

2019 and 2020 Quality Assurance Report Atmospheric Mercury Network

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National Atmospheric Deposition Program

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Abbreviations

AMNet	Atmospheric Mercury Network
GEM	Gaseous Elemental Mercury (expressed in ng/m ³)
GOM	Gaseous Oxidized Mercury (expressed in pg/m ³)
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
PBM _{2.5}	Particulate-Bound Mercury less than 2.5 µm in diameter (expressed in pg/m ³)
QAP	Quality Assurance Program
SOP	Standard Operating Procedures

Units and Conversion Factors

°F	degrees Fahrenheit
°C	degrees Celsius
cm	centimeters
L	liters
µl	microliter (1 µl = 10 ⁻⁶ L)
lpm	liters per minute
ng	nanograms (1 ng = 10 ⁻⁹ g)
ng/m ³	nanograms per cubic meter
pg	picograms (1 pg = 10 ⁻¹² g)
pg/m ³	picograms per cubic meter

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1.0 Introduction

The Atmospheric Mercury Network (AMNet) started in 2009. Seventeen AMNet sites operated in 2019 and thirteen in 2020, including one site (Mt LuLin) in Taiwan (Table 1). The concentration of gaseous elemental mercury (GEM) was measured at all sites. Speciated mercury: gaseous oxidized mercury (GOM) and particulate bound mercury (PBM_{2.5}), was measured at 11 sites in 2019 and 9 sites in 2020. MS12 stopped collecting mercury data on 2/18/2020. In 2019, six sites (IN34, MA22, NJ54, NY06, NY20, and NY43) measured GEM and while in 2020, four sites (NJ54, NY06, NY20, and NY43) in 2020 measured GEM only. All measurements followed the AMNet Standard Operating Procedures (SOPs). Copies of the SOP available upon request.

The AMNet Site Liaison provides remote technical support to site operators for the operation of AMNet equipment, completes site performance and systems surveys, and reviews the data on a monthly basis to identify problems. Data review includes both manual and automated quality control checks. Site operators are notified whenever problems are discovered.

Following the 2018 NADP move to the University of Wisconsin, site visits were delayed and reinitiated in December 2019. Two sites were surveyed by the AMNet Site Liaison in 2019 and no sites were surveyed in 2020 due to the pandemic. Several sites have exceeded the 2 year site visit criteria. This report includes a summary of the findings from each of the surveys.

Table 1. AMNet Sites

NADP Site ID	State	Operating Agency	START_DATE	END_DATE	Lapse
AK03	Alaska	National Park Service	2/5/2014	12/20/2018	
AL03	Alabama	ARA Inc.	1/29/2016	11/9/2016	
AL19	Alabama	ARA Inc.	1/1/2009	6/28/2016	
FL96	Florida	ARA Inc.	1/1/2009	10/5/2016	
GA40	Georgia	ARA Inc.	1/1/2009	10/4/2016	
HI00	Hawaii	NOAA/EPA	12/30/2010	Current	
IL11	Illinois	NADP/CAL	3/30/2017	11/19/2019	
IN21	Indiana	LADCO	4/29/2016	12/31/2019	
IN34	Indiana	LADCO	10/2/2018	12/18/2019	
MA22	Massachusetts	MIT	7/29/2017	5/10/2019	
MD08	Maryland	University of Maryland	1/1/2008	Current	6/30/2011 - 1/12/2012
MD98	Maryland	NOAA	11/7/2006	Current	
ME97	Maine	Micmac Tribe	12/3/2013	12/31/2015	
MI09	Michigan	University of Michigan	8/10/2015	7/11/2016	
MS12	Mississippi	NOAA	9/29/2006	2/18/2020	
NJ30	New Jersey	State of New Jersey	10/11/2016	Current	
NJ54	New Jersey	State of New Jersey	10/12/2016	Current	
NS01	Nova Scotia, Canada	Environment Canada	1/26/2009	11/27/2018	
NU15	Nunavut, Canada	Environment Canada	1/4/2002	Current	
NY06	New York	State of New York	8/27/2008	7/1/2020	
NY20	New York	SUNY ESF	11/21/2007	Current	
NY43	New York	State of New York	11/21/2007	6/30/2020	
NY98	New York	State of New York	9/30/2020	Current	
OH02	Ohio	Ohio University	1/1/2007	Current	2/15/2012 – 9/24/2013
OH52	Ohio	Ohio State University	1/1/2012	Current	

Changes in 2019 and 2020 include the following:

Four sites (IL11, IN21, IN34 and MA22) closed in 2019 and two sites (NY06 and NY43) closed in 2020. One site (NY98) started in 2020.

