



# Quality Assurance Project Plan for Summer 2024 Tri-Cities and Yakima Mobile Ozone Study

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By

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For the

**Air Quality Program**

Washington State Department of Ecology  
Olympia, Washington

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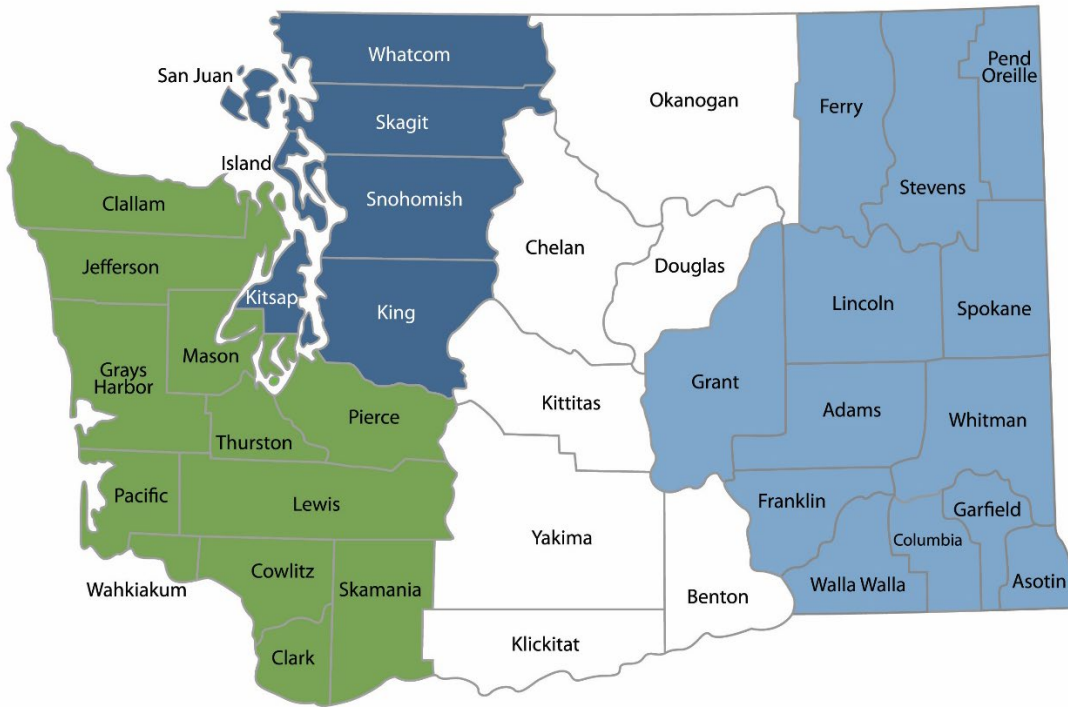
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# Department of Ecology's Regional Offices

## Map of Counties Served



<b>Southwest Region</b> 360-407-6300	<b>Northwest Region</b> 206-594-0000	<b>Central Region</b> 509-575-2490	<b>Eastern Region</b> 509-329-3400
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Region	Counties served	Mailing Address	Phone
<b>Southwest</b>	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	PO Box 47775 Olympia, WA 98504	360-407-6300
<b>Northwest</b>	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline, WA 98133	206-594-0000
<b>Central</b>	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
<b>Eastern</b>	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
<b>Headquarters</b>	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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Washington State Department of Ecology  
Olympia, WA

**June 2024 | Publication 24-02-012**



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

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## Acronyms and Abbreviations

ARP	Air Resource Program
AQP	Air Quality Program
CRO	Ecology Central Regional Office
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
MQO	Measurement Quality Objective
NAAQS	National Ambient Air Quality Standards
POM	2B Technologies Personal Ozone Monitor
ppb	Parts per billion
QA	Quality Assurance
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
SOP	Standard operating procedure



# 1. Project Description

Ground-level ozone is a criteria air pollutant regulated by the EPA under the Clean Air Act. It forms when nitrogen oxides and volatile organic compounds react together in the presence of sunlight. While ozone in the upper atmosphere protects from solar radiation, ground-level ozone adversely affects the respiratory system and can harm the environment (EPA ISA 2020).

