Frontier Geosciences Inc.

Environmental Research & Specialty Analytical Laboratory

National Atmospheric Deposition Program

Mercury Deposition Network

Mercury Analytical Lab

2000 Annual Quality Assurance Report

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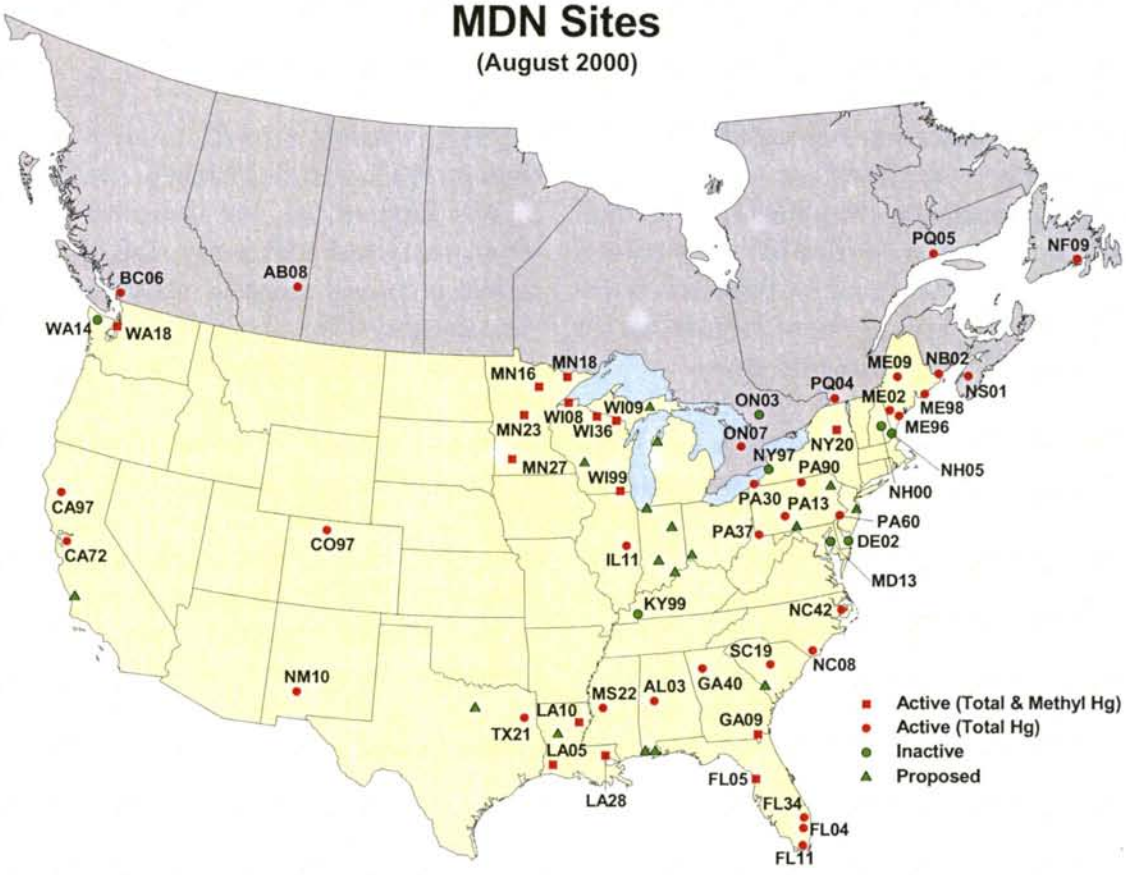
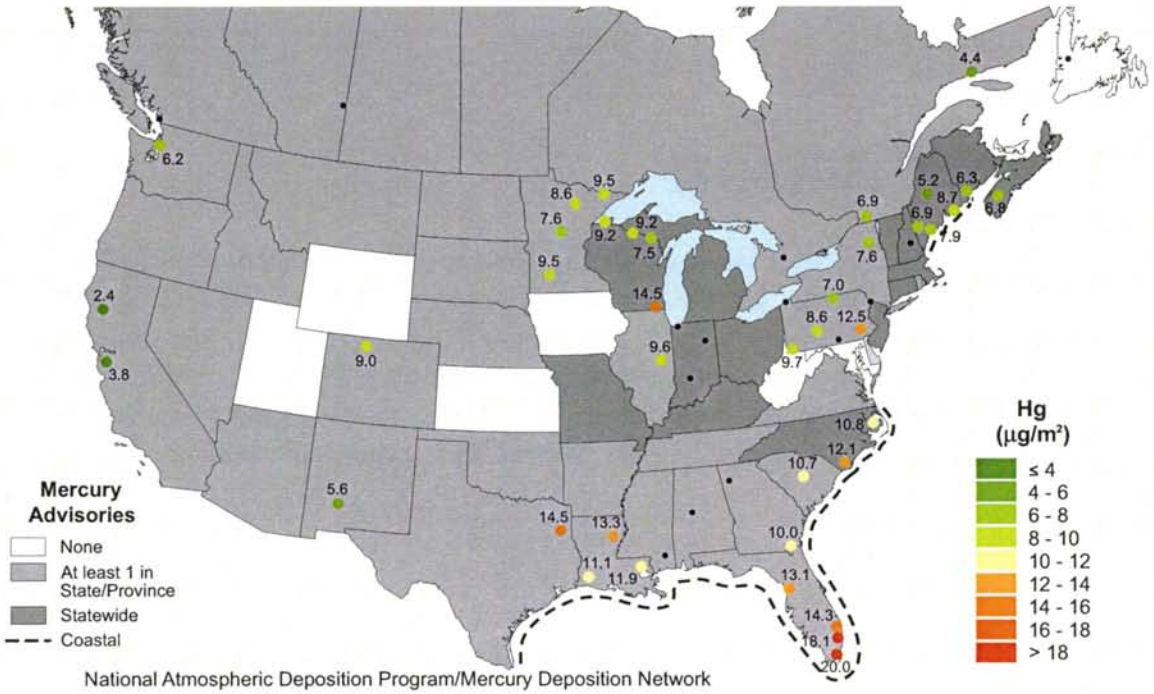
I. Introduction