2.0 Site Performance and Systems Surveys

Sites are required to be surveyed at least once every two years by the AMNet Site Liaison. The Program relocation and pandemic has led to several two year exceedances. Normally, the site performance and systems surveys would be performed by an external entity. This is true for the other NADP networks. However, the expertise required to operate and troubleshoot the AMNet instrumentation inhibits a third party from providing this service. Site survey reports are completed to document problems that are discovered during the survey and their resolution.

Site surveys evaluate site operator, field and laboratory operations, equipment performance, and siting criteria. Site surveys ensure data comparability within the network, resolve operational problems that may not be apparent in data review, and address training needs at each site. Additional information regarding site surveys may be found in the document titled *Atmospheric Mercury Network: Site Performance and Systems Survey*. This document is available from the NADP website (<http://nadp.slh.wisc.edu/>).

2.1 AMNet Sites Surveyed in 2019

Site surveys were conducted at two AMNet sites in 2019 and zero in 2020. Station ID's, survey dates and station names are presented in Table 2.

Table 2. AMNet Sites Surveyed in 2019.

Site ID	Station Name	Survey Date
NJ30	New Brunswick	12/10/2019
NJ54	Elizabeth	12/9/2019

2.2 Instrument Test Results

As part of the site survey, instrument sensitivity (i.e., response factor) and the internal calibration source are verified. Independent, third party calibration certificates for the survey test equipment are included in the appendix to this document.

Table 3 lists the serial numbers for the AMNet instruments at each site. Illegible serial numbers are listed as “n/a” (not available). Not present instruments are listed as “n/p”.

Table 3. Serial Numbers for Instruments at Surveyed Sites.

Site ID	1102	2537	1130P	1130	1135	2505
NJ30	140	5114	167	162	152	n/p
NJ54	n/p	5110	n/p	n/p	n/p	n/p

Table 4 lists the results [i.e., pass (p), fail (f)] for each test of the field instruments. Criteria for assigning pass/fail are defined in *Atmospheric Mercury Network: Site Performance and Systems*

Survey. Significant deviation from the test criteria are indicated with an uppercase F. Parameters that were not tested are listed as “n/a.” Tables 5 and 6 show recoveries from the cartridge tests.

Table 4. Survey Results.

Site ID	Air Flow and Leak Tests				Cartridge A and B Recoveries			
	Temps OK	Inlet Flow	2537 Flow	Leak Check	Response Factor	Low Level	High Level	Ambient Air
NJ30	p	p	p	p	p	p	p	p
NJ54	n/a	p	p	p	p	p	p	p

Table 5. Site NJ 30 Recoveries

Site NJ30 Cartridge Recoveries				
Low Level		Tekran target = 101.6 ng/m3		
Mass	Tekran	% recovery	Trap	Mass recovered
100 pg	98.852	98.4	B	98.4
100 pg	97.249	95.6	A	95.6
100 pg	97.398	95.8	B	95.8
100 pg	98.239	96.6	A	96.6
100 pg	96.792	95.2	B	95.2
100 pg	96.731	95.1	A	95.1
High Level		Tekran target = 151.8 ng/m3		
Mass	Tekran	% recovery	Trap	Mass recovered
150 pg	145.45	95.8	B	143.7
150 pg	146.54	96.6	A	144.9
150 pg	146.9	96.8	B	145.2
150 pg	146.39	96.4	A	144.6
150 pg	146.81	96.7	B	145.05
150 pg	146.21	96.3	A	144.45
Ambient Air		Tekran target = 24.4 ng/m3		
		% recovery	Trap	Mass recovered
100 pg	25.07	102.7	A	102.7
100 pg	25.1	103	B	103
100 pg	25.2	103.4	A	103.4
100 pg	25.5	104.5	B	104.5

Table 6. Site NJ 54 Recoveries

Site NJ54 Cartridge Recoveries				
Low Level		Tekran target = 20 ng/m3		
Mass	Tekran	% recovery	Trap	Mass recovered
100 pg	19.614	98.1	B	98.1
100 pg	19.07	95.4	A	95.4
100 pg	19.548	97.7	B	97.7
100 pg	19.629	98.1	A	98.1
100 pg			B	
100 pg	18.796	94	A	94
100 pg	19.299	96.5	B	96.5
100 pg	18.896	94.5	A	94.5
High Level		Tekran target 30 ng/m3		
Mass	Tekran	% recovery	Trap	Mass recovered
150 pg	28.27	94.2	B	141.3
150 pg	27.77	92.6	A	138.9
Ambient Air	Tekran	% recovery	Trap	Mass recovered
100 pg	18.682	93.4	A	93.4
100 pg	18.023	90.1	B	90.1

2.3 Siting Criteria

Compliance with siting criteria is evaluated with regard to obstructions (>20°) in each of 8 cardinal directions (i.e., N, NE, E, SE, S, SW, W, and NW) from the instrument inlet. Also, the height from the ground to each inlet is measured. Results are presented in Table 8. Obstructions are evaluated as pass (p)/fail (f). Deviations from the siting criteria are discussed with the operator during the site survey. Corrective action, when necessary, is the responsibility of the site operator and the site supervisor.