In 2015, EPA lowered the 8-hour National Ambient Air Quality Standard (NAAQS) for ozone to 70 ppb by volume (85 FR 87256, 2020). Compliance with NAAQS is determined using a formula specific to each pollutant and averaging period called a design value. The form of the NAAQS for ozone is the 3-year average of the annual 4<sup>th</sup> highest Maximum Daily 8-hour average. The NAAQS are attained if this value is 70 ppb or below (40 C.F.R § 50.4, 2015).

Ecology monitors ozone at 13 sites across Washington, including Kennewick in the Tri-Cities region. When the population of the Tri-Cities reaches 350,000 people, which is expected by 2030, two ozone monitors will be federally required in the Kennewick-Richland, WA Metropolitan Statistical Area. Ecology does not monitor ozone in or near Yakima, but some community members have raised concerns about ground-level ozone in the Yakima region.

This study is supported by an EPA grant awarded under the American Rescue Plan (ARP) Direct Award for Continuous Monitoring of PM<sub>2.5</sub> and Other NAAQS Air Pollutants. The grant provided funding for two monitors, which will be deployed to the Tri-Cities area and Yakima.

This study aims to improve understating of ozone concentrations in these areas with distinct goals for each location:

1. **Tri-Cities:** Identify best location for a permanent ozone monitoring station
2. **Yakima:** Establish an understanding of baseline of ozone levels using the existing monitoring site on 4<sup>th</sup> Avenue

In the Tri-Cities, concentrations will be measured during peak ozone hours for four days over a three-week period. A total of eight locations will be monitored, with each measurement being the average concentration over a 15-minute period. In Yakima, concentrations will be measured at a single location continuously throughout the same three-week period.

## 1.1. Project Schedule

Table 1: Project timeline

Task Description	Complete By
Purchase monitors	September 2022
Complete Quality Assurance Project Plan	April 30 <sup>th</sup> 2024
Train CRO operators on equipment	April 30 <sup>th</sup> 2024
Mobile Ozone Study window	July 22 <sup>nd</sup> - Aug. 9 <sup>th</sup> 2024
Submit final report	September 30 <sup>th</sup> 2024

## 1.2. Personnel

Operations will be conducted by Department of Ecology personnel. Operators from Central Regional Office will lead the completion of project tasks, including installation and operation of the monitoring equipment. Support will be provided by staff in Ecology's Calibration and Repair Laboratory and Quality Assurance personnel. All team members will contribute to quality assurance and quality control, data analysis, and reporting.

## 1.3. Budget

In agreement with the ARP grant, Ecology used \$10,000 to purchase two 2B Technologies Personal Ozone Monitors (POMs).

## 1.4. Sample process design

### 1.4.1. Study locations

Sampling will be conducted at seven locations across the Tri-Cities area: Benton County Fairgrounds, Columbia Basin College, Columbia High School, Highland Park, Pasco Sporting Complex, River View High School, and Washington State University Tri-Cities. The location of these sites is shown in Figure 1.

Additionally, sampling will be conducted at the Benton Clean Air Agency (BCAA) headquarters, where an existing ozone monitor is operated. This will allow for a comparison of data collected by the POMs to the permanent FEM ozone monitor and will be used to estimate bias of the instruments.

Sampling in Yakima will be conducted near the existing PM<sub>2.5</sub> and PM<sub>10</sub> monitors at the Yakima Regional Clean Air Agency's Yakima-4<sup>th</sup> Ave S air quality monitoring station.

