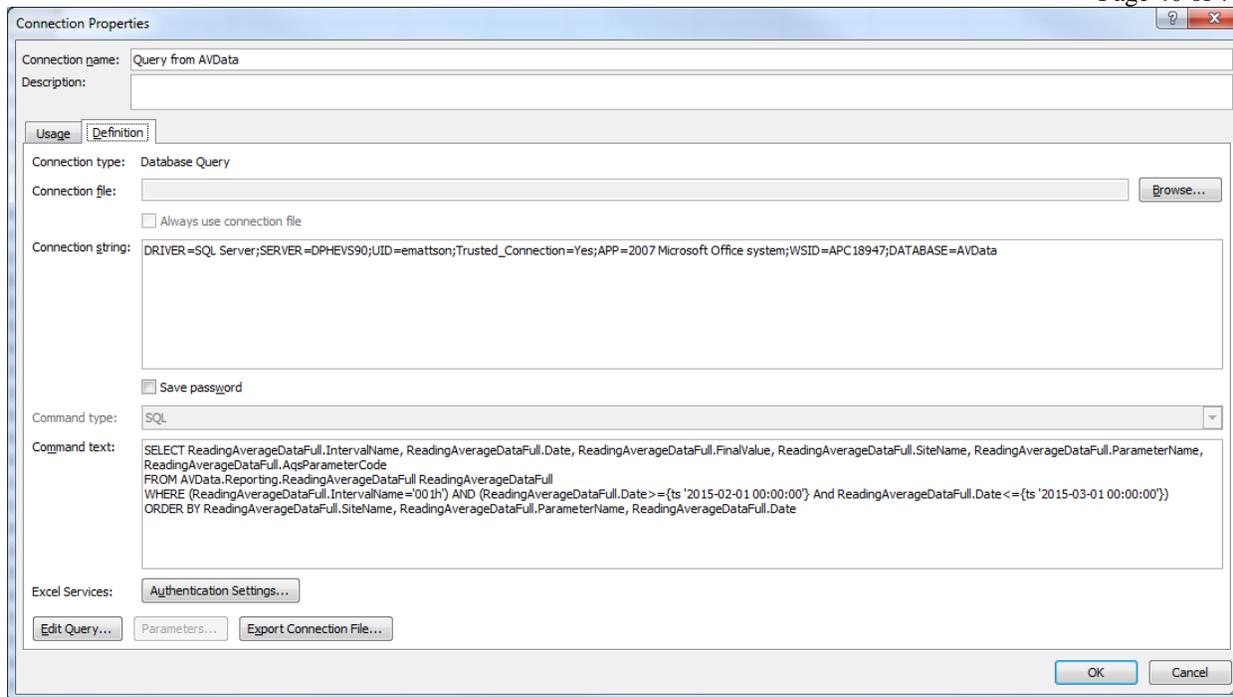


Figure 3. Connection Properties Dialog

In the Command text: box there is a lengthy SQL Statement. Within that statement is a date restriction that reads ...>={ts 'YYYY-MM-DD HH:MM:SS'} and ... <= {ts 'YYYY- MM-DD HH:MM:SS'} where the year, month, day, hour, minute, and second are replaced with real values. Change these dates to be the beginning day of the month being reviewed and the beginning day of the month after the month being reviewed. In Figure 3 these dates are '2015-02-01' and '2015-03-01'. This would be a review for February of 2015. Click OK. The data refresh may take some time. A green progress bar will appear at the bottom right of the Excel window displaying progress. Once this is completed, the review may begin.

Diag is designed to show a single diagnostic parameter from every site, so it may show, for example, all ozone sample flow rates from every site at once. It is also capable of showing criteria parameters in the same fashion, ozone at every site for example. Criteria only shows criteria parameters and shows each parameter at a single site, so it may show, for example, NO, NO₂, NO_x, and SO₂ from CAMP (and CAMP only). While both of these approaches are modifiable, practical experience has shown this approach to be useful.

Though personal preference may vary, begin review with the Diag cross-tab and follow with the Criteria cross-tab. In both, select the Chart1 sheet and highlight the chart. This will display the PivotChart Filter Pane. In Diag, select each ParameterName of interest from the Report Filter dropdown. The Legend Fields (Series) drop-down may be used to remove unwanted sites but this is not normally needed. In Criteria, select each SiteName from the Report Filter and alter selection in the Legend Fields (Series) dropdown to best accommodate parameters available for that site. This cross-tab can become very crowded if all parameters at, for example, La Casa are shown, illustrated in Figure 4. For most single-parameter site selecting all ParameterName options is appropriate.

Print in color each Diag graph that shows an anomaly or indication of potentially poor data quality. This pattern recognition will largely come with practice but the configuration is intended to show particularly when one site is acting differently from all others.

Print in color each Criteria graph that shows an anomaly or indication of potentially poor data quality and any NO, NO₂, and SO₂ graph for use in the zero correction procedure in Section 7.2.2.

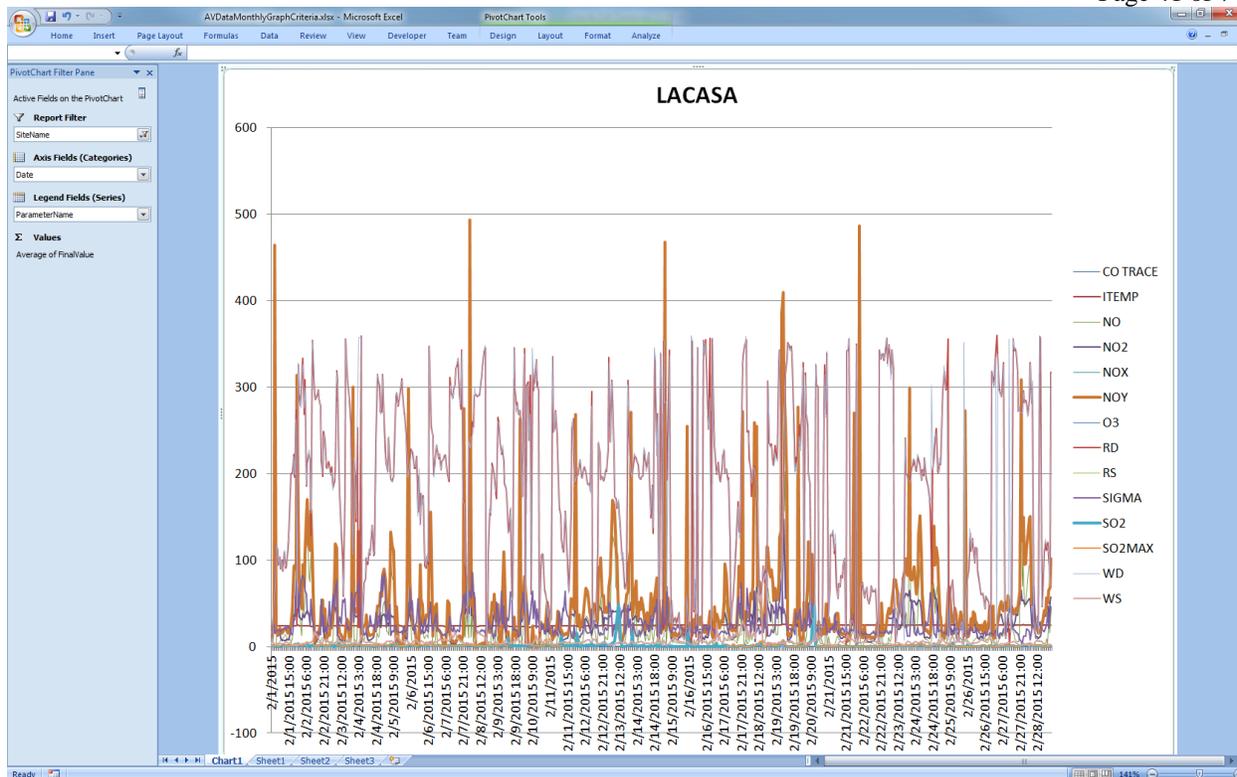


Figure 4. Overcrowded Criteria Pivot Chart

7.2.2 Ambient Data Monthly Printout Review

Armed with the printouts from Section 7.2.1, review the ambient data monthly printout created in Section 7.1.1. Highlight any items to be deleted in red and note the reason for their deletion in red pen at the bottom of the page. Highlight any items of note to the next level of review (ITEMP outside of operational criteria, for example) in green and note the reason for their interest in black pen at the bottom of the page. Highlight any missing data point cells in yellow.

Attach Diag printouts from Section 7.2.1 by staple to the appropriate sheet of data from the ambient data monthly printout and place both pages back in the appropriate order in the printout. This allows direct and easier review by subsequent reviewers.

7.2.3 Site and Analyzer Log Sheet Review

With the site and analyzer log sheets organized during Section 7.1.2, open <\\dphe.local\apc\Programs\ZSFiles\Forms.xlsx>. Select the MonthlyTracking sheet. Using the Station list in the left column as a guide, sort through the log sheets to make sure each is present and accounted for. In the WEEKLY column, indicate the number of weekly site visits performed by reviewing the hand-written columns on the log sheet. Do not include calibrations or audits. In the MONTHLY column, indicate the date the monthly site visit was performed. While sorting through the log sheets, review any notes left on the sheets that may indicate a reason to invalidate data such as maintenance or bottle changes. Change the MONTH: value to the month and year being reviewed and print the sheet. If not already printed, select the C&C Tracking sheet. Change the MONTH: value to the month and year being reviewed and print the sheet. Date and initial in the DATE and BY column for the first six items (if they are complete). Place the sheets in the accordion folder. Finally, select the ZA Tracking sheet. Change the MONTH: value to the month and year being reviewed and print the sheet. This will be used in Section 7.3.

7.3 Zero Correction Procedure

The APCD evaluates ambient data for zero correction during the data verification process. This practice was adopted to address data series that have an elevated or negative zero baseline over an extended time period. This procedure is performed in addition to the evaluation for zero drift. The APCD evaluates the zero drift criteria in two ways. The first evaluation is the zero change between two subsequent nightly performance check (span or prec.) measurements which are typically made every 24 hours. The second evaluation is the zero measurement as an absolute difference from zero. Both evaluations of zero drift must have passing results for the ambient data to be valid and considered for zero correction. The EPA discourages the practice of zero correcting data. However, the APCD believes that if executed properly and judiciously, zero correction produces data that is more accurate and representative of actual ambient concentrations, especially at low concentrations. The APCD has adopted stringent zero correction thresholds that greatly limit the amount of data that is eligible for correction, and the degree to which the data is corrected, while conforming to EPA’s zero drift thresholds. Specifically, zero correction is only considered if zero drift criteria are met. Data with corresponding quality control zero values that exceed zero drift criteria are invalidated and are not considered for correction. This constrains the application of this practice to modest corrections. Most applications of this procedure occurs on SO₂ data where most of the data resides near zero, and where a slight shifts in the analyzer’s baseline can produce a clearly biased response in the ambient data. This procedure is rarely use on carbon monoxide and only infrequently on ozone and oxides of nitrogen data.

The APCD has set tight criteria on when to zero correct ambient data. Typically, ambient data is only considered for zero correction when the corresponding nightly Performance Tests have greater than three consecutive nights of indicated zero values outside the parameter’s Zero Correction Threshold and is between the Lower and Upper Zero Correction Limits. A list of these criteria is given in

Table 2. Zero corrections on ambient data are calculated using one of the below equations.

$$\text{Zero Corrected Ambient Conc.} = \text{Ambient Conc.} - \text{Indicated Zero Conc.}$$

or

$$\text{Zero Corrected Ambient Conc.} = \text{Ambient Conc.} - \text{Zero Offset} *$$

* Note: Zero Offset is a zero correction value that is determined by the validator person to be representative of an average zero bias over a given time period (days/weeks/months). This is held in contrast to zero correction values derived from every Performance Test (Indicated Zero Concentration) and is applied individually to each corresponding 24 hours of ambient data.

