DLZ
ARCHITECTURE • ENGINEERING • PLANNING
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INNOVATIVE IDEAS
EXCEPTIONAL DESIGN
UNMATCHED CLIENT SERVICE

October 17, 2022

Ms. Donna Rice
City of Detroit
Detroit Building Authority
500 Griswold, Suite 200
Detroit, Michigan 48226

RE: Ambient Air Quality Monitoring – Baseline Ambient Monitoring Report
Proposed Department of Transportation (DDOT) Transit Center
Detroit, Michigan
Project No. 2142726100

Dear Ms. Rice:

The City of Detroit Department of Transportation (DDOT) recently completed a property transaction for a new Transit Center to be constructed on Parcel D of the former Michigan State Fairgrounds located at 8 Mile Road and Woodward Avenue in Detroit, Michigan. The City contracted DLZ Michigan, Inc. to conduct ambient air quality monitoring at the proposed Detroit Department of Transportation (DDOT) Transit Center site (Site).

The monitoring program consists of siting localized monitors at an upwind and downwind locations to measure concentrations of particulate matter (PM_{10} and $PM_{2.5}$), nitrogen oxide (NOx, as NO_2), and volatile organic compounds (VOCs), and evaluate air quality from the Site during three (3) distinct phases:

- Pre-development baseline period
- Construction phase
- Post-construction facility operation

Pre-Development Baseline Period (Completed)

DLZ's Baseline Monitoring Report, dated September 14, 2022, presented ambient concentrations prior to significant construction activities at the Site. The baseline period included monitoring data collected by Montrose Air Quality Services, LLC (MAQS), from July 8, 2022 through July 22, 2022, and was supplemented with monitoring data collected by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) from July 8, 2022 through July 22, 2022. The purpose of the Baseline Monitoring Report was to establish an ambient background concentration for each pollutant and use that concentration as a baseline whereas concentrations measured above these levels during construction would trigger the contractor to employ additional mitigation efforts to reduce pollutant concentrations.

Preconstruction Monitoring

The enclosed report presents the results of the Baseline Ambient Monitoring event that was conducted for the two (2)-weeks period of July 8, 2021 through July 22, 2021. The goal of Baseline Ambient monitoring is to collect concentration data of target air pollutants during preconstruction activities consisting of concrete work, steel construction, roofing, interior buildout, electrical work, and plumbing to assess whether additional mitigation efforts are warranted to reduce pollutant concentrations to below baseline levels. Demolition and backfilling of areas were the foundations were removed.

The enclosed Baseline Ambient Monitoring Report describes the monitoring program, objectives, Site overview, monitor locations and equipment, monitoring results, and an overview of data quality assurance.

The report includes monitoring data from two (2) available sources, including:

- Two (2) Site monitors operated by MAQS for DLZ during the monitoring period (July 8, 2022 through July 22, 2022) and identified as Unit 1838 (upwind location) and Unit 1839 (downwind location).

- Nearby off-site monitors operated by Michigan Department of Environment, Great Lakes, and Energy (EGLE) during the MAQS monitoring period.

As part of this air monitoring program, MAQS collected two (2) weeks of air monitoring data for NOx (as NO_2), PM_{10} and $PM_{2.5}$, and VOCs at two (2) monitors, along with prevailing wind directions and speeds (vectors).

The City anticipates that development of the proposed DDOT Transit Center may result in direct and fugitive air emissions from construction activities, as well as future operations. Sources of NOx and VOC emissions related to construction may include vehicular traffic and diesel engines (over-the-road and non-road heavy duty construction). Potential emissions of PM_{10} and $PM_{2.5}$ related to construction may include fugitive dust associated with vehicular traffic, soil handling, material storage piles, concrete batching, and abrasives blasting.

The monitors, designated as Unit 1838 and Unit 1839, were located on opposite sides of the Site and both stations are configured to collect pollutant and meteorological data. The upwind monitor (Unit 1838) measures pollutant concentrations that have not blown across the Site and should be free from potential impacts of on-site development activity and is representative of local area background concentrations.

Results of Preconstruction Monitoring

As presented below and in the enclosed report, for monitoring conducted July 8 through July 22, 2022, concentrations of PM_{10}, $PM_{2.5}$, NO_x (as NO_2) and VOC from the on-site monitors are establishing their baseline concentrations, as summarized in Table 2. NO_x (as NO_2) concentrations are less than the 1-hour NAAQS of 100 ppb for NO_2.[1] Monitored concentrations of PM_{10}, $PM_{2.5}$ are also less than the 24-hour NAAQS of 150 µg/m^3 for PM_{10}, 35 µg/m^3 for $PM_{2.5}$.

Table 2 – Summary of Air Monitoring from July 8 through July 22, 2022

Pollutant	Maximum Concentration	Monitor	Date of Maximum Concentration	Baseline Concentration	NAAQS	Units
PM_{10}	17	Unit 1839	7-9-2022	NA	150	µg/m3
$PM_{2.5}$	4	Unit 1839	7-9-2022	NA	35	µg/m3
NO_2	22	Unit 1838	7-15-2022	NA	100	ppb
VOC	0.03	Unit 1839	7-15-2022	NA	NA[2]	ppm

[1] Baseline Monitoring included two (2) Site monitors operated by MAQS for DLZ from July 8, 2022 through July 22, 2022 and identified as Unit 1838 (upwind location) and Unit 1839 (downwind location), as well as monitoring data provided by Michigan Department of Environment, Great Lakes, and Energy (EGLE).

[2] NAAQS have not been established for VOC. VOCs are considered precursors to the formation of ozone. Ozone is formed downwind by photochemical reaction of NOx and VOCs in certain ambient conditions (typically hot, sunny weather)

In summary, the data collected during this air monitoring event are not indicative of a threat to public health or unusual concentrations of the analyzed parameters.

We appreciate this opportunity to be of service to you. If you have questions or need additional information, please contact us at 248-727-7083.

Sincerely,

DLZ Michigan, Inc.

Dor'Mario Brown
Division Manager

DB/tn

Attachments

[1] NAAQS have not been established for VOC. VOCs are considered precursors to the formation of ozone. Ozone is formed downwind by photochemical reaction of NOx and VOCs in certain ambient conditions (typically hot, sunny weather).

BASELINE AMBIENT MONITORING REPORT 2021
DDOT TRANSIT CENTER AT FORMER MICHIGAN STATE FAIRGROUNDS
DETROIT, MICHIGAN

Prepared For:
DLZ Michigan, Inc.
607 Shelby St. Suite 650
Detroit, MI 48226

Prepared By:
Montrose Air Quality Services, LLC
45 U.S. 46, Suite 601
Pine Brook, NJ
07058

4949 Fernlee Avenue
Royal Oak, MI 48073

Document Number: **027AA-016697-RT-13**
Monitoring Period: **July 8 through July 22, 2022**
Submittal Date: **9/14/2022**

ACCREDITED TO ASTM D7036 ONLY CERT #3925.01

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Project Overview

Background

DLZ Michigan, Inc. (DLZ) has retained Montrose Air Quality Services, LLC (Montrose) to conduct an ambient air monitoring program in support of the planned Detroit Department of Transportation (DDOT) Transit Center to be constructed on Parcel D of the former Michigan State Fairgrounds located at 8 Mile Road and Woodward Avenue in Detroit, Michigan. The monitoring program will collect continuous measurement data for a mixture of pollutants that may originate from construction activities at the site as well as vehicular traffic, diesel engines, surface attrition, dust emissions and future site operations.

This report includes data from monitors operated by Montrose and Michigan Department of Environment, Great Lakes, and Energy (EGLE) during the baseline monitoring period (July 8, 2022 through July 22, 2022).

Objectives

The specific objectives are to measure ambient concentrations of the following parameters at two (2) monitoring locations:

- Particulate Matter (PM_{10}) of diameter less than 10 microns
- Particulate Matter ($PM_{2.5}$) of diameter less than 2.5 microns
- Nitrogen Dioxide (NO_2)
- Volatile Organic Compounds (VOC)
- Meteorological parameters (wind speed, wind direction, temperature, relative humidity, and barometric pressure) at two (2) monitoring locations

Potential Sources

Sources of NO_x and VOC emissions related to construction include vehicular traffic and diesel engines (over-the-road and non-road heavy duty construction). Potential emissions of PM_{10} and $PM_{2.5}$ related to construction may include fugitive dust associated with vehicular traffic, soil handling, material storage piles, concrete batching, and abrasives blasting.

Operational Staff and Contacts

Facility Information

Monitoring Location: Construction site of planned DDOT Transit Center
former Michigan State Fairgrounds
1120 W. State Fair Avenue
Detroit, MI 48203

Monitoring Program Coordinator

DLZ Michigan, Inc.
607 Shelby St., Suite 650
Detroit, MI 48226

Project Contacts: Mr. Dor'Mario Brown
Role: Division Manager
Company: DLZ Michigan, Inc.
Telephone: 313-383-3216
Email: dbrown@dlz.com

Monitoring Team Contact Information

Testing Firm: Montrose Air Quality Services, LLC (Montrose)

Contact:	David Cummings	Darrin Barton
Title:	District Manager	Sr. Project Manager
Telephone:	201-213-2913	512-656-6455
Email:	dcummings@montrose-env.com	dabarton@montrose-env.com