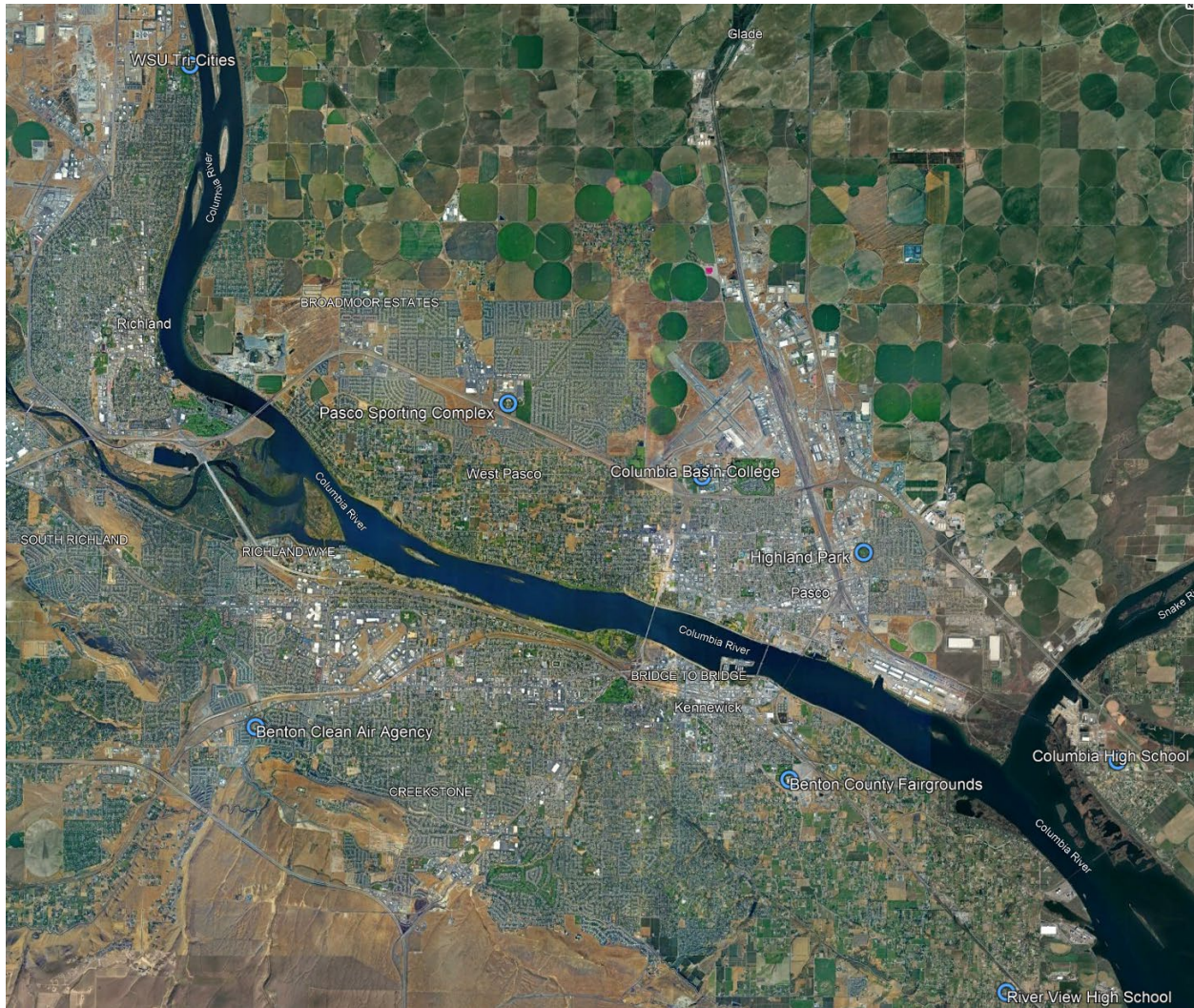


Figure 1: Tri-Cities sampling locations

### 1.4.2. Sampling Schedule

Sampling will be conducted during peak ozone concentrations four days over the three-week study. Previous studies indicate that the window for peak ozone in the Tri-Cities afternoon between 1:00 and 5:30 PM PST. The order of site sampling will be rotated to capture a range of hours at each location. Operators and the Air Monitoring Coordinator will work with Ecology forecasters to identify days for sampling when elevated ozone is expected based on weather and air quality forecasts.

Operators will drive from CRO to each of the 8 sampling locations and measure for 10-15 minutes at each site. While the instrument adjusts to ambient concentrations quickly, sampling should be conducted for a minimum of 10 minutes to ensure the instrument has sufficient time to stabilize. After parking and turning off the vehicle, a PVC pipe will be raised out of the vehicle window to serve as an air inlet.