Table 2. ZA Thresholds and Lower/Upper Adjust Limits Used for Zero Correction

Parameter	Zero Correction Threshold	Lower/Upper Zero Correction Limits*
CO	±0.2 ppm	-0.41 ppm / 0.41 ppm
NO/NO ₂ /NO _x /NO _y	±1 ppb	-3.1 ppb / 3.1 ppb
SO ₂	±0.5 ppb	-3.1 ppb / 3.1 ppb
O ₃	±1 ppb	-3.1 ppb / 3.1 ppb
Note (*) – There may be unique situations where zero values in excess of the Lower or Upper Zero Correction Limit may lead to a zero correction of the ambient values at the discretion of an experienced data analyst.		

The Zero Correction Threshold is a threshold that has to be exceeded in order to consider zero correction. This threshold is based upon the MDL of a standard analyzer for each parameter. The MDL is defined as “the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte” (US EPA,

2014). This level serves as the logical lower limit from which to consider zero correction. From the MDL the threshold value may be adjusted up or down based upon the data validator's experience with the data. APCD's current Zero Correction Threshold values are listed in the above table. Like the Zero Correction Threshold, the Upper Zero Correction Limit is a parameter specific criteria. This limit is the upper limit from which to consider zero correction and is defined by the zero drift limit criteria. The zero correction of ambient data is only considered when the nightly Performance Test indicated zero values lies between these two values, shown in Equation 1.

Equation 1. Zero Correction Boundaries

$$L_{c-} < \{Z_i\} < T_{c-} < 0 < T_{c+} < \{Z_i\} < L_{c+}$$

Where L_c are lower and upper Correction Limits, Z_i is the indicated zero value being considered, bracketed for emphasis, and T_c are the lower and upper Zero Correction Thresholds.

Values in excess of the Upper or Lower Zero Correction Limit will be in excess of the Zero Drift criterion and flagged as invalid. For example, zero correction of ambient O_3 values will only be considered if the indicated zero from the nightly Performance Test is between 1.1ppb and 3.1 ppb or -1.1 ppb and -3.1 ppb. In addition to these thresholds and limits, other factors are also evaluated to determine if a baseline offset exists. The repeatability of zero values are very important and can vary greatly from night to night. Depending upon the parameter, this variance can be significant and may not be representative of a baseline offset. Therefore, consistency of the zero value from night to night is also evaluated. Typically, at least three days of zero values near the same value is required before zero correction is considered. For CO, SO₂, and NO_x the actual source test zero gas has an assumed concentration of zero. However, ozone is unique in that it has a source calibrator that reports a zero test gas value from a reference photometer. A comparison of this value to the analyzer's reported zero value is used in consideration for zero correction. The Ozone Absolute Zero Correction Pivot report reports the difference between these values when they exceed a 3 ppb threshold. A flowchart describing the zero correction process is shown in Figure 5.

At a minimum, two data analysts must review and agree on a zero correction before it is made. The TSP prefers to have three reviewers and will only zero correct if at least two out of the three agree. The following forms should be printed to assist in the zero correction process:

- Manual Zero Correction Tracking Form (Figure 11. Manual Zero Correction Form)
<\\dphe.local\apc\Programs\TSP\ZSFILES\Forms\Forms.xlsx>
- Monthly Data Printout (7.2.1)
- QC Control Charts (7.1.7)
- <\\dphe.local\apc\Programs\TSP\ZSFILES\ZSP Tracking\ZeroCorrection Pivot Table.xlsx>
- Ozone Absolute Zero Correction Pivot

Print the Manual Zero Correction Tracking Form. To print this form click on the above bulleted (1st bullet) hyperlink to open the Form.xlsx workbook. Select the ZC Tracking worksheet and verify the month/year cell is correct for the time period of the assessment, change if necessary. Select the Print function to print the form. This form is use by each reviewer to document proposed zero correction changes.

Print the ZeroCorrection Pivot charts. To print the ZeroCorrection Pivot Table charts, open the bulleted link and in the Data ribbon, in the Connections group, click on Refresh All. Note that this will gather data from the previous month. If a different month is needed, see the Data Manager. In the Parameter Field on the top left of Sheet1, select each of the appropriate parameters: 42101, 42401, 42600, 42601, 42602, 42603, and 44201. For each selected parameter, ensure the y-axis on the chart is appropriate and print the chart in color.

The ZeroCorrection Pivot charts are the most telling tool for the need for zero correction investigation. Using the criteria from

Table 2, review each chart for periods of time where the zero correction criteria is met. When a period is suspected of needing a zero correction is found, reference the control chart for that site, parameter, and period to determine if the zero offset in QC was caused by a fault in the source or in the analyzer. This will generally be apparent by determining whether the zero fault is in the actual (QC source) or indicated (analyzer) data. Finally, review the period of concern in the monthly data printout for apparent shifts in baseline. The shift may not always be obvious and further investigation may be required. Using all of these criteria (though more investigation is used for ozone below) determine whether a zero correction is required using the flow chart in Figure 5.

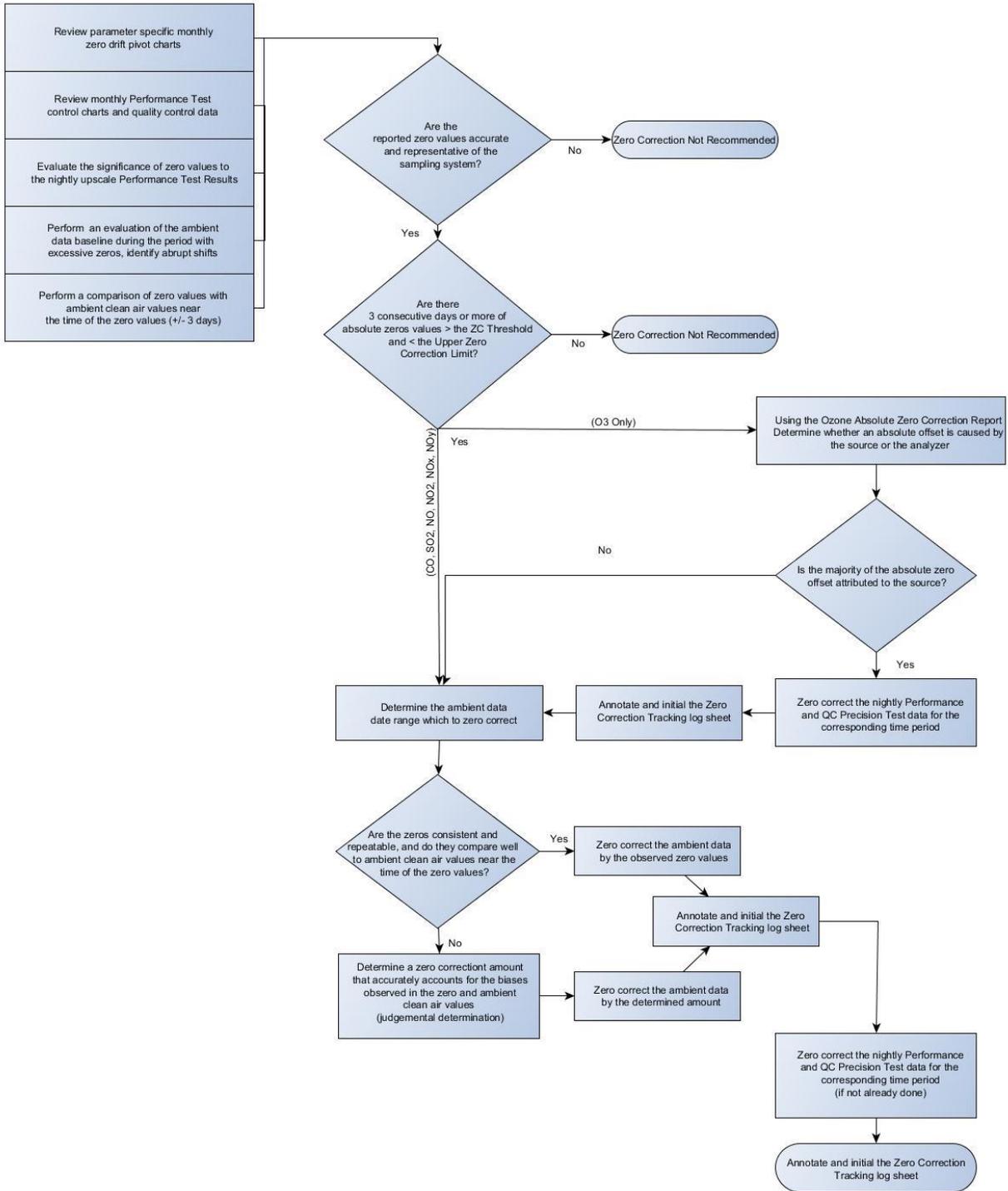


Figure 5. Zero Correction Flow Chart

Print the Ozone Absolute Zero Correction Report, shown in Figure 6. To print this report, in ZPSTracking, from the main form, click Ozone Absolute Zero Correction Report. This report will determine periods where ozone absolute zero difference (between source and analyzer) is ≥ 3 ppb for at least 3 tests. For each period for each site, determine whether the absolute difference between the source and the analyzer (Error column) is caused by the source or the analyzer by reviewing their entry in the ZSPEntry form. Generally, if the error is caused by the source, no zero correction is required though zero correction of the QC data may be required in a process by which associated data is adjusted by zero. If the analyzer is far from zero while the source is zero, zero correction of the data may be required.

ZSPDate	CO Springs - Academy Mines Peak		South Boulder Creek		Grand Total
	Error	Count	Error	Count	
2/3/2015	76	3	4	3	
2/4/2015			7	4	
2/5/2015	79	4	15	3	
2/6/2015	1	3	1	3	
2/27/2015	26	3			
2/28/2015	10	4			
Grand Total					

Figure 6. Absolute Ozone Zero Correction Pivot

7.4 Ambient Data Verification Procedure

The data verification procedure is done on a monthly schedule and usually begins around one month after the end of the month under review in order for all documents and other records to be collected in the central office and organized.

Verification, in this procedure, is ensuring that all accepted ambient data at the end of this process meet all standards of quality control and quality assurance. This includes null coding of unaccepted data and modifying accepted data, if needed (zero correction). In addition, all unaccepted data is examined and documented, as far as is possible, as to the cause of its unacceptability. Null coding of unacceptable data does not make it go away; it remains in the APCD database and is not uploaded to the EPA's Air Quality System (AQS) repository of ambient air quality data.

The starting point and focus for this review is the Monthly Data Packet, as described in section 7.1 above. As questions arise over certain data because of, e.g., data flags, log comments, or out-of-specification QC data, further information that is needed but not contained in the Monthly Data Packet can be found in the AirVision database (which also has useful analyzing tools) and Calibration and QA Audit databases, certain QC spreadsheets like ZSPTracking, and by talking to field personnel who may have detailed knowledge of a particular situation.

The Monthly Data Packet is examined systematically. The log comments are gone over first and any noteworthy action or observation that may affect data quality is noted. Ultimately, all data is evaluated against CDPHE Measurement Quality Objectives and Acceptance Criteria Validation Templates that are presented in CDPHE QAPP Appendix MQO. The order in which these tasks are performed during the following review description does not matter as much, as long as all packets in the Monthly Data Packet are systematically examined and compared.

7.4.1 Quality Control criteria for Data Examination and Acceptance; Documentation of Unaccepted Data

Below are the most common evaluations that are performed during the monthly data validation process. These evaluations require documentation that is provided in the monthly data package and are compared to criteria set forth in CDPHE’s Measurement Quality Objectives and Acceptance Criteria Validation Templates that are presented in CDPHE QAPP Appendix MQO.

- Are ambient measurement devices out of specification? Individual instruments have a number of operating parameter ranges defined in their specific manuals. Many (but not all) of these parameters may be outside of their range while still allowing the device to accurately measure ambient conditions, at least for the short term. In such a situation, usually diagnosed during the Daily Data Evaluation and weekly site visits, these are noted and corrected as soon as possible while allowing collection of acceptable ambient data, as measured by independent QC testing such as the daily automatic z/s/p routines.
- Do the data exceed rate-of-change flagging limits? Often these rate-of-change limits are set so sensitively that normal changes in ambient concentrations sometimes set them off. These limits are set and used less as limiting criteria than as flags to catch, e.g., many non-ambient spiking events with relatively few true ambient readings. These limits are changed from time to time as is practicable for the verification process.
- Are the automated and manual zero/span/precision results within limits? The most important are the automatic zero/span/precision challenges since these happen on a daily basis. Occurring less frequently, manual zero/span/precision challenges during site visits (along with QC and QA audit points) can also add extra information along with the direct observation and diagnosis of ambient measurement devices as the tests are delivered.