Kevin Ruggiero
Sr. Project Manager
973-417-6487
kruggiero@montrose-env.com

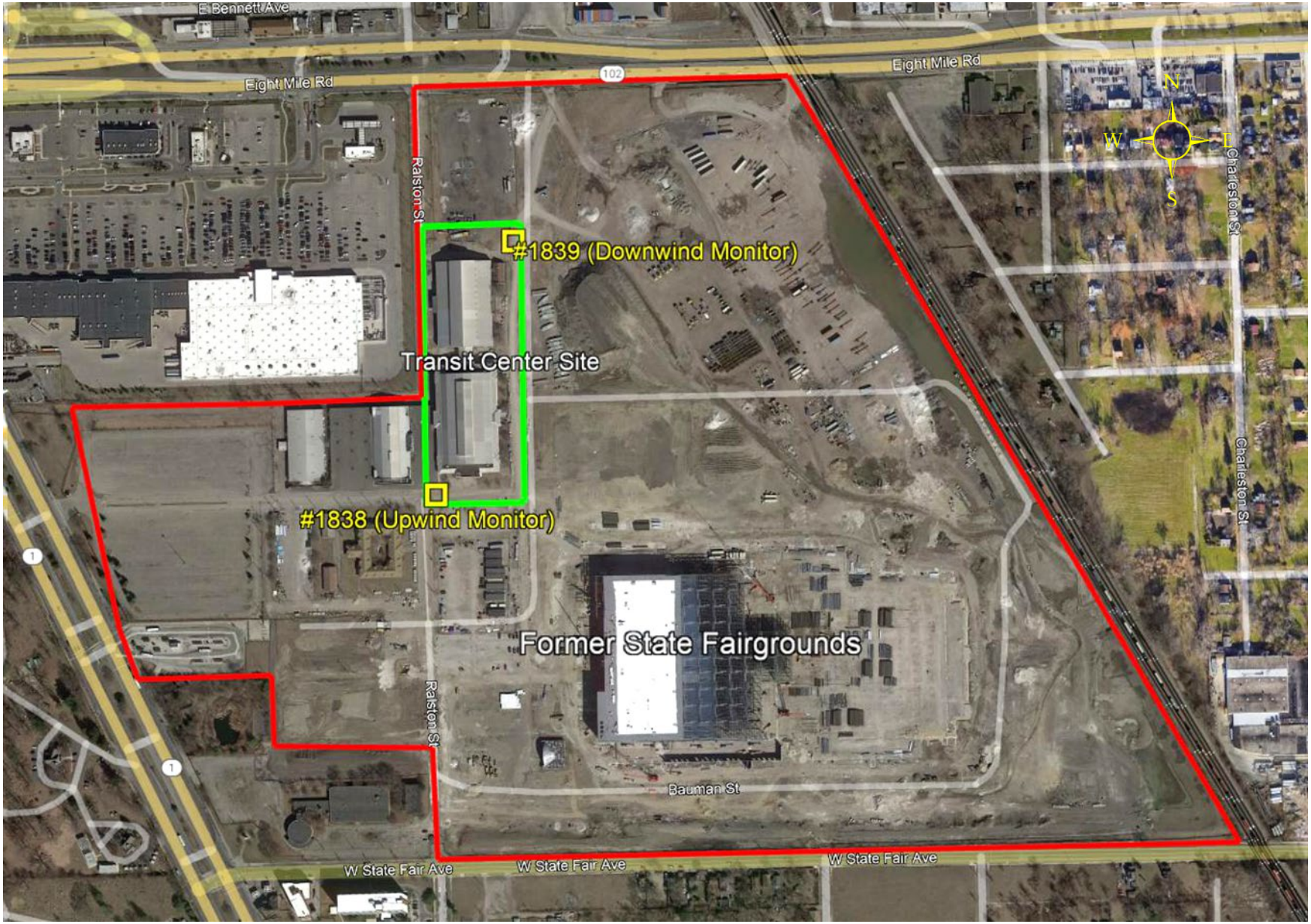
Jeffrey Peitzsch
Shop Coordinator
313-213-4816
jbpeitzsch@montrose-env.com

Linda Quigley
Senior Reporting QC Specialist
973-575-2555 (Ext. 12707)
lquigley@montrose-env.com

Site Overview

The air quality monitoring is performed at the site of the proposed DDOT Transit Center (former Michigan State Fairgrounds) property located at 1120 W State Fair Avenue in Detroit, MI. The existing site contains historically significant buildings: the 1924 Coliseum, the 1926 Dairy Cattle Building and the adjacent Agricultural Building. These structures may be retained or reused for the Transit Center. Other structures onsite in this area will be demolished and re-used to build a new DDOT Transit Center. Figure 1 presents an aerial view of the Site showing the DDOT Transit Center construction site and locations of the upwind and downwind air quality monitors.

Figure 1 – Monitor Locations at the DDOT Transit Center Construction Site



Monitoring Equipment

Air monitoring at the proposed DDOT Transit Center (former Michigan State Fairgrounds) is performed using an AQS-1 Urban Air Quality Monitor manufactured by Aeroqual. The compact size of the AQS-1 monitor makes it viable for a changing construction site where the monitor equipment may need to be removed and re-deployed during monitoring campaigns. Air monitoring is conducted for the parameters listed in Table 1.

Table 1 - Pollutants Monitored

Air Pollutant/Parameter Category	Principle of Operation
PM_{10} and $PM_{2.5}$	Laser Scattering interferometry with particle counting
NO_2	Electrochemical
VOC	Photoionization
Wind Speed, Wind Direction, Temperature, Relative Humidity, Barometric Pressure	Sonic Anemometer and Various

The AQS-1 integrates all measurement detectors, sample pump, flow controllers, signal processing, data acquisition and data transmission components within a compact, weatherproof enclosure. The AQS-1 features separate, dedicated sample air inlets configured specifically for the measurement of particulate matter (i.e., PM_{10} and $PM_{2.5}$) and gaseous pollutants (i.e., NO_2 and VOC). An internal sample pump and flow controllers regulate and maintain stable, optimal flow rates of ambient air though each sample inlet. The sample air streams are directed to the various detection and measurement modules housed within the instrument. Each AQS monitor is powered in the field by deep-cycle batteries charged via solar photovoltaic panels and a battery charging regulator.

Particulate matter is continuously measured via laser scattering interferometry and particle counting methodology. This method is based on the physical principle of light scattering. Each single particle in the detection and measurement module is illuminated by a defined laser light beam; the coherent laser light is scattered by reflection off the particles. The scattering signal is detected at an angle of 90° by a photo diode within the detector module. In accordance with the Mie theory, each measured pulse height of the scattered light is directly proportional to the particle size. The pulses are classified in an electronic register of 32 different size channels.

NO_2 is continuously measured using an electrochemical sensor consisting of a working counter and reference electrode. NO_2 concentrations are detected and measured by oxidation or reduction reactions on an electrochemical sensor housed within a module containing a liquid electrolyte specific to NO_2. The electrochemical sensor is subjected to a controlled, external electrical circuit. When NO_2 is present, a current proportional to the NO_2 concentration is produced.

VOC is continuously measured using a photoionization detector (PID). The PID sensor lamp produces photons having enough energy to ionize VOC molecules. The PID will only respond to molecules that have an ionization energy at or below the energy of the lamp; the PID used in the AQS-1 project employs a 10.6 electron-volt lamp. The ions produced from VOC compounds generate an electrical current that is measured as the output of the detector.

The meteorological monitors integrated with the AQS-1 are the Vaisala Model WXT536 Weather Transmitter. The meteorological monitors are mounted on a rigid support post elevated above the monitor enclosure cabinet, and are integrated with the data acquisition and data telemetry system housed within the PM2.5 monitor enclosure.

Measurement signals produced by each pollutant detector and the meteorological monitors are acquired by an internal mini-computer that processes, scales, averages and stores the measurement data. The internal computer is integrated with a wireless cellular service) data modem that supports bidirectional communications.

Monitoring methods and activities employed in the monitoring program, including instrument calibration, operation, maintenance and quality control (QC) activities, were performed in accordance with the protocols and procedures contained in the approved *Ambient Air Test Plan 2022 Proposed DDOT Transit Center at Former Michigan State Fairgrounds* dated June 17, 2022.

Discussion of Results

The PM_{10}, $PM_{2.5}$, NO_2, and VOC and monitoring data collected during the Baseline Ambient Monitoring Period (July 8 – 22, 2022) are graphically presented in Figures 1 through 4. Corresponding pollutant data reported from nearby ambient air quality monitoring stations operated by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) are also included in Figures 1 through 4, although it is noted that the EGLE pollutant data presented in this report are preliminary and are still subject to final quality assurance review by EGLE as of the date of this report. The EGLE data in this report are from monitors that are calibrated, operated and maintained in accordance with the Quality Assurance Project Plan (QAPP) developed by the EGLE Air Monitoring Section and approved by U.S. EPA Region 5. The locations of the EGLE monitoring sites from which data were obtained and incorporated in Figures 1 though 4 are identified in the *State Monitor Map* presented in Appendix C to this report.

The Clean Air Act requires the U.S. EPA to promulgate National Ambient Air Quality Standards (NAAQS) for so-called "criteria" pollutants considered harmful to public health and the environment. The PM_{10}, $PM_{2.5}$ and NO_2 monitoring data presented in Figures 1 through 4 for the Baseline Ambient Monitoring Period are referenced to the current, relevant NAAQS Standards.

NO_2, $PM_{2.5}$, and PM_{10} concentrations measured and reported for the Baseline Ambient Monitoring Period were well below associated NAAQS threshold concentrations throughout the monitoring period. The U.S. EPA has not established NAAQS for VOCs. VOCs are considered precursor compounds to the formation of tropospheric ozone. Ozone formation in the atmosphere can occur under certain ambient conditions though photochemical reactions of NO_x and VOCs.

Electronic records of all data and calibrations have been uploaded to the Montrose's Data Server and will be stored for a minimum period of five (5) years.

Pollutant Data Collected

Figure 2 – Baseline PM_{10} Data

The graph in Figure 2 below graphically presents the ambient PM_{10} measurement data collected at the former Michigan State Fairgrounds property during the Baseline monitoring period starting on 7/8/22 and ending on 7/22/22. The graph plots the PM_{10} measurement data as averaged over each 24-hour day (midnight-to-midnight) during the monitoring period. The daily averaging interval for PM_{10} data is consistent with the associated EPA primary and secondary PM_{10} NAAQS, i.e., a 24-hour (daily) averaged value of 150 micrograms per cubic meter ($\mu g/m^3$) not to be exceeded more than once per year on average over 3 years.

The solid yellow line in Figure 2 represents the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. The PM_{10} monitor at the EGLE Dearborn Site is the closest state-operated PM_{10} monitor relative to the former Michigan State Fairgrounds property. Figure 2 includes the 24-hour averaged data from the EGLE Dearborn continuous PM_{10} monitor for comparison to corresponding PM_{10} measurement data reported from the on-site monitors operated at the former Michigan State Fairgrounds. There are no other nearby daily EGLE PM_{10} monitors to supplement the missing data.