Since January of 1996, Frontier Geosciences Inc. (Frontier) has served as the Hg Analytical Lab (HAL) and Site Liaison center for the Mercury Deposition Network (MDN). The MDN, coordinated through the National Atmospheric Deposition Program (NADP), was designed with the primary objective of quantifying the wet deposition of mercury in North America to determine long-term geographic and temporal distributions. The Network has grown to incorporate over 50 sites in the United States and Canada. In 2001, the MDN is expected to add 10-15 additional new sites.



2000 Mercury Deposition and Mercury Advisories for fish and wildlife consumption



National Atmospheric Deposition Program/Mercury Deposition Network

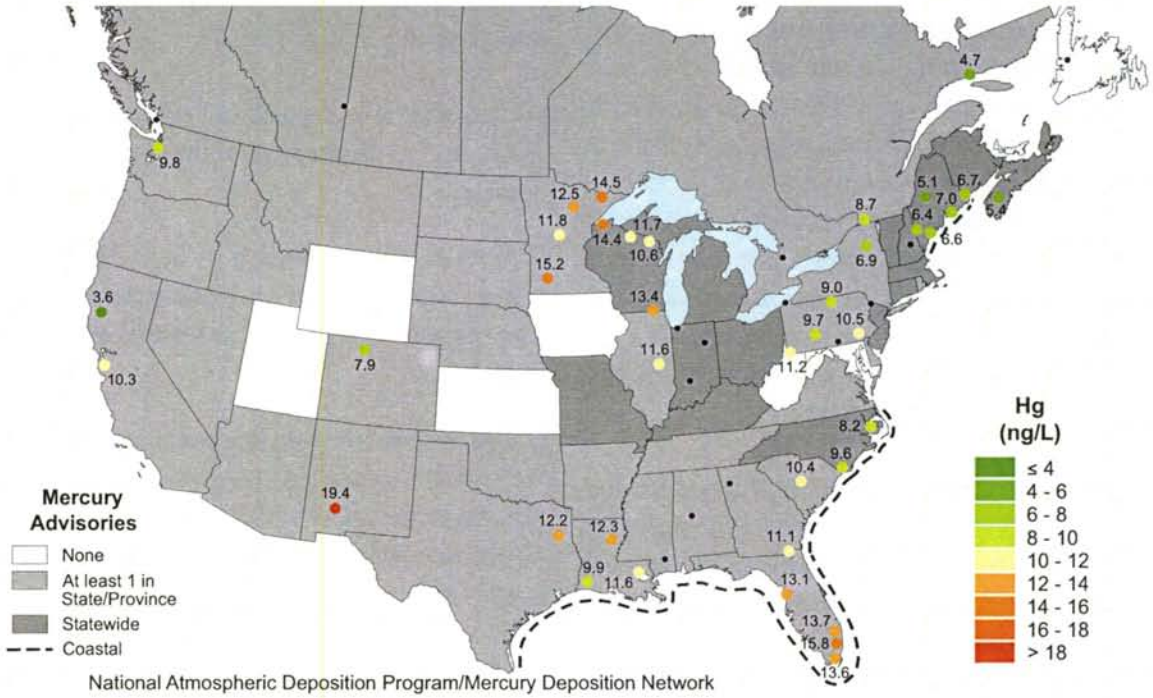
As the HAL, Frontier receives weekly precipitation samples to be analyzed for total mercury. The analytical technique—Modified EPA Method 1631 Revision B—was developed by Nicolas S Bloom, one of Frontier's Senior Research Scientists. Frontier also served as the referee lab for the Method 1631 final validation study.