If all eight sites cannot be completed in a day, two sites have been identified as the lowest priority, due to their proximity to other sampling sites: Columbia Basin College and BCAA Office.

Ideally operators will sample at the BCAA office at least two sampling days for comparison with the permanent monitor located at this office.

### 1.4.3. Instrumentation

The POM is shown in Figure 2 below.



Figure 2: 2B Technologies POM

When not actively sampling, the Tri-Cities POM will be housed at the CRO along with a transfer standard and data logger to conduct automated calibrations and store data. The Yakima location is already equipped with a transfer standard and data logger.

The POMs will be operated according to the Operation Manual (2B Technologies, 2014), as well as Ecology's SOP for ozone monitoring (Publication 17-02-012).

## 2. Data Quality Objectives and Criteria for Measurement Data

This study adheres to QA practices outlined in the EPA Quality Assurance Handbook (EPA-454/B-18-006) and Ecology’s Air Monitoring Quality Assurance Plan (Publication 99-201) to ensure that data collected is of appropriate type and known quality.

### 2.1. Measurement quality objectives

Information collected during any study comes with some uncertainty. To minimize and control uncertainties and errors, specific Measurement Quality Objectives (MQOs) have been defined for the following parameters:

- **Accuracy:** how close a dataset is to the true value
- **Precision:** reproducibility of a dataset
- **Representativeness:** how characteristic a dataset is of a population
- **Completeness:** the of valid data obtained, as a percent. For this study, both 75% of all sites must be included during a sample day, and 75% of recorded data must be valid.
- **Bias:** the difference between a measured (indicated) and “true” (actual) value.

Each MQO, its acceptance criteria, and corrective actions to be taken if criteria are exceeded is listed in Table 2. Acceptance criteria are the same as those listed in Ecology’s Ozone Standard Operating Procedure (Publication 17-02-012). Further discussion of specific parameters follows.

Table 2: Measurement Quality Indicators

MQO	Data Quality Indicator	Acceptance Criteria	Corrective Action
Accuracy of Transfer Standard	Compare transfer standard against primary ozone standard before and after study period	± 2%	Investigate, repair, and re-verify instrument. If necessary, replace Tri-Cities POM with Yakima POM
Precision	Compare against known ozone transfer standard at concentration of 0 ppb	± 3ppb	Investigate, repair, and re-verify instrument. If necessary, replace Tri-Cities POM with Yakima POM
Precision	Compare against known ozone transfer standard at concentrations of 75 and 110 ppb	± 7%	Investigate, repair, and re-verify instrument. If necessary, replace Tri-Cities POM with Yakima POM
Completeness	Percent of sites sampled in one sampling day	75%	Decision makers decide if they have enough data
Completeness	Percent of valid data out of total expected data	75%	Decision makers decide if they have enough data

## **2.2. Representativeness**

To ensure that data collected are representative of ozone concentrations across the Tri-Cities area, sampling will be conducted at multiple locations, over multiple days across a three-week period, and multiple hours within the peak ozone period of 1:00 to 5:30 PM PST to measure during a wide range of conditions.

## **2.3. Completeness**

A data set representing one full sampling day (with all intended stops) will be considered useable for analysis if at least 75% of the established sites are sampled and at least 75% of the expected data for that day meet all other quality control criteria.

Data loss is unavoidable due to many unexpected and unplanned interruptions, therefore the POM used in Yakima will be the backup if necessary to continue the Tri-Cities study if equipment malfunctions.

## **2.4. Bias**

Bias will be determined at the end of the study by comparing the Tri-Cities data sets at each location with the permanent Kennewick ozone station. Calculating bias of the POM will help understanding of measured values and improve decision making.

## 3. Data Generation and Acquisition

### 3.1. Quality Control Requirements

QC procedures will include both automated and manual QC checks at regular intervals throughout the study period. All QC checks must be triggered through Envidas Ultimate on the data logger to ensure Ecology captures the results. This ensures consistency in implementation and allows for comparison between the datasets.

The standalone ozone analyzers (used as a point of comparison) will continue to run regularly scheduled automated QC checks bi-weekly. These checks are typically scheduled for early morning when pollution concentrations are lowest. These tests include zero, precision, and span points, as described in the Ozone Monitoring SOP (2020).