All gaseous parameters, except for ozone ($\pm 7\%$ RE), have a $\pm 10\%$ relative error limit on any type of challenge by any certified source, whether manual or automatic. If it is verified that an out of spec occurrence is valid, then the data is not accepted.

Table 3. Accuracy Acceptance Criteria for Ambient Parameters

Parameters	Accuracy Limits
Ozone	$\pm 7\%$ RE
CO, SO ₂ , SO ₂ MAX, NO, NO ₂ , NO _x , NO _y , CAPS NO ₂	$\pm 10\%$ RE
WS	± 0.45 mph
WD	± 5 degrees
T	± 0.9 degrees F
RH	$\pm 5\%$

- Are there unusual ambient measurements given known meteorological conditions and comparisons to nearby stations measuring the same parameter? At times, unrepresentative spiking in the measurement reading occurs, sometimes caused by electronic surging, and these can be seen at the minute level of time resolution with AirVision.

Since there are no daily QC challenges for meteorological measurements, unusual readings from these instruments are compared with other sites to see if they seem unreasonable. E.g. if one station out of several shows zero mph wind speed (WS) while others in the same airshed consistently show a non-zero value, the anemometer may be binding and not moving freely. Usually the Daily Data Evaluation picks up on these anomalies and notes them, along with assigning maintenance and final diagnostics done in the field, before the monthly data verification procedure starts.

- Do pre-calibration and QA audits show the measurement device results to be in specification or show any other noteworthy problem that may affect data quality?

- For an hourly average of data, is there greater than 75% data completion? The data logger normally assesses this and flags accordingly (e.g., noting that the device has been taken offline or a power outage has occurred). Occasionally manual field operations fail to successfully take a device offline while the device is no longer sampling ambient conditions and these instances will be noted during verification from the logs on the “Ambient Data Monthly” printout for later null coding.
- Is the internal temperature of the station in specification as noted on the field log sheet?
- Are there any comments by field personnel in the Central Report or station hard copy logs that show potential problems with data quality?
- If no data was captured, can it be explained how this may have occurred, e.g. power or communication failure?
- If data is shown to be compromised or not meeting other QC acceptance criteria, can an explanation be found for the occurrence?

If a pollutant or meteorological measurement apparently does not meet its verification criteria as indicated by its Quality Control (QC) data, then the timeline and circumstances of its indicated failure are investigated from the documentation in order to find the cause of the out of specification situation.

Sometimes, from this investigation, it will be found that it is the QC data that is faulty and the pollutant measurement actually falls within its criteria for acceptance. In such a situation, the QC data fault must be thoroughly understood and documented. Also needed is other independent QC data that support the pollutant measurement is in specification and is acceptable.

7.4.2 Hard Copies in Monthly Data Packet

All hard copies are contained in the Monthly Data Packet as explained in section 7.1 above.

7.4.2.1 Ambient Data Monthly Printouts

These are printout of the hourly averages of gaseous and meteorological measurements and are the data to be verified that will later be sent to the AQS. It is generated from the AirVision database. Internal station temperature (Itemp) printouts, in the same format, are also generated but are used for QC of the other hourly averages.

Selection Criteria																								
Site	Parameter																							
ACADEMY	O3																							
	001h																							
Date	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01/01/2015	0.007	0.005	0.007	0.012	0.016	0.016	0.016	0.020	0.030	0.037	0.034	0.042	0.045	0.045	0.045	0.046	0.046	0.045	0.045	0.045	0.044	0.044	0.038	0.040
01/02/2015	0.037	0.040	0.035	0.033	0.024	0.017	0.012	0.004	0.010	0.016	0.032	0.041	0.041	0.039	0.038	0.040	0.030	0.019	0.002	0.007	0.005	0.003	0.001	0.006
01/03/2015	0.007	0.010	0.013	0.022	0.021	0.028	0.027	0.026	0.025	0.031	0.037	0.043	0.044	0.042	0.041	0.040	0.028	0.027	0.026	0.027	0.028	0.028	0.025	0.018
01/04/2015	0.005	0.006	0.002	0.005	0.007	0.009	0.002	0.004	0.010	0.021	0.023	0.022	0.025	0.027	0.027	0.027	0.016	0.004	0.004	0.002	0.001	0.005	0.014	0.024
01/05/2015	0.016	0.018	0.021	0.019	0.026	0.025	0.021	0.011	0.012	0.021	0.030	0.039	0.037	0.036	0.035	0.035	0.035	0.035	0.032	0.032	0.022	0.018	0.023	0.025
01/06/2015	0.016	0.006	0.025	0.029	0.026	0.009	0.005	0.003	0.011	0.025	0.022	0.017	0.030	0.042	0.028	0.029	0.025	0.015	0.009	0.001	0.001	0.004	0.005	0.006
01/07/2015	0.011	0.006	0.011	0.018	0.019	0.018	0.019	0.019	0.021	0.024	0.025	0.026	0.029	0.030	0.029	0.028	0.024	0.021	0.022	0.020	0.019	0.016	0.009	0.008
01/08/2015	0.013	0.037	0.043	0.042	0.040	0.040	0.037	0.027	0.035	0.033	0.041	0.039	0.040	0.043	0.047	0.041	0.034	0.030	0.036	0.032	0.037	0.036	0.029	0.030
01/09/2015	0.035	0.036	0.034	0.032	0.031	0.035	0.034	0.033	0.032	0.030	0.028	0.028	0.027	0.025	0.022	0.022	0.020	0.020	0.019	0.020	0.019	0.016	0.011	0.013
01/10/2015	0.014	0.009	0.003	0.022	0.038	0.038	0.037	0.038	0.043	0.037	0.042	0.041	0.044	0.045	0.044	0.044	0.036	0.020	0.028	0.027	0.022	0.010	0.007	0.012
01/11/2015	0.007	0.012	0.012	0.023	0.022	0.027	0.028	0.023	0.017	0.017	0.022	0.040	0.040	0.040	0.035	0.021	0.024	0.014	0.023	0.031	0.033	0.034	0.028	0.027
01/12/2015	0.024	0.030	0.029	0.025	0.021	0.026	0.031	0.031	0.025	0.024	0.023	0.025	0.026	0.027	0.025	0.023	0.020	0.018	0.019	0.022	0.024	0.027	0.027	0.028
01/13/2015	0.027	0.026	0.021	0.019	0.015	0.012	0.013	0.014	0.016	0.014	0.014	0.014	0.021	0.033	0.026	0.025	0.026	0.026	0.026	0.028	0.029	0.032	0.035	0.034
01/14/2015	0.026	0.026	0.023	0.017	0.018	0.011	0.010	0.013	0.018	0.020	0.023	0.024	0.023	0.021	0.023	0.016	0.007	0.001	0.000	0.000	0.003	0.006	0.009	0.016
01/15/2015	0.009	0.024	0.028	0.026	0.022	0.023	0.018	0.007	0.014	0.012	0.023	0.033	0.035	0.034	0.031	0.032	0.018	0.006	0.001	0.002	0.004	0.005	0.006	0.019
01/16/2015	0.038	0.043	0.042	0.045	0.045	0.044	0.051	0.038	0.031	0.028	0.036	0.037	0.046	0.048	0.036	0.023	0.017	0.014	0.028	0.041	0.047	0.046	0.044	0.046
01/17/2015	0.047	0.046	0.046	0.045	0.044	0.041	0.045	0.049	0.050	0.050	0.049	0.048	0.048	0.048	0.047	0.042	0.041	0.031	0.012	0.012	0.014	0.019	0.013	0.023
01/18/2015	0.021	0.028	0.024	0.040	0.042	0.046	0.047	0.045	0.044	0.042	0.042	0.042	0.041	0.040	0.040	0.039	0.036	0.035	0.039	0.040	0.041	0.042	0.043	0.043
01/19/2015	0.043	0.045	0.045	0.044	0.043	0.042	0.042	0.043	0.043	0.043	0.043	0.044	0.043	0.044	0.045	0.042	0.036	0.031	0.032	0.031	0.022	0.022	0.029	0.030
01/20/2015	0.029	0.025	0.021	0.021	0.030	0.032	0.026	0.018	0.021	0.035	0.032	0.022	0.028	0.030	0.027	0.023	0.024	0.024	0.024	0.021	0.018	0.018	0.020	0.036
01/21/2015	0.041	0.038	0.038	0.039	0.036	0.033	0.030	0.026	0.031	0.032	0.034	0.041	0.043	0.042	0.043	0.043	0.041	0.038	0.041	0.039	0.022	0.014	0.007	0.022
01/22/2015	0.024	0.024	0.021	0.017	0.015	0.011	0.010	0.008	0.013	0.016	0.031	0.033	0.036	0.031	0.032	0.030	0.023	0.010	0.002	0.000	0.008	0.007	0.021	0.017
01/23/2015	0.019	0.034	0.020	0.014	0.009	0.016	0.004	0.009	0.010	0.051	0.112	0.113	0.105	0.044	0.043	0.041	0.036	0.031	0.025	0.034	0.015	0.012	0.010	0.016
01/24/2015	0.013	0.013	0.018	0.020	0.024	0.033	0.032	0.030	0.030	0.032	0.042	0.047	0.048	0.048	0.045	0.036	0.032	0.035	0.038	0.036	0.026	0.018	0.023	0.028
01/25/2015	0.031	0.028	0.026	0.027	0.019	0.012	0.008	0.016	0.022	0.025	0.029	0.034	0.039	0.039	0.040	0.036	0.021	0.009	0.006	0.008	0.006	0.008	0.017	0.017
01/26/2015	0.011	0.010	0.023	0.019	0.021	0.015	0.006	0.004	0.009	0.034	0.038	0.049	0.050	0.050	0.051	0.033	0.021	0.003	0.001	0.001	0.001	0.001	0.004	0.008
01/27/2015	0.019	0.019	0.020	0.028	0.025	0.024	0.020	0.016	0.018	0.016	0.020	0.043	0.047	0.049	0.043	0.039	0.032	0.026	0.011	0.006	0.030	0.039	0.041	0.041
01/28/2015	0.043	0.045	0.044	0.045	0.045	0.043	0.039	0.023	0.029	0.044	0.047	0.047	0.047	0.047	0.046	0.043	0.036	0.022	0.017	0.032	0.030	0.031	0.030	0.030
01/29/2015	0.034	0.034	0.029	0.030	0.032	0.027	0.026	0.025	0.024	0.028	0.029	0.029	0.032	0.038	0.039	0.039	0.037	0.030	0.028	0.033	0.031	0.033	0.032	0.031
01/30/2015	0.031	0.029	0.023	0.027	0.022	0.017	0.013	0.004	0.016	0.016	0.013	0.016	0.016	0.018	0.013	0.007	0.002	0.001	0.011	0.027	0.024	0.021	0.026	0.023
01/31/2015	0.023	0.027	0.026	0.023	0.012	0.010	0.010	0.011	0.017	0.018	0.023	0.029	0.027	0.022	0.018	0.018	0.012	0.007	0.011	0.008	0.002	0.013	0.023	0.022

Figure 7. Ambient Data Cross Tab

When zero correcting, null coding, editing or otherwise making a change to this database because of the verification process, access AirVision to get an active data edit window that shows the site, the parameter(s) under question and the time period under investigation as above (usually a month – but this can be of any length needed) and make the adjustments directly.

1. Start AirVision.
2. Select the Home tab.
3. Select Data Editors tab.
4. Start Average Data Editor.

Within the Average Data Editor the presentation of the hourly average data can be of several different formats, including time series that can be useful for comparing different sites for one or more ambient parameters. Flags and null codes can be identified also with the cursor above a particular record.

The flags that are colored red are the ones of most concern during the first part of data verification. They are:

- Out of Control. Accuracy tests out of limits. Only put in manually after investigating these events.
- Logger Invalid. This is the flag that covers the instrument being offline for any reason (e.g. auto span, maintenance, known inoperability of measurement device, etc.) and also <75% data capture for the averaging interval.
- Power Failure.