Figure 2: Baseline PM_{10} Data

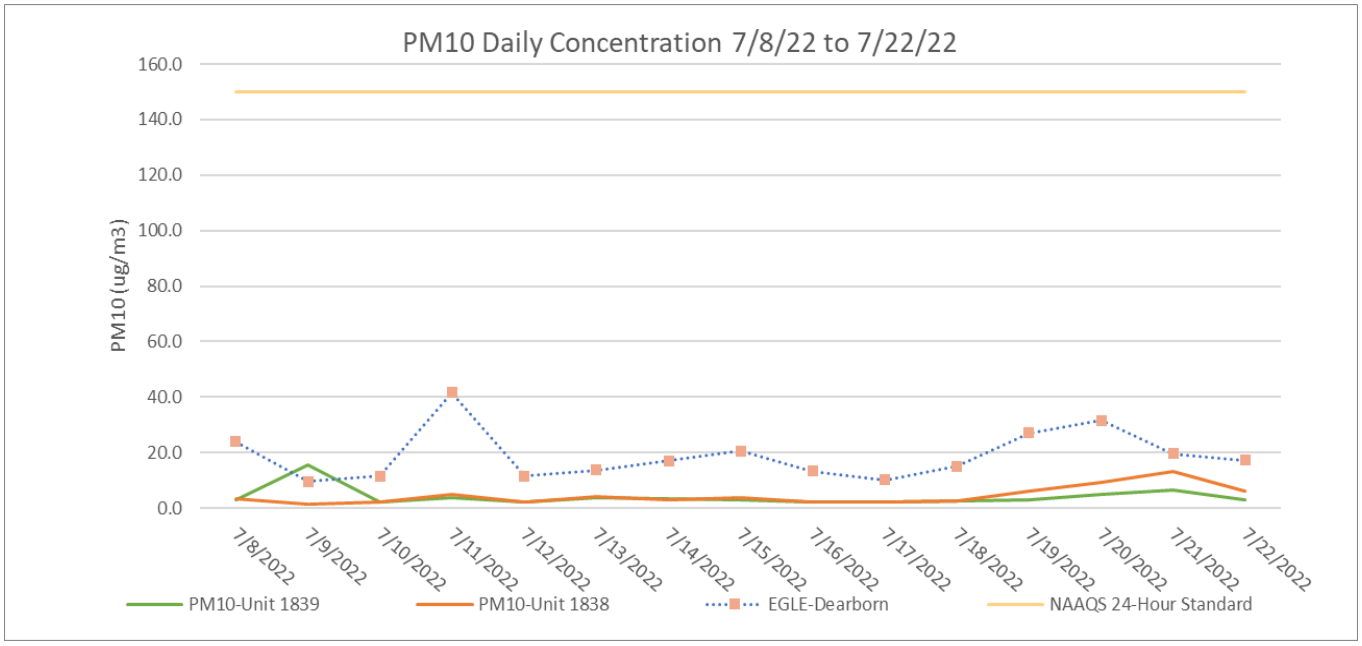


Figure 3 – Baseline $PM_{2.5}$ Data

The graph in Figure 3 below represents the ambient $PM_{2.5}$ measurement data collected at the former Michigan State Fairgrounds property during the Baseline monitoring period starting on 7/8/22 and ending on 7/22/22. This graph is a plot of the $PM_{2.5}$ measurement data as averaged over each 24-hour day (midnight-to-midnight) during the monitoring period. The daily averaging interval for $PM_{2.5}$ data is consistent with the associated EPA primary and secondary $PM_{2.5}$ NAAQS, i.e., a 24-hour (daily) averaged value of 35 micrograms per cubic meter ($\mu g/m^3$) not to be exceeded more than once per year on average over 3 years.

The solid yellow line in Figure 3 represents the 24-hour $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$. The EGLE Oak Park monitoring Site is the nearest state-operated $PM_{2.5}$ monitor relative to the former Michigan State Fairgrounds property. The EGLE Oak Park $PM_{2.5}$ monitor is a 24-hour, filter-based sampler that collects samples at 3-day intervals. Filter-based PM samples require gravimetric analysis at a laboratory; EGLE estimates that analytical results for the Oak Park $PM_{2.5}$ filters are delayed on average by approximately three months. Therefore, the graph below presents the 24-hour averaged $PM_{2.5}$ data from the EGLE Dearborn, Detroit-SW (DET-SW) and Eliza Howell-NR (EH-NR) continuous $PM_{2.5}$ monitors for comparison to corresponding $PM_{2.5}$ measurement data reported from the on-site monitors operated at the former Michigan State Fairgrounds.

Figure 3: Baseline PM2.5 Data

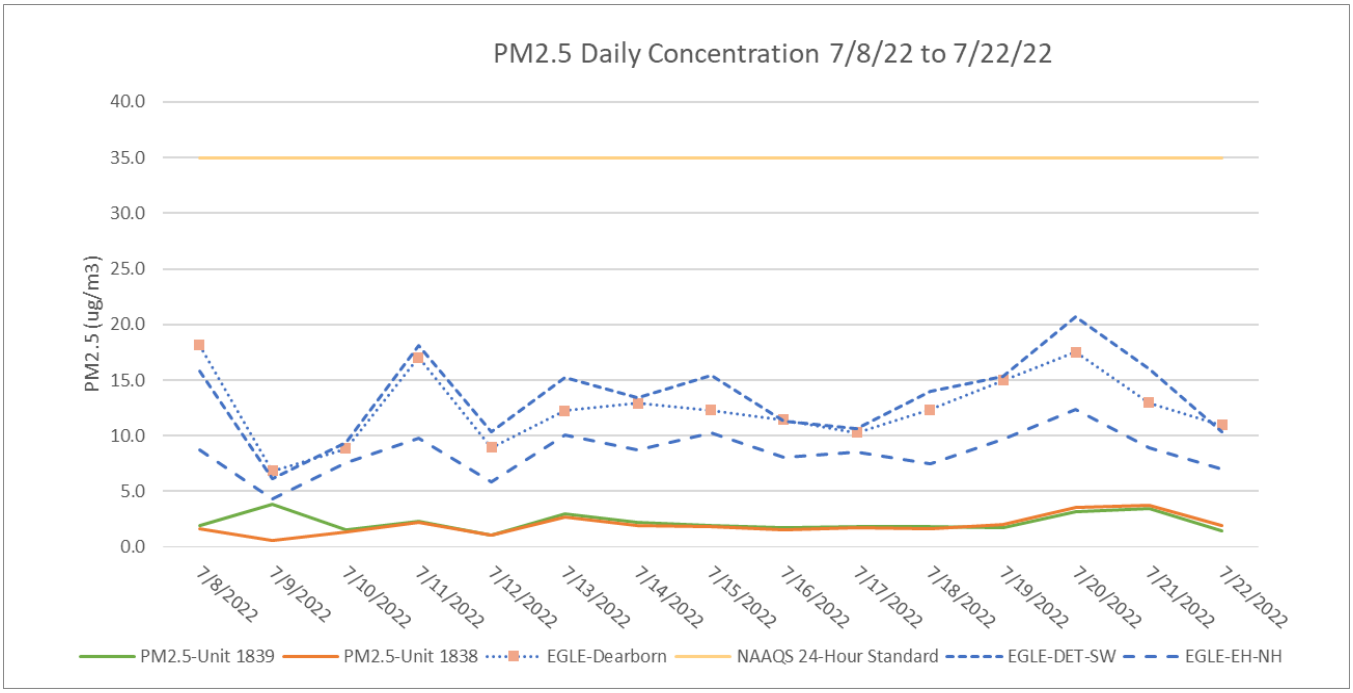


Figure 4 – Baseline NO_2 Data

The graph in Figure 4 below represents the ambient NO_2 measurement data collected at the former Michigan State Fairgrounds property during the Baseline monitoring period starting on 7/8/22 and ending on 7/22/22. This graph is a plot of the NO_2 measurement data as averaged over one (1) hour intervals. This is consistent with the associated EPA primary NO_2 NAAQS: A 1-hour averaged value of 100 parts-per-billion (ppb) not to be exceeded more than once per year on average over 3 years.

The solid yellow line in Figure 4 represents the 1-hour NO_2 NAAQS of 100 ppb. The NO_2 monitors at the EGLE Detroit -SW (DET-SW) Site and Eliza Howell-NR (EH-NR) site are the closest state-operated NO_2 monitors relative to the former Michigan State Fairgrounds property. The graph below presents the 1-hour averaged NO_2 data reported from the EGLE DET-SW and EH-NR continuous NO_2 monitors for comparison to corresponding NO_2 measurement data reported from the on-site monitors operated at the former Michigan State Fairgrounds.

Figure 4: Baseline NO2 Data

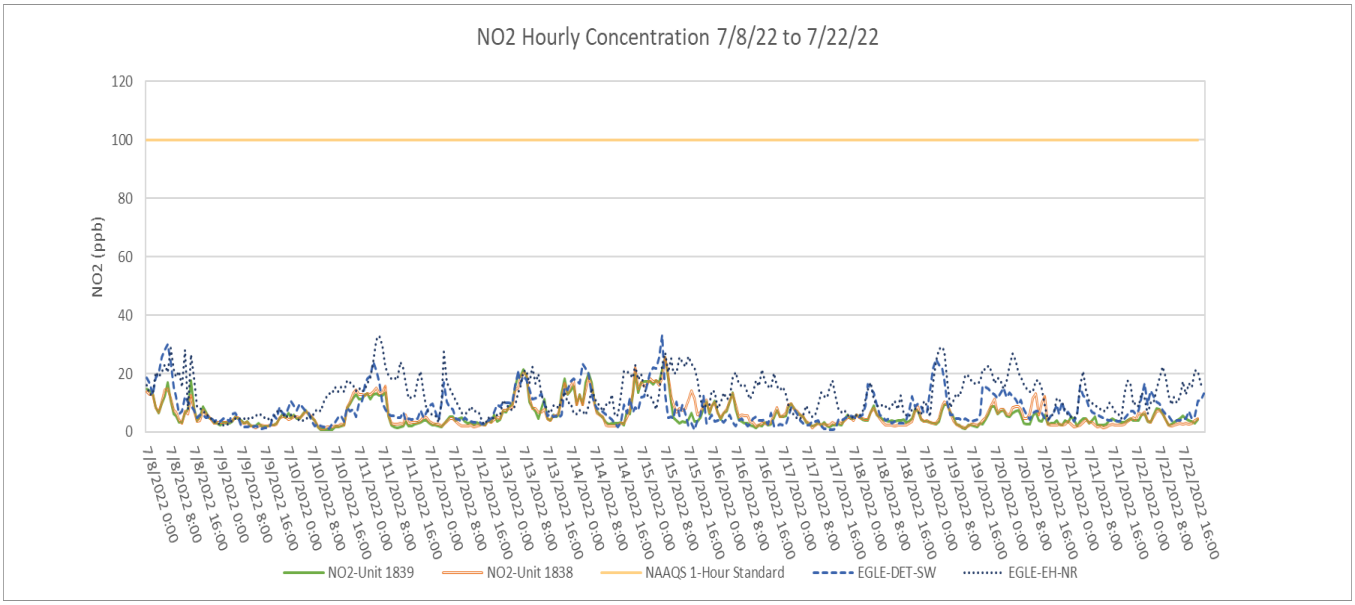
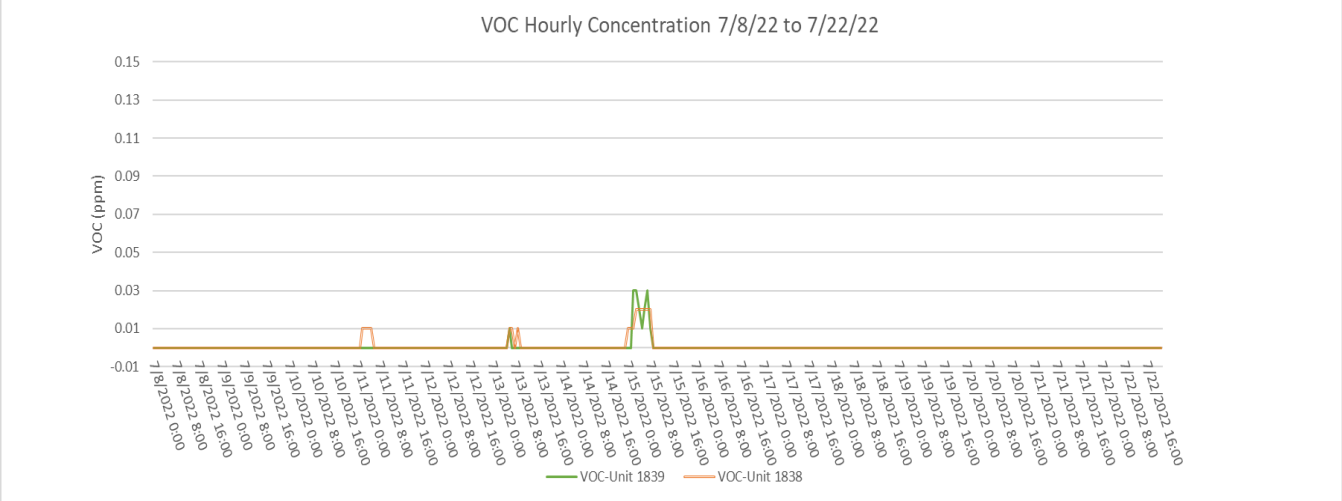