Manual QC checks will be conducted on each POM:

- By the Calibration and Repair Lab before deployment
- By Operators at the start of every sampling day
- By the Operators at the end of every sampling day, if sampling is not forecast for the following day

Operators must notify the Calibration and Repair Lab as soon as possible if any verifications are outside of the precision acceptance criteria (7%). The cause of the problem must be explored and corrected before monitoring continues.

The identification of a site in the Tri-Cities area is the main priority. Therefore, if the POM assigned to the Tri-Cities is not operating well, the Monitoring Coordinator and Operators can decide to use the Yakima POM to complete sampling in the Tri-Cities.

#### 3.1.1. Calibration Standards for Ozone

The reliability of the data collected from any analytical instrument depends on the accuracy of its calibration, which is largely dependent upon its analytical traceability to a reference material or reference instrument. Since ozone is unstable, it cannot be stored long-term. Therefore, it must be generated on site to for use in calibration and verification of monitors.

Ozone standards can be classified into two basic types:

- **Primary Ozone Standard:** A combination of an ozone generator and monitor based on UV absorbance. The setup follows EPA guidelines in Title 40, Part 50, Appendix D.
- **Ozone Transfer Standard:** Produces accurate ozone concentrations related to the primary standard. Certification is required per EPA procedures in Title 40, Part 50, Appendix D.

For this study, a multipoint calibration will be performed before beginning the study, any time major disassembly of components is performed, or any time the zero or span checks give results outside of the acceptable limits. The instrument may be returned to the Calibration Lab at Ecology or to 2B Technologies for calibration service.

### 3.1.2. Multipoint Performance Audit

Ecology QA personnel will visit both the Tri-Cities and Yakima to audit each POM with their independent ozone transfer standard. Test concentrations will be simultaneously measured by the QA standard and the monitoring station's analyzer. After stable readings are achieved at given test levels, the responses of the station analyzer are compared against the output of the QA standard. The audit (“actual” or “assessment”) concentration and the corresponding analyzer (“indicated” or “monitor”) response must be within acceptance limits ( $\pm 3$ ppb for zero,  $\pm 15\%$  for precision checks) as defined in the CFR (for FRM/FEMs) and Washington Network SOPs. Audit results outside of acceptable limits are investigated by QA personnel in coordination with station operators to determine validity of results.

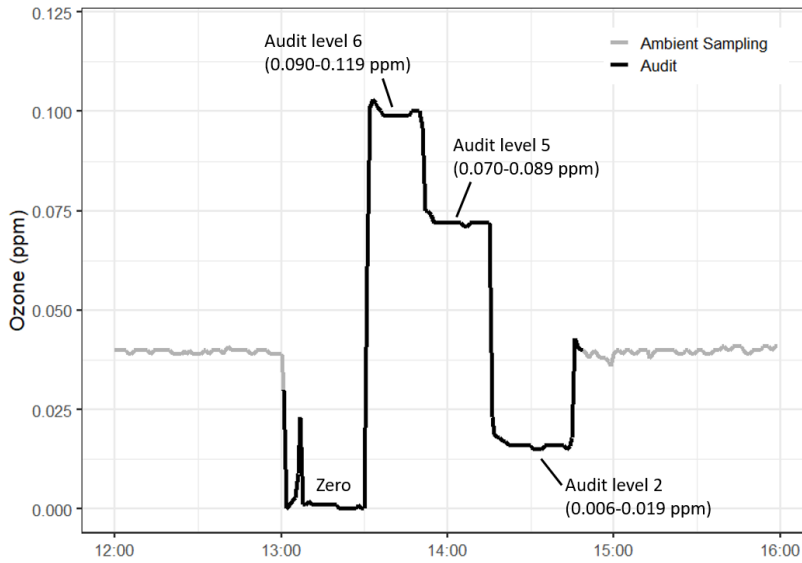


Figure 3: Example of an ozone performance audit



## 4. Data Management

### 4.1. Data Collection

Ozone concentrations will be measured by Operators using a POM at each sampling location during periods of peak ozone concentration. Based on previous peak ozone days in Kennewick, the median window of time for peak ozone is between 1:00 and 5:30 PM PST. Operators will hover at each location for 10-15 minutes to obtain stable averages.