Almost all of these red flags will lead to null coding (indicating that the data flagged are not accepted and are manually coded for type of fault; see section 7.4.3 below) of the cells.

The centerpiece of the verification procedure, the monthly printout is directly compared to the logs, control charts and any other relevant documents in this folder. At times, analytical tools in AirVision will be needed and also access to the Calibration and QA audit databases and spreadsheets such as Z/S/P Tracking (see this QAPP document for details). Any needed data modifications, cells to be null coded (marked as unaccepted) and other changes to be made later in the verification procedure are marked and commented on directly on the print out.

7.4.2.2 Site and Analyzer Log Sheets

These logs will have analyzer and meteorological operational parameters and comments from when the site is visited. These logs will usually have more routine information than the Logger Central Message Report which will have only overall activities performed and notable analyzer/site conditions that are exceptional.

As noted above, often times an operational parameter may be outside of its limits but its analyzer is still producing acceptable data. Knowledge of the impact of different operational parameters is key. Refer to the specific operation manuals of the measurement device to distinguish these.

For example, if a source lamp is outside of its range, but automatic z/s/p and other external challenges show that the analyzer's responses are comfortably in specification, then the data can be judged acceptable. However, if the source lamp is allowed to further go out of range (as when it is degrading naturally over time), there will come a point when the analyzer cannot measure ambient conditions properly or accurately, and this will be reflected in the QC data. Normal day to day operations attempt to keep all operational parameters within their limits or limit the time of their out of specification condition.

From these logs, different offline actions such as field maintenance, QA audits, and calibrations can be distinguished and noted on the Ambient Data Monthly Printout according to their appropriate null code.

Site and analyzer log sheets can be found at the end of their respective SOPs in this QAPP.

As mentioned before, there are no daily QC tests for the meteorological instruments. Here there must be reliance on the visual checks made on the Station/Met log sheet and on noticing aberrant hourly and minute data (e.g. wind direction sticks at a single value for a number of measurements) and inter-site comparisons made in AirVision (the scatter plot view is an excellent tool for inter-site comparisons as well as for ozone/NO_x or other interdependent species).

When meteorological QC audits and calibrations are performed it may be discovered that an instrument is out of specification at that time but was not noticed during the daily and monthly verification procedures. In such cases it may be necessary to null code data back to the latest known good performance of the instrument if there are no other indicators of the instrument's measurement acceptability in the mean time. The AirVision database, and by extension the AQS, would be modified accordingly.

7.4.2.3 Power Failure Report

Power failures are automatically flagged on the monthly parameter report and printout.

Logger Power Failure Report		
Site Name	CHATPARK	Site Description CHATFIELD RES
Logger Name	CHATPARK	Logger Identifier 08
Failure Time	Restored Time	Duration
06-Feb-2015 20:23	06-Feb-2015 20:28	0:4
Site Name	DESCI	Site Description DESCI Visibility Site
Logger Name	DESCI	Logger Identifier 07
Failure Time	Restored Time	Duration
04-Feb-2015 07:36	04-Feb-2015 07:36	0:0
05-Feb-2015 14:02	05-Feb-2015 14:02	0:0

Figure 8. Logger Power Failure Report

7.4.2.4 Central Message Report

These are a useful adjunct to the hard copy log sheets as they give a good overview of actions and observations with each site visit.

Logger Central Message Report	
Site Name ACADEMY	Site Description Co. Springs - Air Force Acadan
Logger Identifier 62	Logger Name ACADEMY
Message Time	Message Text
1/7/2015 11:39:58 AM	MONTHLY.MDR
1/10/2015 10:13:20 AM	WEEKLY. DH
1/16/2015 2:48:09 PM	WEEKLY. DH
1/23/2015 12:17:43 PM	O3, Z=000, S=241, P=060 703 READ, VRS.
1/24/2015 4:08:56 PM	WEEKLY. DH
1/27/2015 3:29:42 PM	WEEKLY. DH
1/28/2015 10:13:32 AM	MONTHLY COMPLETE. 400E NEEDS NEW EXHAUST PUMP, WILL INSTALL NEXT VISIT. - KH
1/30/2015 10:30:41 AM	INSTALLED NEW SAMPLE PUMP. LEAK TEST PASSED WITH NEW PUMP. - KH
Site Name ASPENPK	Site Description Aspen Park
Logger Identifier 17	Logger Name ASPENPK
Message Time	Message Text
1/5/2015 4:14:59 PM	WEEKLY.MDR
1/14/2015 12:43:18 PM	WEEKLY COMPLETE. - KH
1/21/2015 10:15:31 AM	WEEKLY COMPLETE. - KH
1/26/2015 12:36:23 PM	MONTHLY COMPLETE. - KH
1/26/2015 12:49:10 PM	REPAIR VERY HARD TO LOCK/UNLOCK DOOR. - KH
Site Name AUREAST	Site Description Aurora East
Logger Identifier 18	Logger Name AUREAST
Message Time	Message Text
1/6/2015 4:59:23 PM	WEEKLY.MDR
1/20/2015 10:26:27 AM	WKLY CMLPT. RMVE EXHST PMP MOUNT REDUCE RATTLING. SITE CLEANUP. - KH
1/27/2015 9:18:02 AM	MONTHLY COMPLETE. - KH
Site Name CHATPARK	Site Description CHATFIELD RES
Logger Identifier 08	Logger Name CHATPARK
Message Time	Message Text
1/14/2015 10:26:20 AM	WEEKLY COMPLETE. INSTALL BROOM AND SHOVEL HANGERS. - KH
1/21/2015 12:42:09 PM	WEEKLY COMPLETE. - KH
1/26/2015 1:45:42 PM	MONTHLY COMPLETE. - KH

Figure 9. Logger Central Message Report

7.4.2.5 Maintenance Forms

These forms are filled out every time there is any major maintenance action that will possibly have an effect on data quality. These will often indicate the end time, and sometimes the beginning, of a period of unacceptable data.

MAINTENANCE REPORT	
DATE _____	
STATION _____	
ASSIGNED TO _____	
ORIGINATED BY _____	
ANALYZER or EQUIPMENT _____	S/N _____
MALFUNCTION DESCRIPTION OR COMPLAINT	
ACTION TAKEN	
DATA TO BE DELETED (IF ANY) ENTER EXACT DATES AND DATA HOURS	
COMPLETED BY _____	
COMPLETION DATE _____	
J:\zsf\files\forms\forms.xls: MaintRpt	

Figure 10. Maintenance Report

7.4.2.6 Zero Correction Documentation

The verification person is usually one of the people who reviews whether a zero correction action should take place or not within the entire gaseous dataset. See section 7.3. This review is done concurrently with the rest of the verification procedure, but actual zero correction to the database, performed by the verification person, is not done until at least one other person has systematically reviewed the entire month and made their recommendations.

December 2014 Manual Zero Adjust	
Welby SO2 / SO2 Max	
Reviewer 1:	
Reviewer 2:	
Reviewer 3:	
Reviewer 4:	
Welby NO / NO2 / Nox	
Reviewer 1:	
Reviewer 2:	
Reviewer 3:	
Reviewer 4:	
CAMP SO2 / SO2 Max	
Reviewer 1:	
Reviewer 2:	
Reviewer 3:	
Reviewer 4:	
CAMP NO / NO2 / NOx	
Reviewer 1:	
Reviewer 2:	
Reviewer 3:	
Reviewer 4:	
LA CASA SO2 / SO2 Max	
Reviewer 1:	
Reviewer 2:	
Reviewer 3:	
Reviewer 4:	
LA CASA NO / Nox	
Reviewer 1:	
Reviewer 2:	
Reviewer 3:	
Reviewer 4:	

Figure 11. Manual Zero Correction Form

7.4.2.7 QC Control Charts

These are central for a consistent check on gaseous analyzer accuracy and repeatability. For the actual source and subject test values, consult the Z/S/P Tracking form (see section 6 of this SOP).

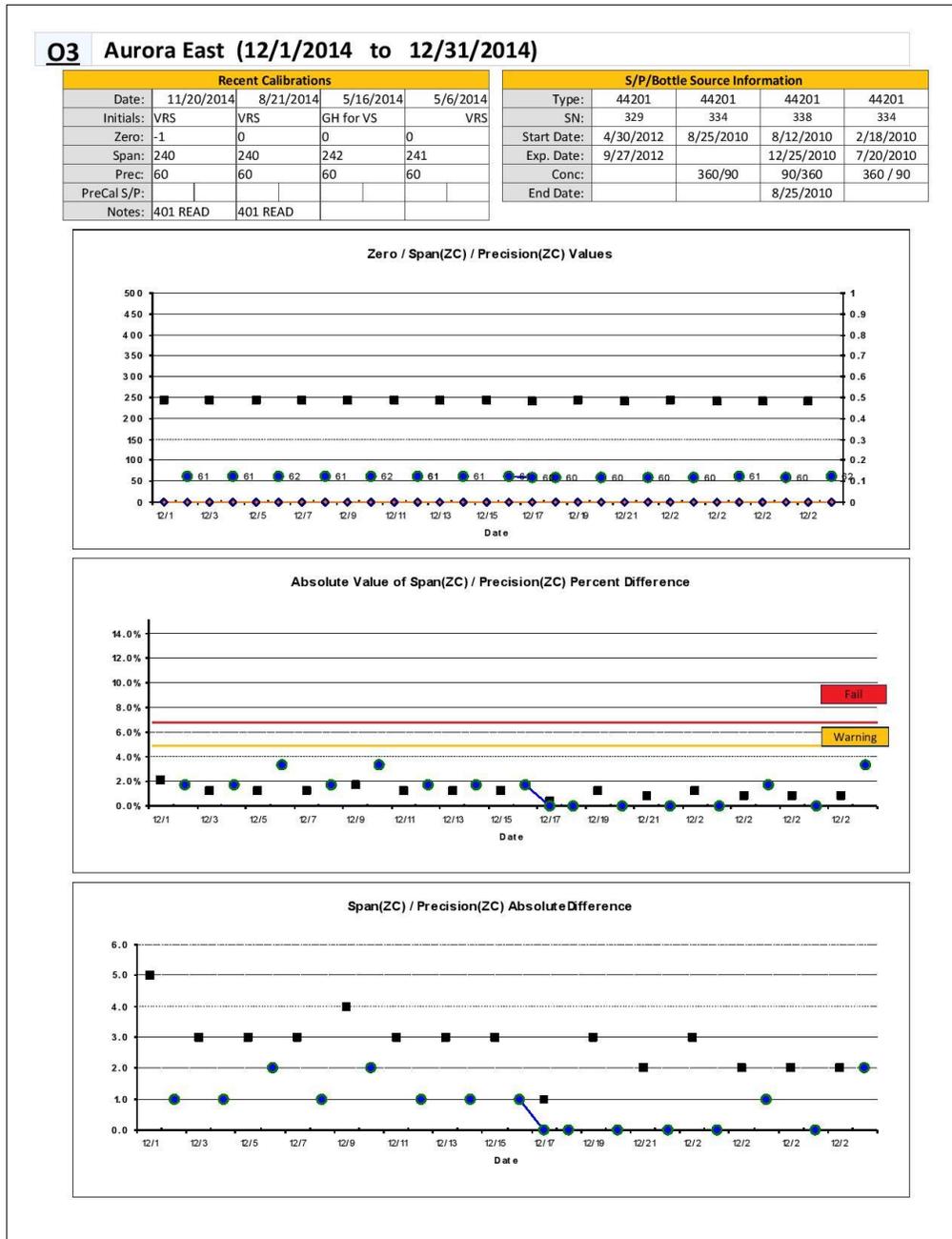


Figure 12. QC Control Chart

7.4.2.8 Manual Precision Summary Report

The Manual Precision Summary report gives a summary of all manual QC Precision tests that have been selected to be transfer to the AQS repository. This report is generated from within the ZSPTracking database as described in Section 7.1.8. These QC Precision tests are to be representative of their associated ambient data. If for some reason, the surrounding ambient data was null coded during the verification process, the corresponding QC Precision test must also be invalidated and vice versa.

7.4.2.9 Chain of Custody Tracking

The Ambient Data Verification Procedure is covered in the second section of the Chain of Custody Tracking form.