Figure 5 – Baseline VOC Data

The graph in Figure 5 below presents the ambient VOC measurement data collected at the former Michigan State Fairgrounds property during the Baseline monitoring period starting on 7/8/22 and ending on 7/22/22. This graph plots the VOC measurement data as averaged over a period of one (1) hour. The EPA has not established a NAAQS for VOC. Continuous VOC data are not available from any nearby EGLE monitoring Sites.

Figure 5: Baseline VOC Data



Meteorological Data Collected

Figure 6 presents a wind rose derived from the wind speed and wind direction data collected from AQS-1 Monitor No. 1839 over the course of the monitoring period of 7/8/22 to 7/22/22. Monitor No. 1839 was deployed at a nominally downwind location at the DDOT Transit Center construction site, as depicted in Figure 1 in this report.

Figure 6: Wind Rose From AQS-1 No. 1839 Meteorological Monitor

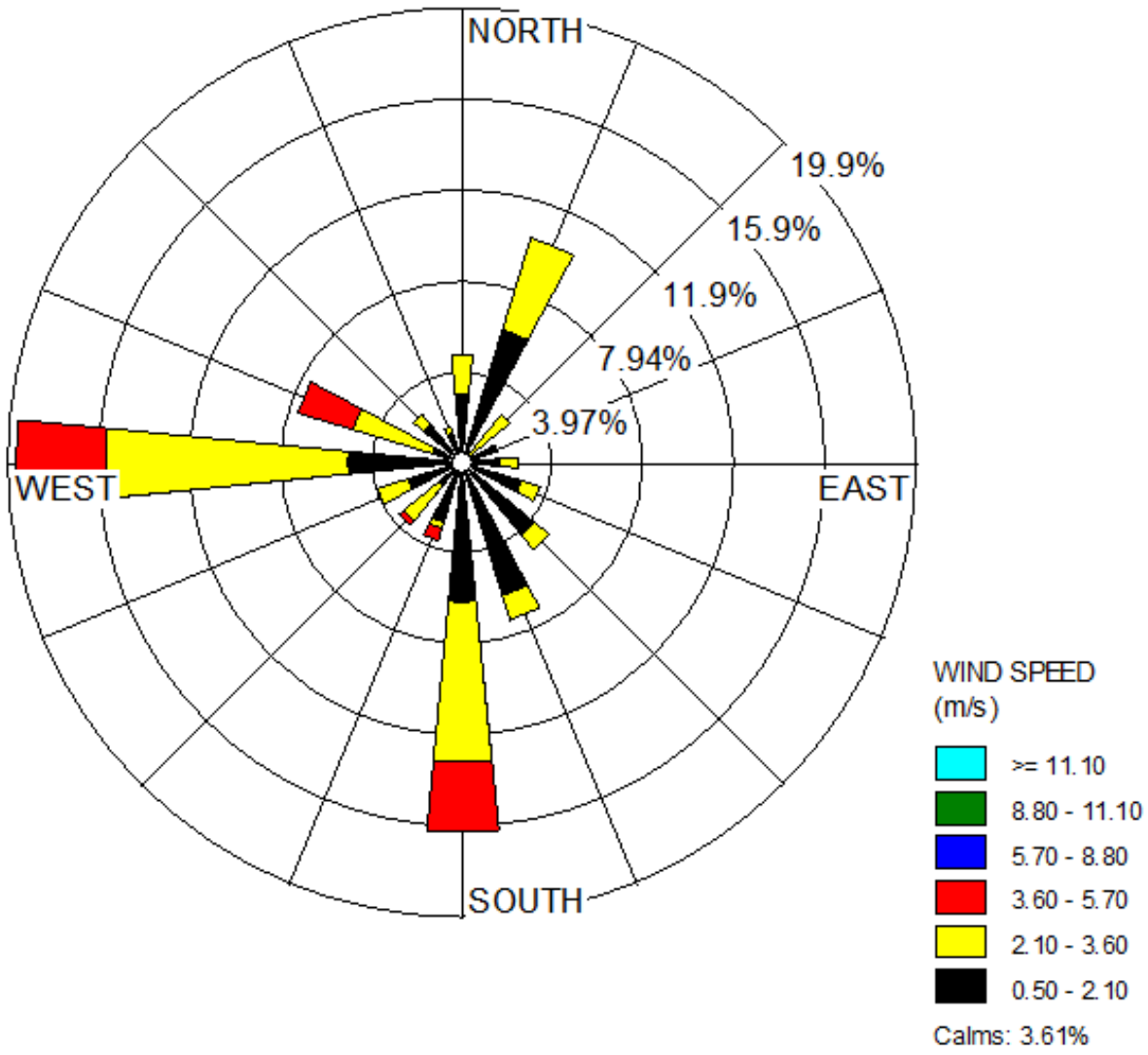
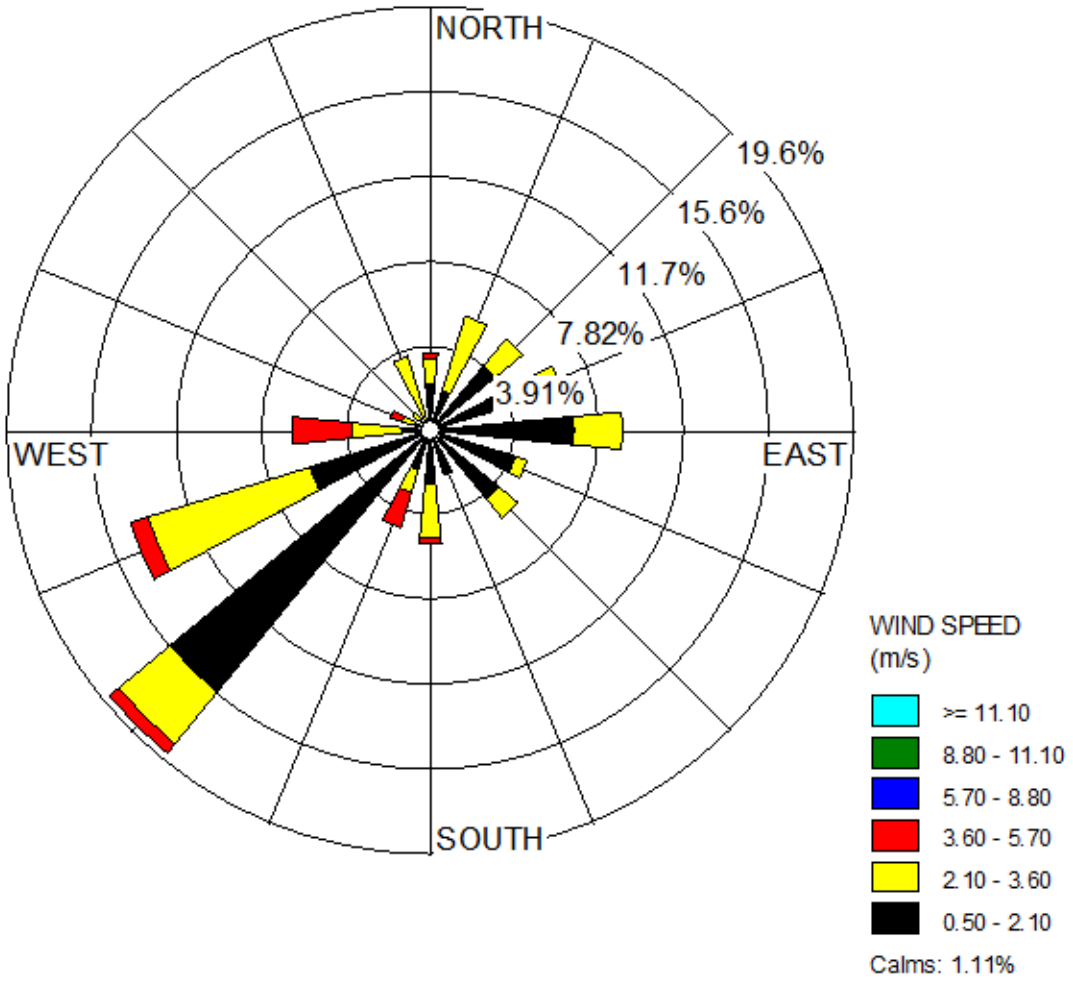


Figure 7 presents a wind rose derived from the wind speed and wind direction data collected from AQS-1 Monitor No. 1838 over the course of the monitoring period of 7/8/22 to 7/22/22. Monitor No. 1838 was deployed at a nominally upwind location at the DDOT Transit Center construction site, as depicted in Figure 1 in this report.