Table 7. Siting Criteria Obstructions and Inlet Heights.

Site	Inlet Height (m)	N	NE	E	SE	S	SW	W	NW
NJ30	4.0	p	f	p	p	p	p	p	p
NJ54	5.5	p	p	p	p	p	p	p	p

2.4 Instrument Repairs

In 2019, no instruments needed repair prior to checks.

2.5 Test Equipment Calibration

Due to ongoing as-received calibration failures the Bios flowmeters were retired in 2018 and a TetraCal venturi flow meter was purchased for use in the field. The TetraCal has no moving parts, can measure the complete dynamic range, continuously measures both Standardized and Volumetric flow and has an operating range down to -30° C. The TetraCal is expected to perform better “as-received” and will only require one certification saving the NADP Program Office hundreds of dollars a year.

Table 8. Flow Meter Calibration Results for 2019 and 2020.

Flow Meter		Calibration Date	
		11/2019	07/2021
TetraCal	as-received	In Tolerance	In Tolerance
	as-shipped	In Tolerance	In Tolerance

A Tekran 2505 Mercury Vapor Primary Calibration Unit and a certified Hamilton 25 µL syringe (model 1702RN) are used to validate instrument internal permeation sources. On December 3, 2019 syringe SN 7473 was found to be within tolerance both as-received and as-shipped. SN 7473 was certified again on January 16, 2020 and found to be within tolerances.

3.0 Training

No formal AMNet training sessions were held in 2019 or 2020. Operator performance is reviewed with each site visit.

4.0 Data

AMNet data are evaluated using a series of automated checks and through manual inspection by the AMNet Site Liaison. Additional information on this process is available in the *Atmospheric Mercury Network Data Management Manual*. Table 9 lists problems impacting data completeness for individual sites. Table 10 lists the percentage of valid data collected at each site in 2019. Table 11 lists the percentage of valid data collected at each site in 2020. Values are presented for each of the three forms of mercury that are measured including: GEM, GOM, and PBM_{2.5}. One site (NJ54) did not meet data quality objectives ($\geq 75\%$ data completeness on an annual basis) for GEM and one site (HI00) did not meet data quality objectives for GOM and PBM_{2.5} in 2019. All sites met data quality objectives in 2020.

Table 9. Problems Impacting Data Completeness.

SiteID	Problem Description	Period Impacted
HI00	High Speciation Blanks	January into February and August thru September 2019
NJ54	Cartridge and calibration bias	July into October 2019

Table 10. Percent Valid Data by Site for 2019*.

Site ID	GEM	GOM	PBM _{2.5}
HI00	99	51	51
IL11	81	n/a	n/a
IN21	93	87	88
IN34	92	n/a	n/a
MA22	86	n/a	n/a
MD08	n/a	n/a	n/a
MD98	95	92	95
MS12	95	98	98
NJ30	97	96	96
NJ54	67	n/a	n/a
NU15	Data QA performed external to NADP.		
NY06	100	n/a	n/a
NY20	83	n/a	n/a
NY43	93	n/a	n/a
OH02	88	96	96
OH52	88	83	83
TW01	Data QA performed external to NADP.		
Average	87	86	87

* Based on period of operation

Table 11. Percent Valid Data by Site for 2020*.

Site ID	GEM	GOM	PBM _{2.5}
HI00	99	88	88
MD08	n/a	n/a	n/a
MD98	98	95	95
MS12	98	98	98
NJ30	99	97	97
NJ54	99	n/a	n/a
NU15	Data QA performed external to NADP.		
NY06	100	n/a	n/a
NY20	93	n/a	n/a
NY43	97	n/a	n/a
OH02	94	93	93
OH52	89	95	95
TW01	Data QA performed external to NADP.		
Average	97	94	94

* Based on period of operation

5.0 Approvals

- 2019 - 2020 AMNet QAR Prepared by Mark Olson, Reviewed by Camille Danielson, NADP CAL/HAL QA Manager Completed Draft: 8/30/2021
- Approved by the NADP Program Office: 9/5/2021
- Shared with the QAAG for review on: 9/30/2021
- Approved by QAAG by vote: 10/19/2021
- Shared at Fall 2021 NADP Technical Meeting