- Data Review/Hard Copy Changes: This covers all database reviews and documentation, besides zero correction review, that are fully noted on the hardcopies.
- Database Correction: This is the actual modification and/or null coding of the database besides the zero correction review.
- Zero Review and Corrections: At least one other person is to have systematically done zero correction review with recommendations before the person doing the data verification procedure does their own zero correction review. If there is a difference of interpretation a consultation between the reviewers is needed before zero correction modifications to the database is done. If there is agreement between the reviewers the zero correction to the database is automatically done by the person doing the verification process.
- Null Code Completeness Check: This is done to see that all ambient measurement cells that are flagged as unacceptable have been properly null coded. See section 1.4.3 below.
- Database Correction: If any unacceptable data cells are found that are not null coded, they are corrected.

MONTH: November 2014		GASEOUS CHAIN OF CUSTODY TRACKING		
	DATE	BY	NOTES	
ALL CHARTS AND LOGS IN				
ZERO/SPAN GRAPHS PRINTED				
POWER FAILURE LOG PRINTED				
INITIAL PRINTOUT COMPLETED				
INITIAL ZERO ADJUST REVIEW				
INITIAL DATA REVIEW				
DATA REVIEW/HARD COPY CHANGES				
DATABASE CORRECTION				
ZERO REVIEW AND ADJUSTMENTS				
NULL CODE COMPLETENESS CHECK				
DATABASE CORRECTION				
AQS AMBIENT DATA FILE GENERATED				
AQS AMBIENT DATA FILE REVIEWED				
AQS P&A DATA FILE GENERATED				
AQS P&A DATA FILE REVIEWED				
AQS AMBIENT DATA FILE SENT				
AQS P&A FILE SENT				
INDEPENDENT CHECK COMPLETED				
CORRECTIONS SENT TO AQS				

J:\zsf\files\forms\forms.xls: C&C Tracking

Figure 13. Gaseous Chain of Custody Tracking Form

7.4.2.10 Z/S/P Precision Failure Report

All precision failures are printed out for the month from the Z/S/P Tracking database. Each failure is examined for legitimacy as a representation of the analyzer being out of specification. If the precision failure is representative, then the appropriate ambient data is null coded in AirVision and noted so in Z/S/P Tracking. If the reported precision failure isn't representative for a known reason, then the Invalid box is checked and comments made in Z/S/P Tracking and changes saved. After all precision failures have been examined and acted on, the Z/S/P Precision Failure Report is reprinted with all of the new Invalid checkoffs and comments and put into the monthly data packet. The old Precision Failure Report is discarded.



**Z/S/P Precision Failure Report
10/1/2017 to 10/31/2017**

Parameter	Site	Date	Type	A/M	Actual	Actual Z	Indicated	Indicated Z	% Diff	ZC	Invalid	Notes
42101	Swansea	10/1/2017	Prec	A	0.9903	0	1.094	0.096	10.5%	<input type="checkbox"/>	<input type="checkbox"/>	APCD does not do this data validation. Actual Ze
	125 Denver	10/5/2017	Prec	A	3.924	0	0	0	-100.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	data null coded. Actual Zero Assumed.
	Swansea	10/21/2017	Prec	A	0.9892	0	1.138	0.147	15.0%	<input type="checkbox"/>	<input type="checkbox"/>	APCD does not do this data validation. Actual Ze
	Swansea	10/23/2017	Prec	A	0.9891	0	1.196	0.169	20.9%	<input type="checkbox"/>	<input type="checkbox"/>	APCD does not do this data validation. Actual Ze
	Swansea	10/27/2017	Prec	A	0.9897	0	1.134	0.118	14.6%	<input type="checkbox"/>	<input type="checkbox"/>	APCD does not do this data validation. Actual Ze
42401	CAMP	10/29/2017	Prec	A	20	0	0.6	0.6	-97.0%	<input type="checkbox"/>	<input type="checkbox"/>	data null coded. Analyzer fault, data invalid. Actual
	CAMP	10/30/2017	Prec	M	20	0	14.94	-2.14	-25.3%	<input type="checkbox"/>	<input type="checkbox"/>	data null coded. Analyzer fault, data invalid. Actual
42603												
125 Globeville		10/25/2017	Prec	A	100	0	141.56	136.72	41.6%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source in shop for MFC certification EJM
44201	Mines Peak	10/1/2017	Prec	A	60.3	1.7	100.3	0.7	66.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source error
	Mines Peak	10/2/2017	Prec	M	60	0.2	101.4	1	69.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source error
	Mines Peak	10/3/2017	Prec	A	61.4	1	102.5	0.3	66.9%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source error
	Mines Peak	10/5/2017	Prec	A	59.4	0.2	100	0.7	68.4%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source error
	Welby	10/5/2017	Prec	A	-6.5	-5.1	12	11.7	-284.6%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue. Zero drift failure by absolute differe
	Mines Peak	10/7/2017	Prec	A	64.2	-0.2	99.2	0.9	54.5%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source error
	Welby	10/7/2017	Prec	A	-0.3	-0.3	40	39	-13433.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue. Zero drift failure by difference from
	Welby	10/9/2017	Prec	A	-0.3	-0.3	0.1	0.9	-133.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	La Casa	10/11/2017	Prec	M	59.7	-0.9	51.8	1.2	-13.2%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	La Casa	10/11/2017	Prec	A	59.6	-1	53.8	1	-9.7%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue. trace had not stabilized yet.
	La Casa	10/13/2017	Prec	A	59.6	-0.9	55.4	0.9	-7.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	La Casa	10/15/2017	Prec	A	60.1	-0.2	55.7	0.7	-7.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	La Casa	10/17/2017	Prec	M	59.8	-1	54.6	-0.2	-8.7%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	Rocky Flats - N		10/21/2017	Prec	A	60.2	0.2	32.3	32.3	-46.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 14. Z/S/P Precision Failure Report

7.4.2.11 Z/S/P Span Failure Report

All span failures are printed out for the month from the Z/S/P Tracking database. Each failure is examined for legitimacy as a representation of the analyzer being out of specification. If the span failure is representative, then the appropriate ambient data is null coded in AirVision and noted so in Z/S/P Tracking. If the reported span failure isn't representative for a known reason, then the Invalid box is checked, comments are made in Z/S/P Tracking and changes saved. After all span failures have been examined and acted on, the Z/S/P Span Failure Report is reprinted with all of the new Invalid checkoffs and comments and put into the monthly data packet. The old Span Failure Report is discarded.

		Z/S/P Span Failure Report 10/1/2017 to 10/31/2017										
Parameter	Site	Date	Type	A/M	Actual	Actual Z	Indicated	Indicated Z	% Diff	ZC	Invalid	Notes
42101	I25 Denver	10/4/2017	Span	A	9.161	0	6.738	-2.578	-26.4%	<input checked="" type="checkbox"/>	<input type="checkbox"/>	data null coded. QC and data invalid. analyzer noi
42401	CAMP	10/28/2017	Span	A	80	0	0.6	0.6	-99.3%	<input type="checkbox"/>	<input type="checkbox"/>	data null coded Analyzer fault. data invalid. Actual
42601	I25 Globeville	10/26/2017	Span	A	0	0	2.94	2.77	294.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source in shop for MFC certification EJM
42602	I25 Globeville	10/26/2017	Span	A	0	0	7.49	8.09	749.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source in shop for MFC certification EJM
42603	I25 Globeville	10/26/2017	Span	A	0	0	12	10.87	1200.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source in shop for MFC certification EJM
44201	Mines Peak	10/2/2017	Span	A	232.6	0.9	264	0.7	13.5%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source error
	Welby	10/2/2017	Span	A	239	-1.3	220.6	0.4	-7.7%	<input type="checkbox"/>	<input type="checkbox"/>	data null coded
	Greeley Tower	10/4/2017	Span	A	237.5	-1	262.9	-1.7	10.7%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	Welby	10/4/2017	Span	A	-0.3	-0.3	0.5	0.4	-266.7%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	Welby	10/6/2017	Span	A	-0.3	-0.9	40.9	39.7	-13733.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue. Zero drift failure by absolute differe
	Welby	10/8/2017	Span	A	-0.3	-0.3	29.7	29.8	-10000.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue. Zero drift failure by difference from
	Greeley Tower	10/20/2017	Span	A	176.2	243.1	-3.7	-1.7	-102.1%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue
	Rocky Flats - N	10/20/2017	Span	A	240.6	0.1	28.2	30	-88.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source not configured correctly. Zero drift failur
	Mines Peak	10/22/2017	Span	A	240.2	60	250.8	0	39.2%	<input checked="" type="checkbox"/>	<input type="checkbox"/>	source error. Zero drift failure by difference fro
	Rocky Flats - N	10/22/2017	Span	A	240.6	0.3	33.4	32.6	-86.1%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source not configured correctly. Zero drift failur
	CAMP	10/26/2017	Span	A	217.4	-1.6	248.4	0	14.3%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	source issue.
	Welch	10/30/2017	Span	A	-0.5	-0.5	18	15.9	-3700.0%	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Source did not activate, QC invalid EJM

Figure 15. Z/S/P Span Failure Report

7.4.2.12 Zero Drift Report

All out-of-bounds zero drifts are printed out for the month from the Z/S/P Tracking database. Each reported drift is examined for legitimacy as a representation of the analyzer being out of specification. If the drift failure is representative, then the appropriate ambient data is null coded in AirVision and noted so in Z/S/P Tracking. If the reported drift failure isn't representative for a known reason, then the Invalid box is checked, comments are made in Z/S/P Tracking and changes saved. After all out-of-bounds drifts have been examined and acted on, the Z/S/P Zero

Drift Failure Report is reprinted with all of the new Invalid checkoffs and comments and put into the monthly data packet. The old Zero Drift Failure Report is discarded.

Site	Parameter	POC	ZSPDate	IndicatedZ	24-hour Zero Drift	ZD14Dy	Invalid	
CAMP	42401	1	10/30/2017	-2.14	2.74	-999	<input type="checkbox"/>	data null coded.Analyzer fault, data inv Assumed. Zero drift failure by absolute has drifted by 2.74000024795532 Zero difference from zero.
Summary for 'POC' = 1 (1 detail record)				Max	2.74	-999		
Summary for 'Parameter' = 42401 (1 detail record)				Max	2.74	-999		
I25 Denver	42101	1	10/4/2017	-2.58	2.544	-999	<input checked="" type="checkbox"/>	data null coded. QC and data invalid, ar EJMZero drift failure by difference from
Summary for 'POC' = 1 (1 detail record)				Max	2.544	-999		
Summary for 'Parameter' = 42101 (1 detail record)				Max	2.544	-999		
La Casa	42101	1	10/8/2017	-0.60	0	-999	<input checked="" type="checkbox"/>	CE GPTZero drift failure by difference fr
			10/8/2017	-0.60	0	-999	<input checked="" type="checkbox"/>	CE IPNZero drift failure by difference fr
Summary for 'POC' = 1 (2 detail records)				Max	0	-999		
Summary for 'Parameter' = 42101 (2 detail records)				Max	0	-999		
NREL	44201	1	10/24/2017	60.80	61.3	-999	<input checked="" type="checkbox"/>	source issue. Zero drift failure by absol Zero has drifted by 61.2999992370605 by difference from zero.
Summary for 'POC' = 1 (1 detail record)				Max	61.3	-999		
Summary for 'Parameter' = 44201 (1 detail record)				Max	61.3	-999		
Rocky Flats - N	44201	1	10/20/2017	30.00	29.8	-999	<input checked="" type="checkbox"/>	Source not configured correctly. Zero difference from zero.
			10/22/2017	32.60	0	-999	<input checked="" type="checkbox"/>	Source not configured correctly. Zero difference from zero.
Summary for 'POC' = 1 (2 detail records)				Max	29.8	-999		
Summary for 'Parameter' = 44201 (2 detail records)				Max	29.8	-999		
Swansea	42601	1	10/27/2017	-3.77	3.64	-999	<input type="checkbox"/>	APCD does not do this data validation. Assumed. Zero drift failure by absolute has drifted by 3.6399998664856 Zero c difference from zero.
			10/28/2017	0.32	4.09	-999	<input type="checkbox"/>	APCD does not do this data validation. Assumed. Zero drift failure by absolute has drifted by 4.09000015258789
Summary for 'POC' = 1 (2 detail records)				Max	4.09	-999		
Summary for 'Parameter' = 42601 (2 detail records)				Max	4.09	-999		

Figure 16. Zero Drift Report

7.4.2.13 Monthly Calibration Data Report

For completeness, and to assist in errors of omission or errors not otherwise caught during daily performance check validations, a print out of the entire monthly performance checks should be printed and included in the data packet. Retention of the word “calibration” in the title reflects the misleading nomenclature in the data logger software.