Figure 7 – Wind Rose From 1838 Monitor



As is evident from the wind rose data, winds from the south/southwest were predominate during the monitoring period. of 7/8/22 to 7/22/22 Wind speeds recorded by monitors 1839 and 1838 were also predominantly light, being mostly within the range of 0.5 to 3.6 m/s.

Data Quality Assurance/Quality Control

Quality Assurance/Quality Control

Quality assurance is a general term for the procedures used to ensure that a particular measurement meets the quality requirements for its intended use. Quality control for monitoring instrumentation consists of calibrations, sample flow rate verifications, leak checks and verification of other monitor performance indicators.

Monitoring methods and activities employed in the monitoring program, including instrument calibration, operation, maintenance and quality control (QC) activities, were performed in accordance with the protocols and procedures contained in the approved *Ambient Air Test Plan 2022 Proposed DDOT Transit Center at Former Michigan State Fairgrounds* dated June 17, 2022.

Documentation of quality control checks and results are reproduced in Appendix A to to this report, entitled "*Quality Assurance Logs"*.

Conclusion

In conclusion, the ambient air quality monitoring data collected from the site during the baseline monitoring period from July 8 to July 22, 2022, do not indicate a threat to public health or unusual elevated concentrations of the analyzed parameters.

Signature Page

This report was prepared and reviewed by the following individuals:

Linda Quigley
Data Manager
Montrose Air Quality Services, LLC

David Cummings
District Manager
Montrose Air Quality Services, LLC

Appendix

A: Quality Assurance Logs

AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

Network:	City of Detroit Transit	Site:	MTMS Lab	Date:	4/25/22
Time Off-Line:	09:09 AM EDT	Time On-Line:	4:10 PM EDT	Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1838	Last Cal:	new
	Calibrator Model No:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	AirGas	Cyl. Conc. (PPM):	49.33	Cyl. Pressure (PSIG)	2,100

VOC Sensor Module Calibration Settings	"As Found" (Before Any Adjustment)	"As Left" (After Adjustment)
OFFSET	n/a	0.00
GAIN	n/a	0.940

"AS FOUND" (UNADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		Calibrator Air Channel		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF			0.00			-
				#DIV/0!			#DIV/0!
				#DIV/0!			#DIV/0!

"AS LEFT" (ADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		Calibrator Air Channel		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF	5.0000	5.0099	0.00	0.00	0.0	-
0.0500	0.0501	4.9493	4.9708	0.49	0.53	0.0	8.2%
0.0500	0.0501	2.4493	2.4666	0.98	0.98	0.1	0.0%

NOTES:

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

Comments:

Technician: *Jeremy Levine*

QA Review: Ken Leggett

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

Calibration Data on This Form Are For:			**Unadjusted Cal.**	X	**Adjusted Cal.**	
Network:	City of Detroit (Transit)	Site:	MTMS Lab		Date:	4/25/22
Time Off-Line:	9:09 EDT	Time On-Line:	16:10 EDT		Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1838	Last Cal:	new
	Calibrator Model No.:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No.:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	Airgas	Cyl. Cert. Date:	1/26/21	Cyl. Pressure (PSIG)	1,500
	Gas Cylinder ID #:	D068357	Cyl. Conc. (PPM):	30.95	Gas Module Total Flow Rate	130 mL

Analyzer Calibration Settings	**"As Found" (Before Any Adjustment)**	**"As Left" (After Adjustment)**
OFFSET	n/a	-0.6
GAIN	n/a	1.270

Calibrator Flow and Test Gas Data					**NO_2 Response** *Observed from AQS-1*		Δ% (Observed Response Vs. Known Conc.) 3	PASS/FAIL
Calibrator Gas Channel		**Calibrator Air Channel**		**Known NO_2 Gas Conc. (PPB)**				
Display Setting (SLPM)	**Actual Flow Rate** (SLPM)	Display Setting (SLPM)	**Actual Flow Rate** (SLPM)		Response (PPB)	Std. Dev. (PPB)		
0.0484	0.0485	3.7016	3.7243	397.9	418.6	0.5	5.2%	
0.0484	0.0485	4.9516	4.9745	298.8	313.7	0.6	5.0%	
0.0323	0.0324	4.9677	4.9915	199.6	208.7	0.2	4.6%	
0.0161	0.0162	4.9839	5.0044	99.9	102.3	0.3	2.4%	
OFF	OFF	5.0000	5.0163	0.0	1.0	0.2	-	
Linear Regression Analysis:								
Slope:	1.052165	Intercept:	-0.773269		Corr. Coefficient (r):		0.999963	

NOTES:

1. The NO2 sensor zero response should be 0.0 ppb ± 0.2 ppb with a Std. Dev. < 0.2 ppb. If the sensor response error is greater than ± 0.2 ppb then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppb then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppb ± 0.2 ppb.
3. The NO2 sensor SPAN response should be 400 ppb ± 20 ppb (5% span of 400 ppb) with a Std. Dev. < 8 ppb (2% span of 400 ppb). If the sensor response error is greater than ±20 ppb then a GAIN adjustment is required. If the Std. Dev. is greater than 8.0 ppb then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 400 ppb ± 20 ppb.

Comments:

Technician: *Jeremy Levine*

QA Review: Ken Liggett

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

QC Checks are: X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

Network:	City of Detroit (Transit)	**Site:**	Fairgrounds	**Date of Checks:**	4/27/2022
Operator:	Rob Bienenstein			**Time Off-Line:**	10:00 EST
AEROQUAL QS-1 S/N	1838			**Time On-Line:**	10:33 EST

Reference Standards:

Flow Standard:	Aeroqual Rotometer	**S/N#**	n/a	**Cert Date:**	n/a

AS FOUND CHECK DATA

Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM (A-B)	Profiler Flow Rate Error Δ% (A-B) ÷ A x 100
1.0 LPM	1.00 LPM	0.00	0.0%

Flow Check Procedure Link

Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	>30 seconds	(Must be >10 sec for 10 kPa pressure change)

Leak Check Procedure Link

AS LEFT CHECK DATA

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM	Profiler Flow Rate Error Δ%
LPM	LPM		

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	seconds	(Must be > 10 sec for 10 kPa pressure change)

Comments:

Technician: *Jeremy Levine*

QA Review: Kenneth Lewis

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

Network:	City of Detroit Transit	Site:	MTMS Lab	Date:	7/26/22
Time Off-Line:	08:49 AM EDT	Time On-Line:	09:45 PM EDT	Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1838	Last Cal:	4/25/22
	Calibrator Model No:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	AirGas	Cyl. Conc. (PPM):	49.33	Cyl. Pressure (PSIG)	2,100

VOC Sensor Module Calibration Settings	"As Found" (Before Any Adjustment)	"As Left" (After Adjustment)
OFFSET	0.00	0.00
GAIN	0.940	0.751

"AS FOUND" (UNADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		Calibrator Air Channel		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF	5.0000	5.0156	0.00	0.00	0.00	-
0.0500	0.0501	4.9493	4.9714	0.49	0.67	0.00	36.1%
0.0500	0.0501	2.4930	2.4601	0.98	1.26	0.00	28.0%

"AS LEFT" (ADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		Calibrator Air Channel		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF	5.0000	5.0156	0.00	0.00	0.0	-
0.0500	0.0501	4.9493	4.9714	0.49	0.53	0.0	8.2%
0.0500	0.0501	2.4930	2.4601	0.98	1.00	0.0	2.0%

NOTES:

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

Comments:

Technician: *Jeremy Levine*

QA Review: Ken Liggett

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

Calibration Data on This Form Are For:			**Unadjusted Cal.**	X	**Adjusted Cal.**	
Network:	City of Detroit (Transit)	Site:	MTMS Lab		Date:	7/26/22
Time Off-Line:	9:45 EDT	Time On-Line:	10:23 EDT		Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1838	Last Cal:	4/25/22
	Calibrator Model No.:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No.:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	Airgas	Cyl. Cert. Date:	1/26/21	Cyl. Pressure (PSIG)	1,500
	Gas Cylinder ID #:	D068357	Cyl. Conc. (PPM):	30.95	Gas Module Total Flow Rate	130 mL

Analyzer Calibration Settings	**"As Found" (Before Any Adjustment)**	**"As Left" (After Adjustment)**
OFFSET	-0.6	-0.6
GAIN	1.270	1.270

Calibrator Flow and Test Gas Data					**NO_2 Response** *Observed from AQS-1*		Δ% (Observed Response Vs. Known Conc.) 3	PASS/FAIL
Calibrator Gas Channel		**Calibrator Air Channel**		**Known NO_2 Gas Conc. (PPB)**				
Display Setting (SLPM)	**Actual Flow Rate** (SLPM)	Display Setting (SLPM)	**Actual Flow Rate** (SLPM)		Response (PPB)	Std. Dev. (PPB)		
0.0484	0.0485	3.7016	3.7266	397.6	410.1	1.1	3.1%	
0.0484	0.0485	4.9516	4.9742	298.9	319.3	0.9	6.8%	
0.0323	0.0324	4.9677	4.9927	199.6	213.8	0.4	7.1%	
0.0161	0.0162	4.9839	5.0044	99.9	106.7	0.2	6.8%	
OFF	OFF	5.0000	5.0163	0.0	1.1	0.2	-	
Linear Regression Analysis:								
Slope:	1.036676	Intercept:	3.694141	Corr. Coefficient (r):	0.999607			

NOTES:

1. The NO2 sensor zero response should be 0.0 ppb ± 0.2 ppb with a Std. Dev. < 0.2 ppb. If the sensor response error is greater than ± 0.2 ppb then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppb then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppb ± 0.2 ppb.
3. The NO2 sensor SPAN response should be 400 ppb ± 20 ppb (5% span of 400 ppb) with a Std. Dev. < 8 ppb (2% span of 400 ppb). If the sensor response error is greater than ±20 ppb then a GAIN adjustment is required. If the Std. Dev. is greater than 8.0 ppb then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 400 ppb ± 20 ppb.