Robert Brunette, Project Investigator and HAL Director, oversees Frontier's involvement in the MDN. He serves as the MDN Liaison, HAL contact for the multiple agencies currently sponsoring the MDN, and as Chair of the Data Management and Analysis Subcommittee for the NADP. His multiple roles require him to provide guidance and direction to all HAL staff, and to maintain his proficiency at all aspects of HAL activities, including MDN site selection and equipment installation, MDN equipment troubleshooting, field and laboratory training, analysis and report writing, as well as research on new MDN initiatives including Trace Metals (in addition to Hg) in Wet Deposition. Mr. Brunette is supported by an analytical laboratory staff skilled in processing incoming samples, analyzing sample sets, cleaning glassware, shipping weekly field equipment, and entering data. Senior Research Scientist, Eric M. Prestbo, serves as Science Advisor for the HAL, and helps support MDN related research initiatives. The Project Investigator also works closely with Frontier's Laboratory Manager, Michelle Gauthier, and Beverly van Buuren, Frontier's Quality Assurance Program Director, to ensure that all quality control (QC) parameters are consistently maintained, and that Frontier's high standards of professional and scientific quality are met.

Frontier continued to maintain and demonstrate high quality control standards in 2000. Due to

the addition of new MDN sites, the number of quality control points increased from 705 in 1999 to greater than 945 quality control measurements in 2000. Frontier further demonstrated excellent consistency and reproducibility with Reagent (1% BrCl Preservative) Blanks, Bottle Blanks, Standard Reference Materials, Matrix Duplicates, and Matrix Spikes. All of these parameters are control charted in Appendix A of this report.

2000 Mercury Concentration and Mercury Advisories for fish and wildlife consumption



National Atmospheric Deposition Program/Mercury Deposition Network

II. General Description of Frontier's Quality Assurance Program

A. Quality Assurance and Quality Control

Frontier has a strong and vital commitment to its Quality Assurance Program, viewing quality assurance as a program and a philosophy. We begin quality control at the bench level, and continuously work to improve our processes at the management level. Our management style is to solicit process improvements and problem-solving from our laboratory technicians and analysts, then utilize management to help implement these improvements — rather than the traditional management style of issuing orders which may or may not have much bearing on how things actually work in the laboratory.

Our Quality Assurance Program is a system for ensuring that all information, data and interpretation resulting from an analytical procedure are technically sound, statistically valid, and appropriately documented. Our quality control parameters are the mechanisms used to achieve quality assurance.

Due to our growth and increase in employees, the QA department at Frontier has expanded and added one position. This addition will help in maintaining our quality control parameters to ensure we continue to achieve quality assurance as we grow.

B. Data Quality Objectives

Data quality is achieved through Frontier's Data Quality Objectives (DQO's). Our DQO's consist of five components: precision, accuracy, representativeness, comparability and completeness (PARCC).