This report will be tied to the date fields on the StartPage form in ZSPTracking, and a button will be included for its production.

Monthly Calibration Data Report

Site	System	Date	Auto/Manual	Actual	AZero	Indicated	IZero	%Difference
Aspen Park	O3	12/1/2017	A	241.90	-1.00	243.40	0.20	0.6%
		12/2/2017	A	60.10	-1.50	60.50	-0.30	0.7%
		12/3/2017	A	242.00	-1.50	243.80	0.10	0.7%
		12/4/2017	M	60.30	-1.00	60.00	-1.00	-0.5%
		12/4/2017	A	60.00	-0.50	57.90	0.00	-3.5%
		12/5/2017	A	242.50	-0.90	242.80	0.00	0.1%
		12/6/2017	A	59.90	-0.30	59.20	-0.20	-1.2%
		12/7/2017	A	242.10	-1.10	243.10	0.20	0.4%
		12/8/2017	A	59.50	-0.60	59.10	0.00	-0.7%
		12/9/2017	A	242.50	-0.40	244.10	0.30	0.7%
		12/10/2017	A	60.00	-0.60	59.50	-0.10	-0.8%
		12/11/2017	A	242.10	-0.40	243.40	0.30	0.5%
		12/12/2017	M	60.10	-0.70	59.50	-0.30	-1.0%
		12/12/2017	A	59.60	-0.90	59.60	0.40	0.0%
		12/13/2017	A	242.60	-1.00	244.30	0.50	0.7%
		12/14/2017	A	60.40	-0.50	60.00	-0.40	-0.7%
		12/15/2017	A	243.00	-1.10	245.40	0.90	1.0%
		12/16/2017	A	59.60	-1.00	59.10	0.30	-0.8%
		12/17/2017	A	242.50	-1.50	245.40	1.10	1.2%
		12/18/2017	A	59.40	-1.30	59.60	-0.40	0.3%
		12/19/2017	A	242.30	-1.20	243.20	0.40	0.4%
		12/20/2017	A	60.00	-1.50	60.30	0.00	0.5%
		12/21/2017	A	241.90	-0.50	243.00	-0.90	0.5%
		12/22/2017	A	60.10	-1.50	60.20	-0.50	0.2%
		12/23/2017	A	241.80	-0.50	241.60	-0.60	-0.1%
		12/24/2017	A	60.40	-1.40	60.50	-0.50	0.2%
		12/25/2017	A	241.70	-1.10	242.60	-0.60	0.4%
		12/26/2017	A	59.90	-1.40	59.60	-0.50	-0.5%
		12/27/2017	A	241.90	-0.90	243.40	-0.10	0.6%
12/28/2017	A	59.90	-0.90	59.50	-0.70	-0.7%		
12/29/2017	A	242.10	-1.20	243.50	-0.80	0.6%		

Figure 17. Monthly Calibration Data Report

7.4.3 Final Data Editing and Null Coding

As all ambient data cells that are found unacceptable have been marked up on the Ambient Data Monthly Printout, they must now be null coded in AirVision. This effectively invalidates the data, though the original values will be preserved. The null codes also code for the reason for the absence of acceptable data.

On the live Ambient Data Monthly Data Editor (linear or crosstab data view) right click the cell or cells that contain unacceptable data and select Set AQS Null Codes, then select the appropriate code and enter and save. Below is a list of null codes for AQS.

AA	SAMPLE PRESSURE OUT OF LIMITS
AB	TECHNICIAN UNAVAILABLE
AC	CONSTRUCTION/REPAIRS IN AREA
AD	SHELTER STORM DAMAGE
AE	SHELTER TEMPERATURE OUTSIDE LIMITS
AF	SCHEDULED BUT NOT COLLECTED
AG	SAMPLE TIME OUT OF LIMITS
AH	SAMPLE FLOW RATE OUT OF LIMITS
AI	INSUFFICIENT DATA (CANNOT CALCULATE)
AJ	FILTER DAMAGE
AK	FILTER LEAK
AL	VOIDED BY OPERATOR
AM	MISCELLANEOUS VOID
AN	MACHINE MALFUNCTION
AO	BAD WEATHER
AP	VANDALISM
AQ	COLLECTION ERROR
AR	LAB ERROR
AS	POOR QUALITY ASSURANCE RESULTS
AT	CALIBRATION
AU	MONITORING WAIVED
AV	POWER FAILURE (POWR)
AW	WILDLIFE DAMAGE
AX	PRECISION CHECK (PREC)
AY	Q C CONTROL POINTS (ZERO/SPAN)
AZ	Q C AUDIT (AUDT)
BA	MAINTENANCE/ROUTINE REPAIRS
BB	UNABLE TO REACH SITE
BC	MULTI-POINT CALIBRATION
BD	AUTO CALIBRATION
BE	BUILDING/SITE REPAIR
BF	PRECISION/ZERO/SPAN
BG	Missing ozone data not likely to exceed level of standard
BH	Interference/co-elution
BI	Lost or damaged in transit
BJ	Operator Error
BK	Site computer/data logger down
FI	Filter Inspection Flag
MC	Module End Cap Missing
SA	Storm Approaching
TS	Holding Time Or Transport Temperature Is Out Of Specs.

7.4.3.1 Null Code Completeness Check

To make sure all unacceptable data cells are null coded go into AirVision.

- a) In the Home ribbon select Reports > AQS Text Report
- b) Select all site and gaseous and meteorological parameters under the verification procedure for the given time frame.

- c) Select Generate in AQS Text Report.
- d) After generation, select Export to Notepad.
- e) Within the Notepad txt file use the Find function for “zz.” This will locate all “red” flagged or empty cells that have not been null coded.
- f) Return to AirVision and null code the missed cells as in Section 7.4.3.

7.5 Ambient Data Validation Procedures

Data Validation is the process of determining the validity of verified data and if the verified results will meet the end data user’s needs. The validation process is independent of the verification process in that it serves to validate the verification process. The validation process is a quality assurance role and the data package inspection is generally done by a member of the Quality Assurance group. The inspector reviews all documents in the data package, noting any problems that occurred, and how they were resolved. The inspector uses screening criteria, and best professional judgment, to review the documents. The entire validation process is covered in several sections and appendices within APCD’s Quality Assurance Project Plan. The validation procedures that pertain to this standard operating procedure are covered in Appendix D4. Please reference this appendix for detailed procedures on how to validate gaseous and meteorological data.

7.6 Ambient Data AQS Upload with the Node Administration Utility, AirVision Plug-in

Data can be submitted *en masse* to the EPA’s AQS by using the Node Administration Utility found at <http://enode2.dphe.state.co.us/Admin/>. A login for the utility can be obtained from the CDPHE data manager. Logically the Node Administration Utility uses a plug-in that communicates directly with the AirVision service, specifically to an AQS XML web service that generates the XML version of the file described in Section 7.7. The Administration Utility then processes that file with a header that contains information specific to our screening group and submits the file through CDX to the AQS batch processing mechanism.

The Administration Utility uses pipe-delimited strings to describe the data it will attempt to gather from the AQS XML service. These strings are cross-dependent and sensitive. There must be the same number of entities in all of these fields: SiteCode, ParameterCode, DurationCode, OccurrenceCode, StateCode, CountyTribalCode, and AgencyCode. Additionally, the entities must appear in the same order between each variable so that the Administration Utility can align which parameter is being retrieved with its Site Code, POC, and so on.

To submit a month of data after it has gone through the above quality processes, log into the Administration Utility.



Figure 18. OpenNode2 Login

By default the Administration Utility opens to a dashboard primarily intended for the CDPHE data manager. Click on Schedules in the ribbons near the top of the page.

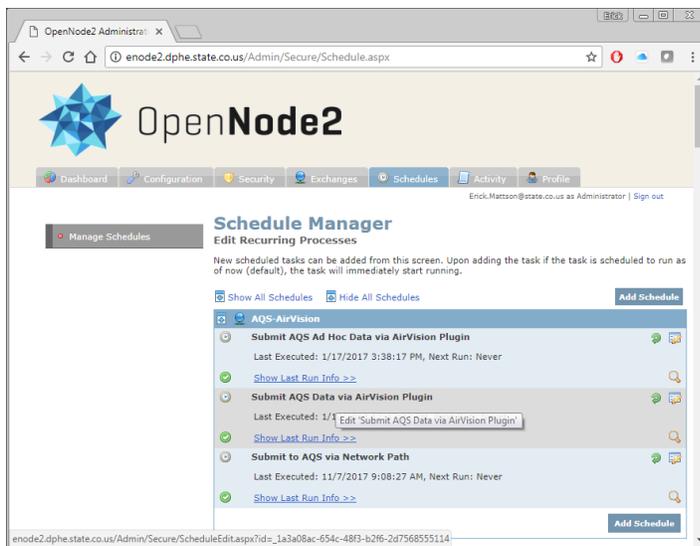


Figure 19. OpenNode2 Schedule Manager

Three methods are available for submitting data to AQS. In addition to the AirVision Plug-in, data can be submitted by accessing a file saved on a shared network path (though this method rarely works), and by entering one or a few parameter combinations to enter a very limited data set, the Ad Hoc Data method.

Two values in the AirVision Plug-in method must be changed each month a batch is submitted, the StartTime and EndTime variables. They should be changed to the first day of the month being submitted, and the first day of the month following the month being submitted. This is due to a flaw in the Administration Utility that does not allow for time to be included in the submission control. If the last day of the month being submitted is used as the EndTime variable, only the first hour of the last day will be included. Using the first of the following month only includes the first hour of that day, which can be overwritten on the subsequent submission for that month. These variables can be entered by clicking on the dialog with a pencil on the right

For more information on the final steps in this process, see Appendix D6 of this QAPP. Further information on configuring the Administration Utility, and its relationship with the AQS XML web service can be found in the AQS v2.2a (AirVision) – Plugin Implementation Guide and the OpenNode2 Administration User Guide v2.1.

7.7 Ambient Data AQS Upload File Development Procedure

Upon completion of the monthly data verification process, the ambient data records residing within the AirVision system are queried and formatted into AQS compliant upload files. Data upload files for ambient data are generated in either a pipe delimited format or an XML format from within the AirVision software. The upload file format is user selected and its format type will ultimately depend upon the requirements of the end user of the data. Recently the EPA has requested that data upload files be submitted to AQS through the node environment in an XML format. Where practical, the APCD attempts to comply with this request. This method of submission is not performed for QC Precision test data due to limitations with the ZSPTracking system. Ambient data is to be generated and submitted to AQS in an XML file. However, because XML files are so difficult to review for errors, a pipe delimited text file is generated and reviewed for errors prior to the generation of the XML file. Pipe delimited text files can be opened, reviewed and edited using a simple text editor. Upon review of the pipe delimited text file and the correction of identified errors in the AirVision database, an XML file is then generated for submission to the AQS database.

The following procedure describes the steps necessary to generate an AQS upload file from within AirVision. This file is then transferred to the APCD person responsible for managing data within the AQS database for uploading to the AQS.

1. AirVision can be accessed through a client located on a local computer (if available) or by a remote desktop connection to the Polling Server. If needed, contact the data manager for credentials and logon instructions to the AirVision system. After connecting to the Polling Server and logging into AirVision, perform the following.
2. If not already selected, select the “Home” tab on the top tab bar.
3. From the Report dropdown menu select AQS Text Report if you want to generate an AQS upload file with the pipe delimited format. Select AQS XML Report if you want to generate an AQS upload file with the pipe delimited format. This will open up the report selection window that is the same for both the AQS Text Report and the AQS XML Report.
4. In the Start Date field enter the beginning date and time for the time period of interest. Typically, this will be the 00:00 hrs on the first day of the month of interest.
5. In the End Date field enter the ending date and time for the time period of interest. Typically, this will be the 23:59 hrs on the last day of the month of interest.
6. In the Average Interval section, select the 1hr interval.
7. In the Record Type Selection section, select the Average Data Records check box. Deselect the remaining check boxes in this section if selected.
8. In the Parameter Selection section select the parameters for each site you wish to include in the AQS upload file. Typically, all active parameters will be selected, including hourly SO₂ 5-min max measurements. Note: multiple sites can be selected by holding down the Ctl key. Note: This report along with the static selection criteria can be saved as a favorite. See the operator’s manual for instructions.