Comments:

Technician: *Jeremy Levine*

QA Review: Ken Liggett

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

QC Checks are: X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

Network:	City of Detroit (Transit)	**Site:**	MTMS Lab	**Date of Checks:**	7/27/2022
Operator:	Jeremy Levine			**Time Off-Line:**	10:00 EST
AEROQUAL QS-1 S/N	1838			**Time On-Line:**	10:33 EST

Reference Standards:

Flow Standard:	Aeroqual Rotometer	**S/N#**	n/a	**Cert Date:**	n/a

AS FOUND CHECK DATA

Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM (A-B)	Profiler Flow Rate Error Δ% (A-B) ÷ A x 100
1.0 LPM	1.00 LPM	0.00	0.0%

Flow Check Procedure Link

Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	>30 seconds	(Must be >10 sec for 10 kPa pressure change)

Leak Check Procedure Link

AS LEFT CHECK DATA

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM	Profiler Flow Rate Error Δ%
LPM	LPM		

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	seconds	(Must be > 10 sec for 10 kPa pressure change)

Comments:

Technician: *Jeremy Levine*

QA Review: Kenneth Lewis

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

Network:	City of Detroit (Transit)	Site:	MTMS Lab	Date:	4/25/22
Time Off-Line:	9:09 AM EDT	Time On-Line:	4:10 PM EDT	Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1839	Last Cal:	new
	Calibrator Model No:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	AirGas	Cyl. Conc. (PPM):	49.33	Cyl. Pressure (PSIG)	2,100

VOC Sensor Module Calibration Settings	"As Found" (Before Any Adjustment)	"As Left" (After Adjustment)
OFFSET	n/a	0.00
GAIN	n/a	0.840

"AS FOUND" (UNADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		Calibrator Air Channel		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF			0.00			-
				#DIV/0!			#DIV/0!
				#DIV/0!			#DIV/0!

"AS LEFT" (ADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		Calibrator Air Channel		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF	5.0000	5.0099	0.00	0.00	0.0	-
0.0500	0.0501	4.9493	4.9708	0.49	0.53	0.0	8.2%
0.0500	0.0501	2.4493	2.4666	0.98	0.99	0.0	1.0%

NOTES:

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

Comments:

Technician: *Jeremy Levine*

QA Review: Ken Leggett

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

Calibration Data on This Form Are For:			**Unadjusted Cal.**	X	**Adjusted Cal.**	
Network:	City of Detroit (Transit)	Site:	MTMS Lab		Date:	4/25/22
Time Off-Line:	9:09 EDT	Time On-Line:	16:10 EDT		Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1839	Last Cal:	new
	Calibrator Model No.:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No.:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	Airgas	Cyl. Cert. Date:	1/26/21	Cyl. Pressure (PSIG)	1,500
	Gas Cylinder ID #:	D068357	Cyl. Conc. (PPM):	30.95	Gas Module Total Flow Rate	130 mL

Analyzer Calibration Settings	**"As Found" (Before Any Adjustment)**	**"As Left" (After Adjustment)**
OFFSET	n/a	0.0
GAIN	n/a	1.250

Calibrator Flow and Test Gas Data					**NO_2 Response** ***Observed from AQS-1***			
Calibrator Gas Channel		**Calibrator Air Channel**		**Known NO_2 Gas Conc. (PPB)**			Δ% (Observed Response Vs. Known Conc.) 3	PASS/FAIL
Display Setting (SLPM)	**Actual Flow Rate** (SLPM)	Display Setting (SLPM)	**Actual Flow Rate** (SLPM)		Response (PPB)	Std. Dev. (PPB)		
0.0484	0.0485	3.7016	3.7243	397.9	420.4	0.4	5.7%	
0.0484	0.0485	4.9516	4.9741	298.9	314.0	0.4	5.1%	
0.0323	0.0324	4.9677	4.9915	199.6	209.1	0.3	4.8%	
0.0161	0.0162	4.9839	5.0052	99.9	102.3	0.4	2.4%	
OFF	OFF	5.0000	5.0163	0.0	-0.2	0.5	-	
Linear Regression Analysis:								
Slope:	1.058391	Intercept:	-1.775052	Corr. Coefficient (r):	0.999969			

NOTES:

AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

QC Checks are: X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

Network:	City of Detroit (Transit)	**Site:**	Fairgrounds	**Date of Checks:**	4/27/2022
Operator:	Robert bienenstein			**Time Off-Line:**	10:20 EST
AEROQUAL QS-1 S/N	1839			**Time On-Line:**	10:32 EST

Reference Standards:

Flow Standard:	Aeroqual Rotometer	**S/N#**	n/a	**Cert Date:**	n/a

AS FOUND CHECK DATA

Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM (A-B)	Profiler Flow Rate Error Δ% (A-B) ÷ A x 100
1.0 LPM	1.00 LPM	0.00	0.0%

Flow Check Procedure Link

Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	>30 seconds	(Must be >10 sec for 10 kPa pressure change)

Leak Check Procedure Link

AS LEFT CHECK DATA

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM	Profiler Flow Rate Error Δ%
LPM	LPM		

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	seconds	(Must be > 10 sec for 10 kPa pressure change)

Comments:

Technician: *Jeremy Levine*

QA Review: Kenneth Lewis

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 VOC HIGH RANGE MODULE VERIFICATION/CALIBRATION FORM

Network:	City of Detroit (Transit)	Site:	MTMS Lab	Date:	7/26/22
Time Off-Line:	08:49 AM EDT	Time On-Line:	09:45 PM EDT	Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1839	Last Cal:	3/25/22
	Calibrator Model No:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	AirGas	Cyl. Conc. (PPM):	49.33	Cyl. Pressure (PSIG)	2,100

VOC Sensor Module Calibration Settings	"As Found" (Before Any Adjustment)	"As Left" (After Adjustment)
OFFSET	0.00	0.00
GAIN	0.840	0.756

"AS FOUND" (UNADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		**Calibrator Air Channel**		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF	5.0000	5.0156	0.00	0.00	0.00	-
0.0500	0.0501	4.9493	4.9714	0.49	0.59	0.00	19.9%
0.0500	0.0501	2.4493	2.4601	0.98	1.12	0.00	13.8%

"AS LEFT" (ADJUSTED) TEST DATA

Calibrator Flow and Test Gas Data					Observed VOC Response from AQS-1		Error (Δ%)
Calibrator Gas Channel		**Calibrator Air Channel**		Known VOC Input Gas Conc. (PPM)			
Display Setting (SLPM)	Actual Flow Rate (SLPM)	Display Setting (SLPM)	Actual Flow Rate (SLPM)		Response (PPM)	Std. Dev. (PPM)	
OFF	OFF	5.0000	5.0156	0.00	0.00	0.0	-
0.0500	0.0501	4.9493	4.9714	0.49	0.53	0.0	8.2%
0.0500	0.0501	2.4930	2.4601	0.98	1.00	0.0	2.0%

NOTES:

1. The VOC sensor zero response should be 0.0 ppm ± 0.2 ppm with a Std. Dev. < 0.2 ppm. If the sensor response error is greater than ± 0.2 ppm then an offset adjustment is required. If the Std. Dev. is greater than 0.2 ppm then the sensor is outside acceptable range and may need relacement.
2. The adjusted zero response NEW offset should be -1 < OFFSET < 1 and the sensor response 0.0 ppm ± 0.2 ppm.
3. The VOC sensor SPAN response should be ± 1 ppm (5% span of 20 ppm) with a Std. Dev. < 0.4 ppm (2% span of 20 ppm). If the sensor response error is greater than ± 1 ppm then a GAIN adjustment is required. If the Std. Dev. is greater than 0.4 ppm then the sensor is outside acceptable range and may need relacement.
4. The adjusted span response NEW gain should be 0.2 < GAIN < 5.0 and the sensor response 0.0 ppm ± 1 ppm.

Comments:

Technician: *Jeremy Levine*

QA Review: Ken Leggett

MONTROSE AIR QUALITY SERVICES LLC

AEROQUAL AQS-1 NO2 MODULE MULTI-POINT CALIBRATION FORM

Calibration Data on This Form Are For:			**Unadjusted Cal.**	X	**Adjusted Cal.**	
Network:	City of Detroit (Transit)	Site:	MTMS Lab		Date:	7/26/22
Time Off-Line:	9:45 EDT	Time On-Line:	10:23 EDT		Technician:	Jeremy Levine

Calibration Equipment Info.	Analyzer Model:	Aeroqual AQS-1	S/N:	1839	Last Cal:	4/25/22
	Calibrator Model No.:	Teledyne API	S/N:	69	Cal. Date:	3/17/22
	Zero Air Model No.:	Teledyne API	S/N:	n/a	Cert Date:	n/a
	Gas Supplier:	Airgas	Cyl. Cert. Date:	1/26/21	Cyl. Pressure (PSIG)	1,500
	Gas Cylinder ID #:	D068357	Cyl. Conc. (PPM):	30.95	Gas Module Total Flow Rate	130 mL

Analyzer Calibration Settings	**"As Found" (Before Any Adjustment)**	**"As Left" (After Adjustment)**
OFFSET	0.0	0.0
GAIN	1.250	1.250

Calibrator Flow and Test Gas Data					**NO_2 Response** ***Observed from AQS-1***			
Calibrator Gas Channel		**Calibrator Air Channel**		**Known NO_2 Gas Conc. (PPB)**			Δ% (Observed Response Vs. Known Conc.) 3	PASS/FAIL
Display Setting (SLPM)	**Actual Flow Rate** (SLPM)	Display Setting (SLPM)	**Actual Flow Rate** (SLPM)		Response (PPB)	Std. Dev. (PPB)		
0.0484	0.0485	3.7016	3.7266	397.6	415.1	1.1	4.4%	
0.0484	0.0485	4.9516	4.9742	298.9	323.3	1.7	8.2%	
0.0323	0.0324	4.9677	4.9927	199.6	215.6	0.4	8.0%	
0.0161	0.0162	4.9839	5.0052	99.9	107.3	0.5	7.4%	
OFF	OFF	5.0000	5.0163	0.0	0.4	0.5	-	
Linear Regression Analysis:								
Slope:	1.051562	Intercept:	2.868872	Corr. Coefficient (r):	0.999605			

NOTES:

AEROQUAL AQS-1 FLOW and LEAK CHECK FORM

QC Checks are: X Scheduled _____ Unscheduled (If unscheduled, explain reason why in "Comments" Section)

Network:	City of Detroit (Transit)	**Site:**	MTMS Lab	**Date of Checks:**	7/27/2022
Operator:	Jeremy Levine			**Time Off-Line:**	10:20 EST
AEROQUAL QS-1 S/N	1839			**Time On-Line:**	10:32 EST

Reference Standards:

Flow Standard:	Aeroqual Rotometer	**S/N#**	n/a	**Cert Date:**	n/a

AS FOUND CHECK DATA

Checks are "as found" checks. Adjust profiler flow or resolve leak and complete "as left" section below if any acceptability limits are exceeded or if any adjustments to the monitor are to be made.

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM (A-B)	Profiler Flow Rate Error Δ% (A-B) ÷ A x 100
1.0 LPM	1.00 LPM	0.00	0.0%

Flow Check Procedure Link

Acceptability Limits: The expected AQS-1 Particle Profiler Flow Rate is 1.0 LPM ± 0.05 LPM (between 0.95 LPM and 1.05 LPM) or ≤±5%.