- Precision is a measure of data reproducibility; it is measured by utilizing sample replicates.
- Accuracy is a measure of how close the data is to the actual, or real value, and is measured by certified reference materials and matrix spikes.
- Representativeness is a measure of how typical a sample is compared to the sample population. It is achieved by accurate, artifact-free sampling procedures and appropriate sample homogenization.
- Comparability is a measure of how variable one set of data is to another.
- Completeness is a measure of how many data points collected are usable; Frontier strives for at least 95% completeness.

III. Quality Control Procedures

A. Bottle Blanks

Bottle blanks are expected to be at or near the method detection limit (MDL). In cases where the blanks are significantly higher, the situation is investigated. Possible contamination sources are researched and identified. Once the problem has been found and corrected, the run is continued. Control charts for bottle blanks are maintained on an ongoing basis, helping to identify trends or anomalies.

The mean for the 2000 lab sample bottle blanks is 0.034 ng/Bottle (n=72) with a standard deviation of 0.020ng/Bottle. Control charts are listed in Appendix A.

B. Reagent Blanks

Reagent blanks consist of 1% (v/v) 0.2N bromine monochloride, 0.2 mL 20% hydroxylamine hydrochloride, and 0.3 mL 20% stannous chloride in 100 mL of reagent water. Reagent blanks are a measure of how much analyte may be found in the bromine monochloride used for oxidizing the samples. Reagent blanks help when researching possible sources of contamination.

The mean for 2000 reagent blanks is 0.071 ng/L (n=242) with a standard deviation of 0.068ng/L. Control charts are listed in Appendix A.

C. Matrix Duplicates

A matrix duplicate sample is run with each analytical set. The relative percent difference (RPD) is calculated, and is expected to be less than 25%. If the result is higher than 25%, the samples are re-run. If the result is still higher than 25%, then the problem is investigated and possible causes are identified and noted in the report.

The mean for 2000 RPD's is 4.36% (n=235) with a standard deviation of 4.3%. Control charts are listed in Appendix A.

D. Certified Reference Material Samples

Certified reference material (CRM) samples are used to compare sample results with a known, certified value. This is a useful tool for validating the analytical curve. The acceptance range for the

reference samples is 75-125%. If the percent recovery lies out of this range, the sample CRM is rerun for more acceptable results. If the percent recovery is within the acceptance range, analysis continues. The CRM used is DORM-2—a fish tissue.

The mean for 2000 CRMs is 98.1% recovery (n=161) with a standard of 5.6%. All reference samples fell within the designated parameters in 2000. Control charts are listed in Appendix A.

E. Matrix Spike Samples

Matrix spikes are a tool for determining if, and how, the sample matrix interferes with analyte quantification. Matrix spikes help answer two questions:

1) Does the analyte in the sample go through the analytical system the same way analyte in the standards does?

2) Are we able to carry the analyte throughout the analytical system without significant losses?

Matrix spikes falling within 75-125% recovery are considered valid. Analytical spikes falling outside these parameters must be re-run. If the spike continues to fall outside 75-125% recovery then possible causes must be looked for and identified. The MDN matrix (rainwater) is spiked with 1.00 ng of Hg (II).

The mean for 2000 matrix spikes is 99.7% recovery (n=235). Control charts are listed in Appendix A.

F. Performance Test and Interlaboratory Intercomparison Studies

Performance evaluation and interlaboratory intercomparison studies are a vital part of our Quality Assurance Program. Frontier is a regular participant in studies prepared by the Analytical Products Group, National Water Research Institute (Canada), National Oceanic and Atmospheric Administration (US), National Research Council (Canada), US Geological Survey, the Institute for National Measurement Standards (Canada), and New York State PT samples.

Included in Appendix C area few of the Performance Evaluation Studies Frontier reported in 2000:

1. New York Dept. Of Health – Non-Potable Water – 7/2000

2. Analytical Products Group – WP June 2000

Included in Appendix D are a few of the Laboratory Intercomparison Studies that Frontier reported in 2000:

1. National Water Research Institute – Ecosystem Performance Evaluation QA Program – Study FP77 – Fall 2000

2. Florida Dept. Of Environmental Protection – Mercury Intercomparison Study October 1999 – April 2000

3. Results Of USGS Analytical Evaluation Program For Standard Reference Samples Distribution in March 2000.

Frontier currently holds certifications in six states, they are: Washington, Wisconsin, Florida, California, New York, New Jersey and Louisiana. We are also pursuing certification status for states where additional Frontier clients reside.