9. Select the “Generate Report” button.
10. Review the error report by selecting the Report Errors tab on the report bar below the Average Interval section. Not all errors warrant corrections in the AirVision system. If data corrections are made, regenerate the upload file by returning to Step 4.
11. Review the data report by selecting the Report Output tab on the report bar below the Average Interval section.
12. Save the data report by selecting the “Save to File” option on the ribbon.
13. A File Save dialog box will open and request the name and save location for the text file that will be generated. Save the file on a network drive. Name the file using the following convention:

AQSDatammyyyy.txt, where *mm*=month (1 to 12) and *yyyy* = year(i.e. 2016). Select the “Save” button.
14. Review the EPA AQS Upload File if the file format is pipe delimited. Open the AQS text string file that was just created in a text editor, such as Notepad. Review the text strings to ensure they are complete and accurate. Verify that all invalid records have null codes. Verify that all negative values are legitimate and negative values in excess of the Method Detection Limit are flagged with a “DA” null code.
15. Transfer the AQS text string file or AQS XML file via email, flash drive, or network drive to the APCD person responsible for the uploading files to AQS.

7.8 Verification Procedure for Quality Control Precision Tests and Nightly Performance Tests

The APCD performs two types of QC tests. These two tests are called Performance tests and QC Precision tests. The former is an automated performance test that is performed nightly and is used to evaluate the health of the sample system. The latter is a manual evaluation performed by qualified personnel who can attest to their validity and are reported to the EPA. The former are not reported to the EPA to prevent an artificial bias introduced by the large sample pool. At the end of each month all the QC Precision tests are reviewed, validated and uploaded to EPA’s AQS. The following procedures describe the steps necessary to perform this task.

- 1) Open J:\ZSFILES\ZSP Tracking\ZPSTracking.accdb.
- 2) From the Start Menu form under the Reports heading, enter the start date and end date that brackets the time period of interest into the Start Date and End Date fields, respectively (Figure 21).
- 3) Under the QC Data Processing heading, select the Generate Report button next to the View Missing Manual Precision Report label. This will open up a report that shows all Quality Control Precision Checks that have been selected to be uploaded to EPA’s AQS database.

Figure 21. ZPSTracking Database - Main Menu

- 4) Review the report and identify missing and failing records. Each two-week time period, for each parameter, and for each site, should have a manual QC Precision check record associated with it. Records that have the AQS checkbox selected (set True) will show up in this report.
 - a) Missing records

Missing records will have no data after the designated time period. If data does exist in these fields, then modifications to the subject data record in the ZSPEntry form are required to remove the record from this report. Specifically, the subject record is to be located and the AQS checkbox de-selected. Once completed, the Overwrite button is to be selected, which saves changes made to the data record. Conversely, if a time period is missing a record, then steps are to be taken to identify why the record is missing. This is best determined by locating and reviewing the subject record in the ZSPEntry form (see Step 5). In most cases, the QC Precision test record exists but accidentally had the AQS checkbox de-selected, or the QC Precision test was not performed and a record does not exist. If the record exists but does not have the AQS checkbox selected, then modifications to the subject data record in the ZSPEntry form will be required to select the AQS checkbox. If a QC Precision test record does not exist, then a nightly automated performance test record (precision level) collected in the same two week time period can be substituted. This is accomplished by selecting the “AQS” checkbox of the substitute record in the ZSPEntry form. QC Precision test records are designated with a “M” and Performance test records are designated with an “A” in the A/M/NP/5Day row. When selecting a substitute record, be sure to pick one that is representative of the entire two week period. Step 5 in this procedure describes how to make changes in the ZSPEntry form.
 - b) Extra records

Review the “Count” column in the Missing Manual Precision Report as developed in Step 3. Counts greater than 1 indicate that multiple QC Precision or Performance tests records exist that have their

AQS checkboxes selected. There is to be only one record for each site and parameter for each time period. Excess records are to have their AQS checkboxes de-selected. This is accomplished by de-selecting the AQS checkboxes of all records that are deemed to be excessive in the ZSPEntry form. Step 5 in this procedure describes how to make changes in the ZSPEntry form.

c) Failing records

Review the “% Diff” column on the Missing Manual Precision Report as developed in Step 3. Values in excess 7% (absolute value) for ozone and 10% (absolute value) for all other parameters are considered to be failing. Review each failing record in the ZSPEntry form and determine if the record is valid and its value is representative of the analyzer at that time. This determination is judgmental and considers factors such as equipment maintenance, performance test trends, atmospheric conditions, internal temperature, calibrations, audits and diagnostic parameters.

If the failing record is determined to be valid, then data surrounding this point, which is bookended by passing Performance tests and/or QC Precision tests, are invalid and are to be appropriately invalidated. If data surrounding the failing QC Precision record is invalid, it means that the failing QC Precision record is no longer representative of any valid data and the failing QC Precision record is to be invalidated and not uploaded to AQS. Within the ZSPEntry form, the invalid record’s “AQS” checkbox is deselected, the “Invalid” checkbox is selected and the “Notes” field is annotated. Only QC Precision records that represent valid data are uploaded to AQS. Documentation is required in the ZSP Notes Tracking Form if a two-week period does not have a valid QC Precision Test because the surrounding data has been invalidated, or is missing for some other reason; or a QC Precision Test record is failing but still deemed valid. Step 6 in this procedure describes how to make a note in the ZSP Notes Tracking Form.

If the failing record is determined to be invalid, then within the ZSPEntry form, the invalid record’s “AQS” checkbox is deselected, the “Invalid” checkbox is selected and the “Notes” field is annotated. If a QC Precision test record has been invalidated, then a nightly automated performance test record (precision level) collected in the same two week time period can be substituted. This is accomplished by selecting the “AQS” checkbox of the substitute record in the ZSPEntry form. QC Precision test records are designated with a “M” and Performance test records are designated with an “A” in the A/M/NP/5Day row. When selecting a substitute record, be sure to pick a record that is representative of the entire two week period. Step 5 in this procedure describes how to make changes in the ZSPEntry form.

5) Changes to QC Precision Test records or Performance Test records can be made from within the ZPSTracking database using the ZSPEntry form.

- a) From the Start Menu (Figure 21), select the “Enter Z/S/P” button next to the Enter Z/S/P Reading label. This opens up the ZSPEntry form (Figure 22).
- b) To make changes to a record, select the site of interest from the Site dropdown box.
- c) Enter the date of interest into the Date text box. Note: The date entered in the Date text box and the 20 most current records prior to this date will be displayed in records fields.
- d) Select the parameter (CO, O₃, NO, NO₂, NO_x, or SO₂) of interest from the Parameter dropdown box. Upon selection of the parameter the database will populate the records fields.
- e) All data record fields are editable except for “Actual (ZC)”, “Indicated (ZC)”, and “%Diff”. To change a field, manually edit the field to the desired value, annotate the “Notes” field for the record of interest explaining the data modification and then select the “Overwrite” button to save the changes.
- f) Repeat these steps to make changes to other data records.

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
 Air Pollution Control Division - Technical Support Program
 Z/S/P Tracking - Data Entry

Show Closed Sites

Date (mm/dd/yy): 10/3/2014

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Figure 23. ZSP Notes Tracking Form

- 7) A zero correction evaluation on all QC Precision Test and Performance Test records is performed during the monthly data validation process. The actual validation and zero correction processes for ambient data are described in Section 7.3. After the zero correction evaluation, data recommend for zero correction is manually documented on the Manual Zero Correction form. Actual zero correction to the data within the data management system are made based upon these recommendations. Further annotation on the Manual Zero Correction form is required when zero correction changes are actually made in the data management system. QC Precision Tests and Performance Tests records are to be treated the same as ambient data. Meaning, if the actual ambient data is zero corrected, then the corresponding QC Precision Tests and/or Performance Tests records are to be zero corrected. Zero Corrections to QC Precision Test and Performance Test records are performed as follows.
- a) Review the Manual Zero Correction form for the month of interest and verify that all zero corrections made to ambient data are appropriate. The Manual Zero Correction form and supporting documents are located in the monthly data package. For each site, parameter, and time period where zero corrections are made in the ambient data, a zero correction is to be made to the corresponding QC Precision Test and/or Performance Test records in the ZSPTracking database.
 - b) Select the “Zero Correction” check box in the main records field on the ZSPEntry form for each record you want zero corrected. Additionally, make a note in the “Notes” field for each record selected for zero correction. Start the note with “ZA” which indicates the following note is in regards to zero correction followed by the amount of zero correction (ppb) that was applied to the ambient data in the central data management system. Be sure to save all record changes by selecting the “Overwrite” button. See Step 5 for a more detail explanation on how to select records and make changes in the ZSPEntry form.
 - c) Document all zero correction changes made on Manual Zero Correction form. Annotate each site/parameter/time period by initialing and adding notes as appropriate.
 - d) Re-generate and print a hardcopy of the Missing Precision Value Report as described in Step 3. File this report with the monthly data package.
 - e) Return the Manual Zero Correction form back to the monthly data package.

7.9 Quality Control Precision Test AQS Upload File Development Procedure – APCD

- 1) Generate the EPA Air Quality Systems Upload File
QC Precision Test records and Performance Test records, that are designated to be uploaded to AQS, are uploaded monthly after the data validation process. Routines built into the ZPSTracking database are used to generate the AQS pipe delimited textstrings that are manually uploaded to the AQS database. The following procedure describes how to generate the AQS pipe delimited textstrings.
 - a) From the StartMenu form within the ZPSTracking database, under the Reports heading, enter the first and the last day of the month you want to generate textstrings for into the “Start Date” and “End Date” text boxes, respectively (Figure 21).
 - b) Under the QC Data Processing heading, select the “All Flags Off” button next to the Set AQS Textstring Flags label. In addition to the “AQS” checkbox field there is another Boolean field in each data record called cbTextstring that must be set true in order to generate an AQS textstring for the record. This field was added to give more flexibility in generating AQS textstrings. By selecting the “All Flags Off” button, all cbTextstring fields will be set to False for all records in the table. This is done to clear any residual flags that may have been left “True” from previous textstring generation requests.
 - c) Under the QC Data Processing heading, select the “All Flags On” button next to the Set AQS Textstring Flags label. This action will set all the cbTextstring Boolean fields “True” for every record that is between the dates entered into the “Start Date” and “End Date” text boxes and has the AQS checkbox set “True”.
 - d) Under the QC Data Processing heading, select the “Generate File” button next to the Generate AQS Textstring File label. A message box popup will indicate the number of records that textstrings generated. Select the “OK” button.
 - e) A File Save dialog box will open and request the name and save location for the text file that will be generated. Save the file on a local or network drive. Name the file using the following convention:
 - f) AQSPAmmyyyy.txt, where *mm*=month (1 to 12) and *yyyy* = year(i.e. 2016). Select the “Save” button.
 - g) A message box popup will indicate the file path of the saved file. Select the “OK” button.
 - h) Another message box will popup when the file has been generated and saved. Select the “OK” button.
 - i) Another message box will popup asking “Do you want to switch all the ‘AQS Textstring Merge Flags’ from True to False. By selecting yes all the cbTextstring Boolean fields will be switched to False. Select “Yes” if you are through generating the textstring file.
- 2) Review the EPA AQS Upload File
Open the AQS textstring file that was just created in a text editor, such as Notepad. Review the textstrings to ensure they are complete and accurate. Verify that one record exists for every criteria pollutant parameter at each site for every two week period. Errors can be corrected in the ZSPEntry form and the textstring file can be regenerated using the above procedure.
- 3) Email the AQS textstring file to the APCD person responsible for the uploading files to AQS.
- 4) Sign-off on the Gaseous Chain of Custody Tracking form located in the monthly data package. Sign and date the two fields labeled “AQS P&A Data File Generated” and “AQS P&A Data File Reviewed”.