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	>30 seconds	(Must be >10 sec for 10 kPa pressure change)

Leak Check Procedure Link

AS LEFT CHECK DATA

FLOW CHECK DATA:

AQS-1 Expected Flow Rate (A)	Reference Flow Rate (B)	Profiler Flow Rate Error LPM	Profiler Flow Rate Error Δ%
LPM	LPM		

LEAK CHECK DATA:

PROFILER LEAKAGE RATE:	seconds	(Must be > 10 sec for 10 kPa pressure change)

Comments:

Technician: *Jeremy Levine*

QA Review: Kenneth Lewis

MONTROSE AIR QUALITY SERVICES LLC

B: Calibration Certification Sheets

GENERAL INFORMATION

Instrument Type	Dust Sentry Pro
Serial Number	DP 11102021-1838

Aeroqual Connect

Version	V1.18.0	**OS Image**	V4.1.18.0
WiFi SSID	DP 11102021-1838	**Password**	Aeroqual
Default User	Administrator	**Password**	aqmadmin
Sensor List	DP_SensorList_V8.3.6.aql		

Please contact Aeroqual for login and password to access your instrument on Aeroqual Cloud (http://cloud.aeroqual.com).

Instrument Configuration

Particle Channels		Environmental Channels		Communication / Software
✓ TSP	8PC 0.3	TEMP	RAIN	✓ Connect
✓ PM 1	8PC 0.5	RH	SOLAR	Support
✓ PM 2.5	8PC 0.7	ITEMP	HAIL	Basic
✓ PM 10	8PC 1.0	WS	PRESS	Plus
	8PC 2.0	WD	AIR T	3G modem
	8PC 2.5	AN1	AIR RH	
	8PC 3.0	AN2	LAT	
	8PC 5.0	AN3	LON	
	8PC 10	Freq	ALT	
			Pyrano	
			Leq	

Integrated Modules

Type	Serial No.	QC		Type	Serial No.	QC
ARK1124C	KSA5124761	Pass		**Met One 9722-1**	B14058	Pass
Pump Module	AQM PMP03 2804211-039	Pass		**Electronics Module**	AQM M1IO 2108101-042	

For technical, maintenance and service information, please refer to Dust Monitor User Guide or contact Aeroqual for access to free online training (http://training.aeroqual.com).

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PERFORMANCE REPORT

Calibration Data

Item	Value	Unit		Item	Value	Unit
Sample System Leak Tightness	Pass	/		Inlet Heater	Pass	/
Sample Flow Rate	1.004	SLPM		Sheath Flow Rate	1.301	SLPM
Zero Filter Reference Reading	0.00	$\mu g/m^3$				

Standards Used

Standard	Make	Serial Number	Calibration Due
Vacuum Gauge	SMC	VAC005	N/A
Flow Meter	TSI	4140 1438 025	24/11/2021

Activate Negative Number Filters on all gas and dust channels: YES

FACTORY MODULE SETTINGS

MODULE	VERSION	H0	H1	H2	H3	TIMA	TIMR	TEMA	TEMR	PWML	PWMH	HTR	GAIN	Gain	Offset
PM1	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
PM2.5	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
PM10	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
TSP	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
Battery voltage	1.3.0	7.200	0.000	0.000	0.000	0	1000	0	0	0	0	0.00	0	0.000	0.000

Approvals

QC Technician	@ Ariyan Hassan	QC Approval	@ Jeremy Turner
Date	12 Oct 2021	Date	13 Oct 2021

Calibration Certificate(s)

Met One Instruments
1600 Washington Blvd
Grants Pass, OR 97526
(541) 471-7111
(541) 471-7116 (Fax)
Service@metone.com

Calibration Certificate

The calibration results on this report certify that this instrument complies with the product specifications at the time of calibration. Calibration was performed according to accepted industry methods using equipment, procedures, and standards that are traceable to NIST and ISO.

Recommended calibration interval is 12 months from the first day of use.

Instrument Model# 9722-1 Instrument Serial# B14058

Date of Calibration 5/7/2021 Sensor # 1362

Brittney Wentowski
Calibration Technician

Quality Check

Temperature 24 °C Relative Humidity 26 %

Test Procedure: 9722-6100

PSL Size (µm)	Test Results	Test Spec.	Lot# NIST	Expiration
0.3	Pass	± 10%	223077	04/30/2023
0.5	Pass	± 10%	219480	11/30/2022
0.7	Pass	± 10%	229561	08/31/2023
1.0	Pass	± 10%	229294	8/31/2023
2.0	Pass	± 10%	231222	09/30/2023
3.0	Pass	± 10%	231458	09/30/2023
5.0	Pass	± 10%	214115	07/31/2022
10.0	Pass	± 10%	230028	09/30/2023

Standards	Model	SN	Cal Due
Particle Counter	GT-526S	X17420	6/20/2021
DMM	117 Multimeter	49320156	6/15/2021
FLOWMETER	4040	40401945009	1/13/2022
RH/TEMP SENSOR	G3120	G4587	2/2/2022

VAISALA

Test report no. HEL221270089

TEST REPORT

Product family	WXT530 series
Product type	WXT536
Order code	6B1B2A2D1A1B
Serial number	U1270032
Manufacturer	Vaisala Oyj, Finland
Test date	27 March 2022

This test report certifies that the product was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Lower limit	Upper limit	Unit
Rain response	385	345	575	mV
Zero wind speed	0	0	0.4	m/s
Pressure difference	0.09	-1	1	hPa
Temperature difference	-0.87	-2	2	°C
Humidity difference	-1.44	-10	10	%RH
Heating current	0.73	0.6	0.8	A
Current (service port)	4.23	0.5	6	mA
Communication (service port)	pass	PASS	PASS	-
Current (main port)	3.68	0.5	6	mA
Communication (main port)	pass	PASS	PASS	-

Ambient conditions / Humidity 8.65 ±5 %RH, Temperature 22.05 ±1 °C, Pressure 1022.07 ±1 hPa.

Signature

Technician

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email helpdesk@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Vaisala is ISO 9001, ISO 14001 and AQAP 2110 certified company.

CALIBRATION CERTIFICATE

Certificate Number: HEL221270090

Instrument: PTUMODULE
Serial Number: U1130038
Manufacturer: Vaisala Oyj
Issue Date: 2022-03-27

Approved by:

Digitally signed by: Saastamoinen Anssi
Date: 2022-03-27 10:53:11 (+03:00)
Location: Vaisala Oyj, Finland

The humidity sensor of the instrument was calibrated by comparing the instrument's humidity reading to a generated reference humidity reading. The reference humidity reading was calculated based on two-pressure humidity generation principle, using the measurement results of saturator pressure and temperature and calibration chamber pressure and temperature.
The temperature sensor of the instrument was calibrated by comparing the instrument's temperature readings to a reference thermometer.
The pressure sensor of the instrument was calibrated by comparing the instrument's pressure readings to a reference barometer.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The measurement results are traceable to the international system of units (SI) through national metrology institutes (NIST USA, MIKES Finland, or equivalent) or via ISO/IEC 17025 accredited calibration laboratories.

Humidity and temperature calibration results, calibration date 2022-03-23

Reference Humidity [%rh]	Reference Temperature [°C]	Observed Humidity [%rh]	Observed Temperature [°C]	Humidity Error [%rh]	Acceptance Limit [%rh]
0.1	22.52	0.0	22.51	-0.1	±3.0
15.0	22.52	14.7	22.51	-0.3	±3.0
33.0	22.52	32.8	22.52	-0.2	±3.0
54.0	22.53	53.9	22.53	-0.1	±3.0
75.1	22.53	75.1	22.53	0.0	±3.0
95.3	22.54	96.4	22.54	1.1	±5.0

Reference Temperature [°C]	Observed Temperature [°C]	Temperature Error [°C]	Acceptance Limit [°C]
22.53	22.53	0.00	±0.30

Ambient conditions in humidity and temperature calibration

Humidity [%rh]	Temperature [°C]	Pressure [hPa]
19 ±4	25 ±2	1019 ±20

Reference equipment used in Humidity and temperature calibration

Type	Identity Number	Certificate Number	Calibration date	Calibration due date
PTU307	19542	K008-E05564	2021-11-08	2022-11-30
PXI Pt-100 sensor	19923	K008-E06355	2021-12-12	2022-12-31
DPS823B	19906	K008-E05706	2021-11-15	2022-11-30
PXI Pt-100 sensor	19921	K008-E06357	2021-12-12	2022-12-31
PXIe-4080	19920	E06358	2021-12-13	2022-12-31

Pressure calibration results, calibration date 2022-03-16

Reference Pressure [hPa]	Observed Pressure [hPa]	Pressure Error [hPa]	Acceptance limit [hPa]
601.3	601.3	0.0	±0.5
800.6	800.6	0.0	±0.5
901.0	901.0	0.0	±0.5
1080.8	1080.8	0.0	±0.5

Reference equipment used in pressure calibration

Type	Identity Number	Certificate Number	Calibration date	Calibration due date
Fluke RPM4	17966	E06297	2021-12-09	2022-06

Calibration uncertainty (k=2, ~95% confidence level):

Humidity	±0.6 %rh @ 0...40 %rh, ±1.0 %rh @ 40...95 %rh
Temperature	±0.10 °C
Pressure	±0.3 hPa

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Email helpdesk@vaisala.com | www.vaisala.com
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GENERAL INFORMATION

Instrument Type	Dust Sentry Pro
Serial Number	DP 11102021-1839

Aeroqual Connect

Version	V1.18.0	**OS Image**	V4.1.18.0
WiFi SSID	DP 11102021-1839	**Password**	Aeroqual
Default User	Administrator	**Password**	aqmadmin
Sensor List	DP_SensorList_V8.3.6.aql		

Please contact Aeroqual for login and password to access your instrument on Aeroqual Cloud (http://cloud.aeroqual.com).

Instrument Configuration

Particle Channels		Environmental Channels		Communication / Software
☑ TSP	8PC 0.3	TEMP	RAIN	☑ Connect
☑ PM 1	8PC 0.5	RH	SOLAR	Support
☑ PM 2.5	8PC 0.7	ITEMP	HAIL	Basic
☑ PM 10	8PC 1.0	WS	PRESS	Plus
	8PC 2.0	WD	AIR T	3G modem
	8PC 2.5	AN1	AIR RH	
	8PC 3.0	AN2	LAT	
	8PC 5.0	AN3	LON	
	8PC 10	Freq	ALT	
			Pyrano	
			Leq	

Integrated Modules

Type	Serial No.	QC		Type	Serial No.	QC
ARK1124C	KSA5124614	Pass		**Met One 9722-1**	B14186	Pass
Pump Module	AQM PMP03 2804211-023	Pass		**Electronics Module**	AQM M1IO 2108101-074	

For technical, maintenance and service information, please refer to Dust Monitor User Guide or contact Aeroqual for access to free online training (http://training.aeroqual.com).