IV. HAL 2001 Outlook

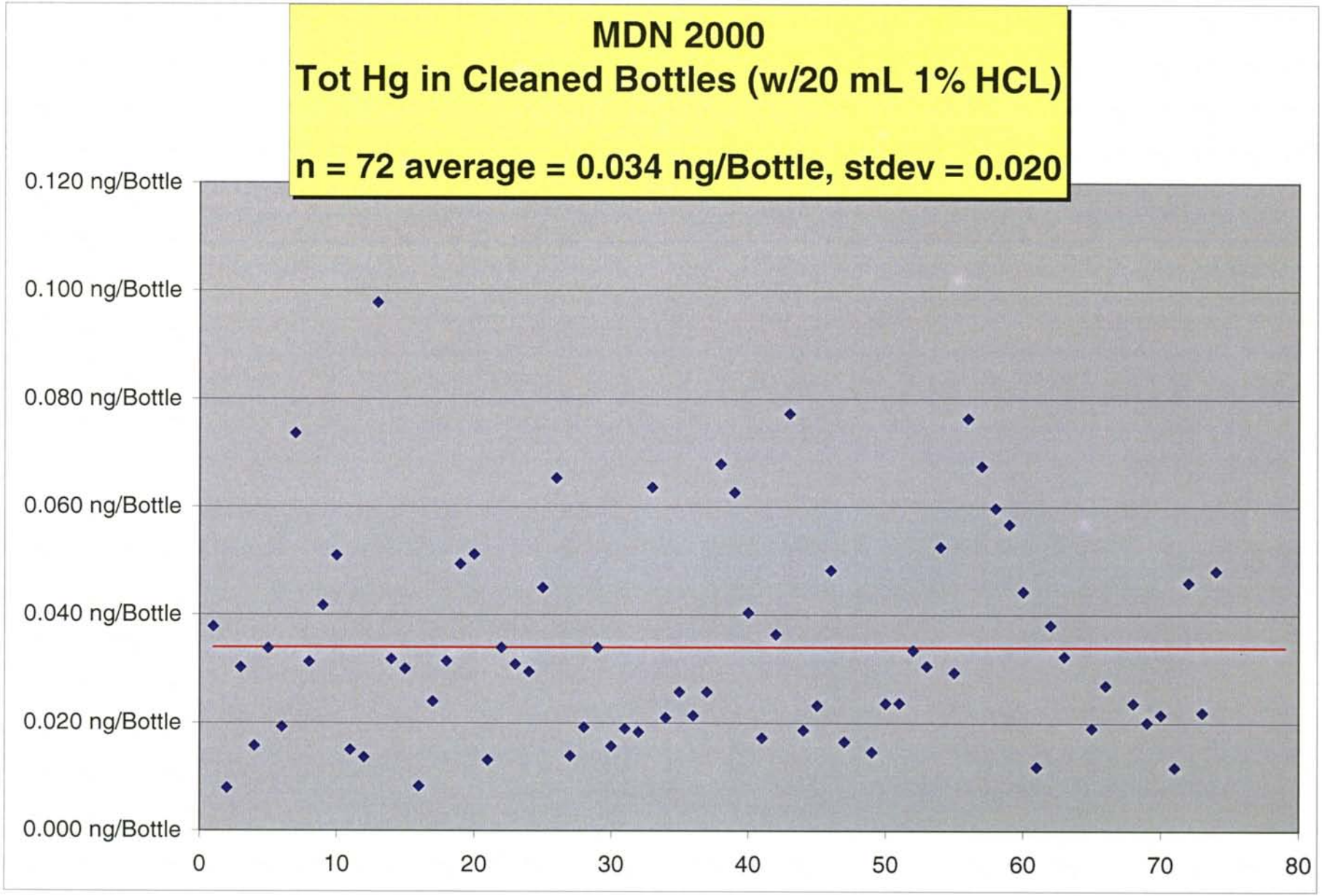
The Mercury Deposition Network continues to gain attention as the largest and longest-running National Hg wet deposition network in North America. This increased exposure will lead to significant growth in 2000-2001. With this growth, the HAL will continue to look for ways to improve the program to ensure the highest quality.