7.10 Quality Control Precision Test AQS Upload File Development Procedure – External Data

The GMM unit of the APCD’s Technical Services Program is responsible for the collection and archiving of ambient air monitoring data into the EPA’s Air Quality System (AQS). It also is responsible for the archiving of data into AQS from “external” data sources, e.g., educational institutions conducting research, private entities, and independent contractors collecting ambient air monitoring data under contract with the APCD. Raw Data collected and forwarded to the GMM Unit by these groups in is in a format identical to that obtained and transformed by the GMM Unit from its own monitoring network. While the specific ambient air Raw Data is entered into AQS using the same methodology described in CDPHE QAPP Appendix D6 – Air Quality System, precision data provided by these groups/contractors is handled somewhat differently due to the methods they have independently developed to generate the precision data from their monitors.

As an example, this section will demonstrate how precision data submitted by an external source is received, amended, and entered into AQS to avoid creating an “overall system bias” due to excessive precision values generated for a particular site. The following example will follow quarterly precision records received from an external source, in this case a contractor, from their receipt by the GMM Unit to their ultimate posting to the AQS database.

Approximately 1-2 months after the end of a quarter, the contractor will send a “pipe-delimited” text string file of all precision data collected from the ozone site operated in Colorado. The example shown below is for Quarter 3, 2014:

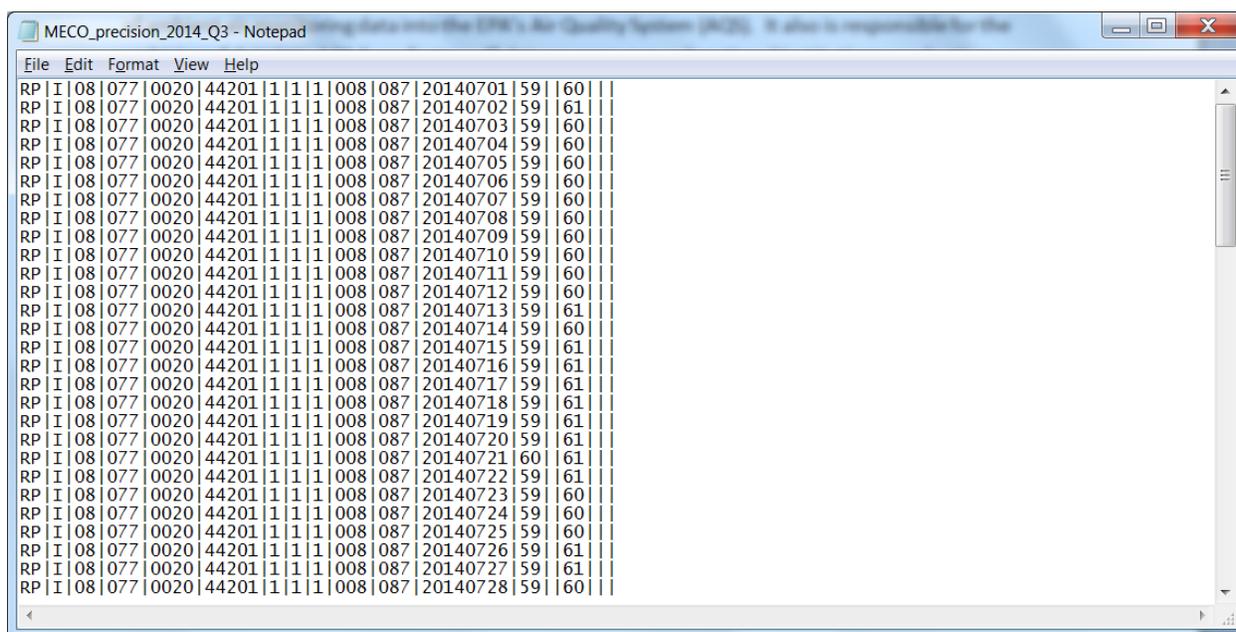


Figure 24. Pipe-delimited AQS Text Example

It is obvious that a Precision test is run nightly. If all of this precision data were to be entered into AQS, an end of year analysis of the precision of all ozone sites in the APCD network would be heavily “weighted” or biased towards the ozone sites where more than one precision record for each two-week span throughout the year. Limited resources and contractual reasons prevents the contractor from sending a technician to the site once every two weeks to perform a Manual Precision test, so the solution is to “thin” or cull records from this file. This needs to be done in a way that is “random”, yet performed in a logical manner so that a file with approximately one record for given two week spans will be created, and this “thinned” file can be submitted for archive in AQS.

Selecting one “overnight” precision record every 12 days will create a “thinned” file where each record will represent a different day of the week. To be truly random, one of the first six days in a quarter must be selected “randomly” to begin the selection of a precision record every 12 days in the quarter. The following link is used to select the first overnight precision record:

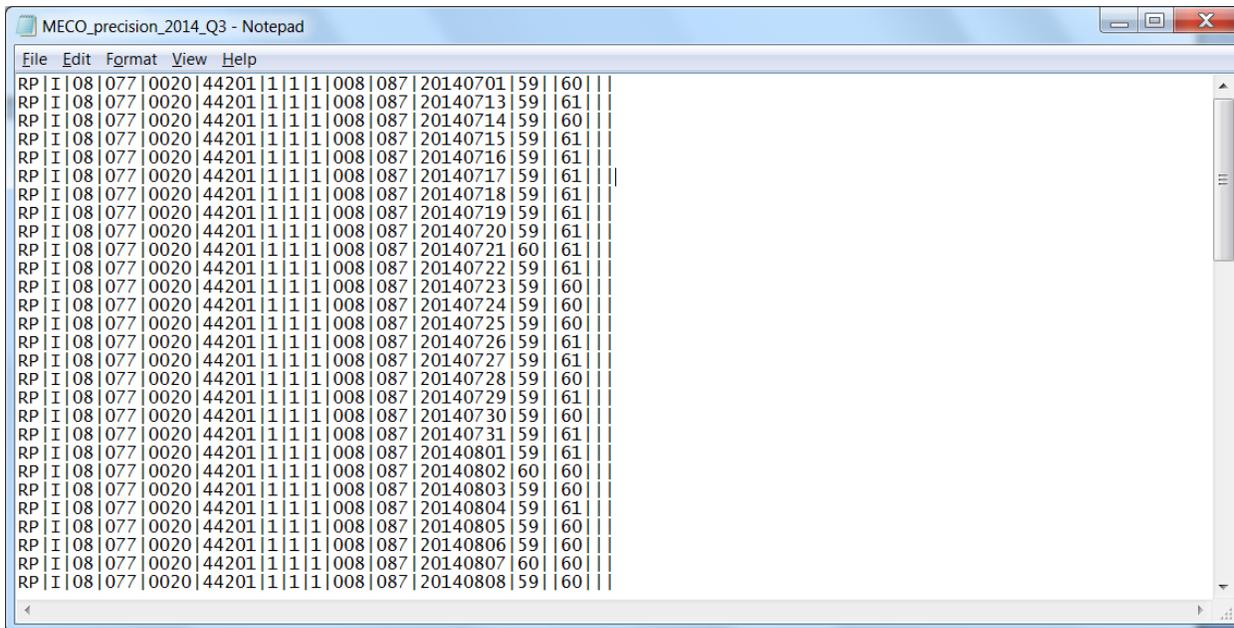
<http://www.random.org/>

Clicking the above link connects the operator with the RANDOM.ORG site homepage:

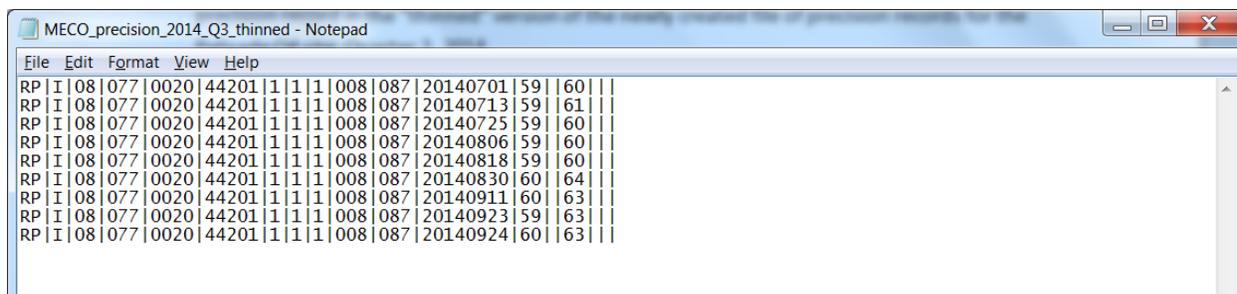


On the RANDOM.ORG homepage there is a box on the upper right side of the homepage labeled, “True Random Number Generator”. There are two fields in this True Random Number generator, “Min:” and “Max:”. The example here will use a Min=1 and a Max=6. With those values entered into the appropriate fields the “Generate” button is clicked, and in this particular instance, the result is “1”. Precision record number 1, generated on 7/1/2014 will be the first precision record in the “thinned” version of the newly created file of precision records for the Colorado site, Quarter 3, 2014.

Returning to the text file of quarterly precision records, the next eleven records following 7/1/2014 are “blocked and deleted”, resulting in the precision record for 7/13/2014 becoming precision record 2 in the newly developing “thinned” precision text file:



This process is repeated—the next record, 3, will be selected from the record corresponding to “12 days from 7/13/2014”, this would be the precision record for 7/25/2014, and all records in between record 2 and record 3 will be deleted. Ultimately the precision record text file will look like the following:



```

MECO_precision_2014_Q3_thinned - Notepad
File Edit Format View Help
RP|I|08|077|0020|44201|1|1|1|008|087|20140701|59|60|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140713|59|61|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140725|59|60|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140806|59|60|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140818|59|60|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140830|60|64|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140911|60|63|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140923|59|63|||
RP|I|08|077|0020|44201|1|1|1|008|087|20140924|60|63|||

```

The file has been saved as **MECO_precision_2014_Q3_thinned.txt** to indicate it has had most of its records purged. This is the file that will be submitted to AQS to represent the Precision tests performed at two-week intervals during Quarter 3, 2014 at the Colorado ozone site.

The example discussed thus far was fairly straightforward as each day in the quarter had a precision value associated with it. There are certainly going to be situations where, due to any number of circumstances, where data, including automated precision results, is going to go “missing”. In such situations, a consecutive precision record may not necessarily be “the following 12th day”. In circumstances such as this, the “next available” valid precision value generated at a site will become the next consecutive precision record, and the 12th consecutive day process will commence once again. This process of selecting appropriate days for the inclusion of a specific precision value may become tedious without the aid of a suitable calendar. The following links provide very useful calendars created by EPA to show 3-day, 6-day, and 12-day intervals for the years 2014 and 2015:

http://www.epa.gov/ttn/amtic/files/ambient/pm25/calendar_2014.pdf

http://www.epa.gov/ttn/amtic/files/ambient/pm25/calendar_2015.pdf

8 YEARLY – DATA EVALUATIONS AND DATA PROCESSING PROCEDURES

8.1 Annual Data Certification Procedure

All criteria pollutant ambient data is reviewed annually during the annual data certification process. This process is federally required by EPA and is described in 40 CFR 58.15. The certification letter and annual summary reports are required to be delivered to the Administrator, through the Regional Office, by July 1, for all air quality data collected between January 1 and December 31 of the previous year at all SLAMS and SPM stations using FRM, FEM or ARMs. The data certification process is a formality that acknowledges to EPA that the previous years of ambient concentration and quality assurance data are completely submitted to AQS and that the ambient concentration data are accurate to the best of the signee’s knowledge. Procedures for data review process, generation of the annual summary reports and certification letter are described in the CDPHE QAPP Appendix D4.

9 REFERENCES

US EPA. (2002, November). Guidance on Environmental Data Verification and Data Validation. *EPA/240/R-02/004*. Washington D.C.: US EPA.

US EPA. (2007). *Guidance for Preparing Standard Operating Procedures*. Research Triangle Park, NC: US EPA OAQPS AQAD.