### 4.2. Data retrieval from POM

To retrieve stored data from the POM, operators will connect it to a laptop with 2B Technologies Display and Graphing Software installed. The POMs have internal storage that can be used as back up to ensure data retrieval post sampling day.

### 4.3. Documentation and records

All records produced during this study will be retained by Ecology under standard records retention laws. Data collected will be uploaded to the AQP's database, and QC forms will be saved on the QA server. Ecology will write a final report to be displayed on Ecology's public website. The report will contain the collected data, observations, analysis, and recommendations for decision makers. Any deviations from this plan will be documented.

### 4.4. Data review and usability

Data quality assessment will be conducted by Ecology QA personnel. They will evaluate monitoring data accuracy, precision, bias, representativeness, and completeness as defined in section 2 of this QAPP. Any measurement data failing the data quality assessment will be flagged as invalid in the raw data file and excluded from reporting and analysis. Any data invalidation will follow the Ozone Monitoring Standard Operating Procedure (2020).

## References

2B Technologies Inc. *Personal Ozone Monitor Model POM Operation Manual, Revision C*, February 2014.

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Washington State Department of Ecology. Air Quality Program. *Ambient Air Monitoring Quality Assurance Plan*, Lacey WA 2021 (Publication 99-201)

Washington State Department of Ecology. Air Quality Program. *Ozone (O3) Monitoring Standard Operating Procedure*, Lacey, 2020 (Publication 17-02-012)

Washington State University. Department of Civil & Environmental Engineering. *The Tri-Cities Ozone Precursor (T-COPS)*, WA 2017

# Appendix A: Ozone Quality Control Check form

## Washington State Department of Ecology Ozone Quality Control Check Form

Revised 03292022

AQS No \_\_\_\_\_  
Location \_\_\_\_\_

Date \_\_\_\_\_  
Operator \_\_\_\_\_

Analyzer Serial No \_\_\_\_\_  
Analyzer State Tag \_\_\_\_\_

Calibrator Serial No \_\_\_\_\_  
Calibrator State Tag \_\_\_\_\_

Probe Last Cleaned \_\_\_\_\_  
Ambient Pressure \_\_\_\_\_ mmHg  
Pressure Standard S/N \_\_\_\_\_  
Standard Calibration Date \_\_\_\_\_

QC Start Time \_\_\_\_\_ PST  
QC Stop Time \_\_\_\_\_ PST

**Analyzer Calibration Factor:**

Slope	_____	Offset	_____
-------	-------	--------	-------

**Conditions since last QC:**

Min Room Temp \_\_\_\_\_ °F  
Max Room Temp \_\_\_\_\_ °F  
Shelter Temp Probe \_\_\_\_\_  
Last Verified \_\_\_\_\_

Any failed QCs? \_\_\_\_\_  
Diagnostics normal\*? \_\_\_\_\_  
\*within normal range per Ozone SOP. If No, specify below.

**Diagnostics during QC:**

Photo/O3 Ref (mV) \_\_\_\_\_  
Sample Pressure (inHg-A) \_\_\_\_\_  
Output Flow (lpm) \_\_\_\_\_  
Photo/Sample Flow (ccm) \_\_\_\_\_

Calibrator	Analyzer	Range
_____	_____	[3000 - 4800]
_____	_____	Enter Ambient Pressure
_____	---	[3.0 - 4.0]
_____	_____	800 ± 10% **

**Multipoint QC Point Results:**

Report Time: \_\_\_\_\_ PST

Target	Actual (Calibrator)	Indicated (Analyzer)	Difference	Acceptance Limits	Results
0	_____	_____	_____	± 3 ppb	_____
70	_____	_____	_____	± 7%	_____
150	_____	_____	_____	± 7%	_____

**Post-Filter Change Results:**

Filter Changed? \_\_\_\_\_

Target	Actual	Indicated	Difference	Acceptance Limits	Results
150	_____	_____	_____	± 7%	_____

**Notes:**

\*\* Sample flow rate should be measured volumetrically at local T & P conditions (EQQA-0992-087).