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PERFORMANCE REPORT

Calibration Data

Item	Value	Unit	Item	Value	Unit
Sample System Leak Tightness	Pass	/	**Inlet Heater**	Pass	/
Sample Flow Rate	0.999	SLPM	**Sheath Flow Rate**	1.251	SLPM
Zero Filter Reference Reading	0.00	$\mu g/m^3$			

Standards Used

Standard	Make	Serial Number	Calibration Due
Vacuum Gauge	SMC	VAC005	N/A
Flow Meter	TSI	4140 1438 025	24/11/2021

Activate Negative Number Filters on all gas and dust channels: YES

FACTORY MODULE SETTINGS

MODULE	VERSION	H0	H1	H2	H3	TIMA	TIMR	TEMA	TEMR	PWML	PWMH	HTR	GAIN	Gain	Offset
PM1	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
PM2.5	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
PM10	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
TSP	4.0.0	0.000	1.000	760.000	298.150	2	60	1.4	2	0	0	1.00	1	1.000	0.000
Battery voltage	1.3.0	7.200	0.000	0.000	0.000	0	1000	0	0	0	0	0.00	0	0.000	0.000

Approvals

QC Technician	@ Ariyan Hassan	**QC Approval**	@ Jeremy Turner
Date	12 Oct 2021	**Date**	13 Oct 2021

Calibration Certificate(s)

Met One Instruments
1600 Washington Blvd
Grants Pass, OR 97526
(541) 471-7111
(541) 471-7116 (Fax)
Service@metone.com

Calibration Certificate

The calibration results on this report certify that this instrument complies with the product specifications at the time of calibration. Calibration was performed according to accepted industry methods using equipment, procedures, and standards that are traceable to NIST and ISO.

Recommended calibration interval is 12 months from the first day of use.

Instrument Model# 9722-1 Instrument Serial# B14186

Date of Calibration 5/19/2021 Sensor # 1379

Brittney Wentowski BW
Calibration Technician

Quality Check

Temperature 24 °C Relative Humidity 26 %

Test Procedure: 9722-6100

PSL Size (µm)	Test Results	Test Spec.	Lot# NIST	Expiration
0.3	Pass	± 10%	223077	04/30/2023
0.5	Pass	± 10%	219480	11/30/2022
0.7	Pass	± 10%	229561	08/31/2023
1.0	Pass	± 10%	229294	8/31/2023
2.0	Pass	± 10%	231222	09/30/2023
3.0	Pass	± 10%	231458	09/30/2023
5.0	Pass	± 10%	214115	07/31/2022
10.0	Pass	± 10%	230028	09/30/2023

Standards	Model	SN	Cal Due
Particle Counter	GT-526S	X17420	6/20/2021
DMM	117 Multimeter	49320156	6/15/2021
FLOWMETER	4040	40401945009	1/13/2022
RH/TEMP SENSOR	G3120	G4587	2/2/2022

Document 9722-9600 Rev B 54226

VAISALA

Vaisala is ISO 9001, ISO 14001 and AQAP 2110 certified company.

CALIBRATION CERTIFICATE

Certificate Number: HEL221270094

Instrument: PTUMODULE
Serial Number: U1130042
Manufacturer: Vaisala Oyj
Issue Date: 2022-03-27

Approved by:

Digitally signed by: Saastamoinen Anssi
Date: 2022-03-27 11:00:15 (+03:00)
Location: Vaisala Oyj, Finland

The humidity sensor of the instrument was calibrated by comparing the instrument's humidity reading to a generated reference humidity reading. The reference humidity reading was calculated based on two-pressure humidity generation principle, using the measurement results of saturator pressure and temperature and calibration chamber pressure and temperature.
The temperature sensor of the instrument was calibrated by comparing the instrument's temperature readings to a reference thermometer.
The pressure sensor of the instrument was calibrated by comparing the instrument's pressure readings to a reference barometer.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The measurement results are traceable to the international system of units (SI) through national metrology institutes (NIST USA, MIKES Finland, or equivalent) or via ISO/IEC 17025 accredited calibration laboratories.

Humidity and temperature calibration results, calibration date 2022-03-23

Reference Humidity [%rh]	Reference Temperature [°C]	Observed Humidity [%rh]	Observed Temperature [°C]	Humidity Error [%rh]	Acceptance Limit [%rh]
0.1	22.52	0.0	22.52	-0.1	±3.0
15.0	22.52	14.6	22.53	-0.4	±3.0
33.0	22.52	32.6	22.53	-0.4	±3.0
54.0	22.53	53.8	22.53	-0.2	±3.0
75.1	22.53	75.1	22.53	0.0	±3.0
95.3	22.54	96.5	22.53	1.2	±5.0

Reference Temperature [°C]	Observed Temperature [°C]	Temperature Error [°C]	Acceptance Limit [°C]
22.53	22.53	0.00	±0.30

Ambient conditions in humidity and temperature calibration

Humidity [%rh]	Temperature [°C]	Pressure [hPa]
19 ±4	25 ±2	1019 ±20

Reference equipment used in Humidity and temperature calibration

Type	Identity Number	Certificate Number	Calibration date	Calibration due date
PTU307	19542	K008-E05564	2021-11-08	2022-11-30
PXI Pt-100 sensor	19923	K008-E06355	2021-12-12	2022-12-31
DPS823B	19906	K008-E05706	2021-11-15	2022-11-30
PXI Pt-100 sensor	19921	K008-E06357	2021-12-12	2022-12-31
PXIe-4080	19920	E06358	2021-12-13	2022-12-31

Pressure calibration results, calibration date 2022-03-16

Reference Pressure [hPa]	Observed Pressure [hPa]	Pressure Error [hPa]	Acceptance limit [hPa]
601.3	601.3	0.0	±0.5
800.6	800.6	0.0	±0.5
901.0	901.0	0.0	±0.5
1080.8	1080.8	0.0	±0.5

Reference equipment used in pressure calibration

Type	Identity Number	Certificate Number	Calibration date	Calibration due date
Fluke RPM4	17966	E06297	2021-12-09	2022-06

Calibration uncertainty (k=2, ~95% confidence level):

Humidity	±0.6 %rh @ 0...40 %rh, ±1.0 %rh @ 40...95 %rh
Temperature	±0.10 °C
Pressure	±0.3 hPa

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
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VAISALA

Test report no. HEL221270093

TEST REPORT

Product family	WXT530 series
Product type	WXT536
Order code	6B1B2A2D1A1B
Serial number	U1270033
Manufacturer	Vaisala Oyj, Finland
Test date	27 March 2022

This test report certifies that the product was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Lower limit	Upper limit	Unit
Rain response	381	345	575	mV
Zero wind speed	0	0	0.4	m/s
Pressure difference	0.06	-1	1	hPa
Temperature difference	-0.81	-2	2	°C
Humidity difference	-1.43	-10	10	%RH
Heating current	0.74	0.6	0.8	A
Current (service port)	4.02	0.5	6	mA
Communication (service port)	pass	PASS	PASS	-
Current (main port)	3.41	0.5	6	mA
Communication (main port)	pass	PASS	PASS	-

Ambient conditions / Humidity 8.67 ±5 %RH, Temperature 22.09 ±1 °C, Pressure 1022.06 ±1 hPa.

Signature

Technician

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
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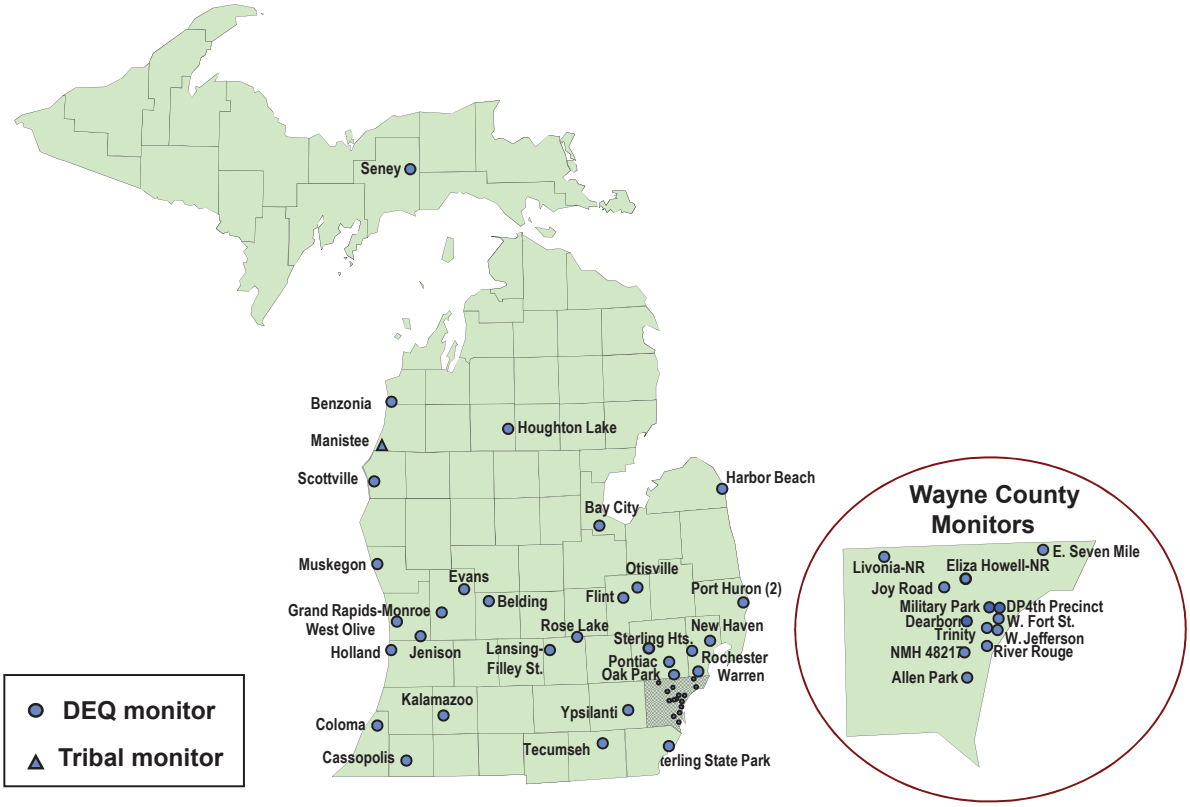
C: State Monitor Map

Michigan Air Monitor Network



Updated June 2019