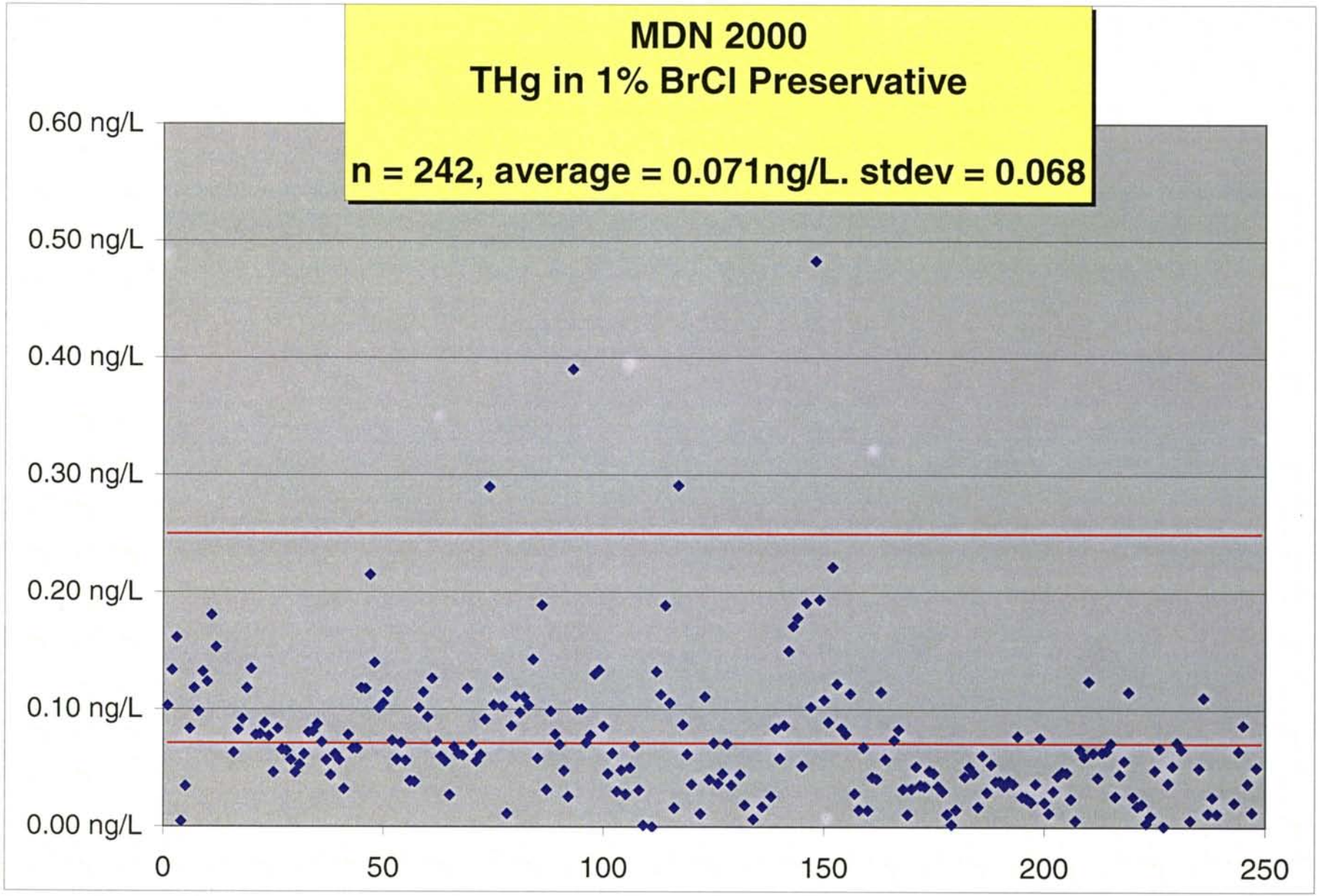
The following are goals the HAL has set to maintain and improve quality throughout 2000:

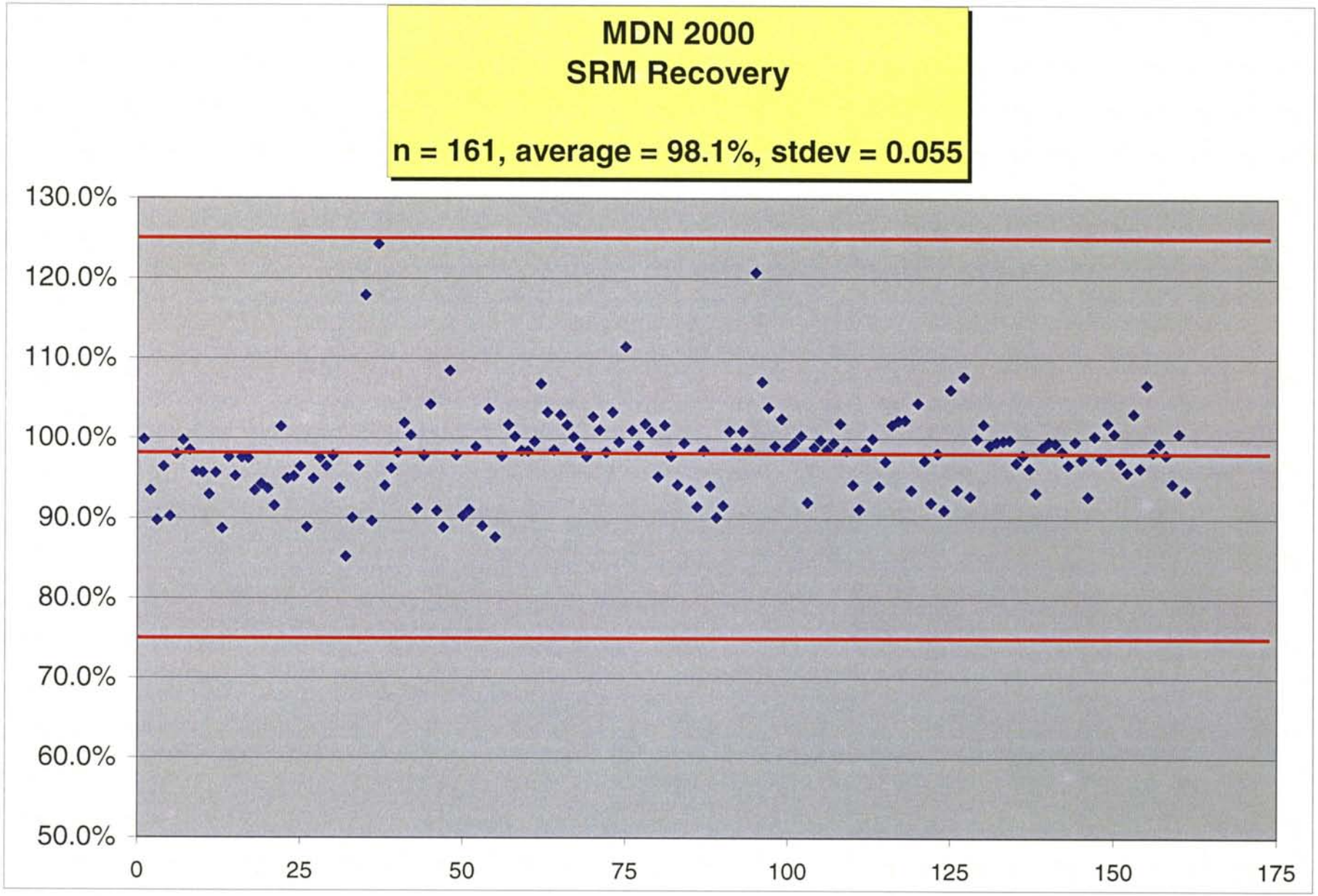
- In 1998, Frontier created an Access Data Base which has greatly improved data handling and coordination. The HAL will continue to improve this data management system in 2000 and expand the Database to include MMHg data.
- The HAL upgraded MDN facilities in order to stay ahead of the projected growth of the Network in 1999 and will continue to improve these facilities in 2000.
- The HAL continued trace metals in wet deposition research in 2000 and is expected to launch a Trace Metals in Wet Deposition initiative in 2000-2001 due to increased interest by MDN site sponsors.
- The HAL will continue research into Dry Deposition of Mercury and Trace Metals in sites in the Southern U.S. as there is great interest from MDN sponsors in this measurement
- The HAL will continue—and work to increase the frequency of mercury laboratory intercomparison studies in 2000.

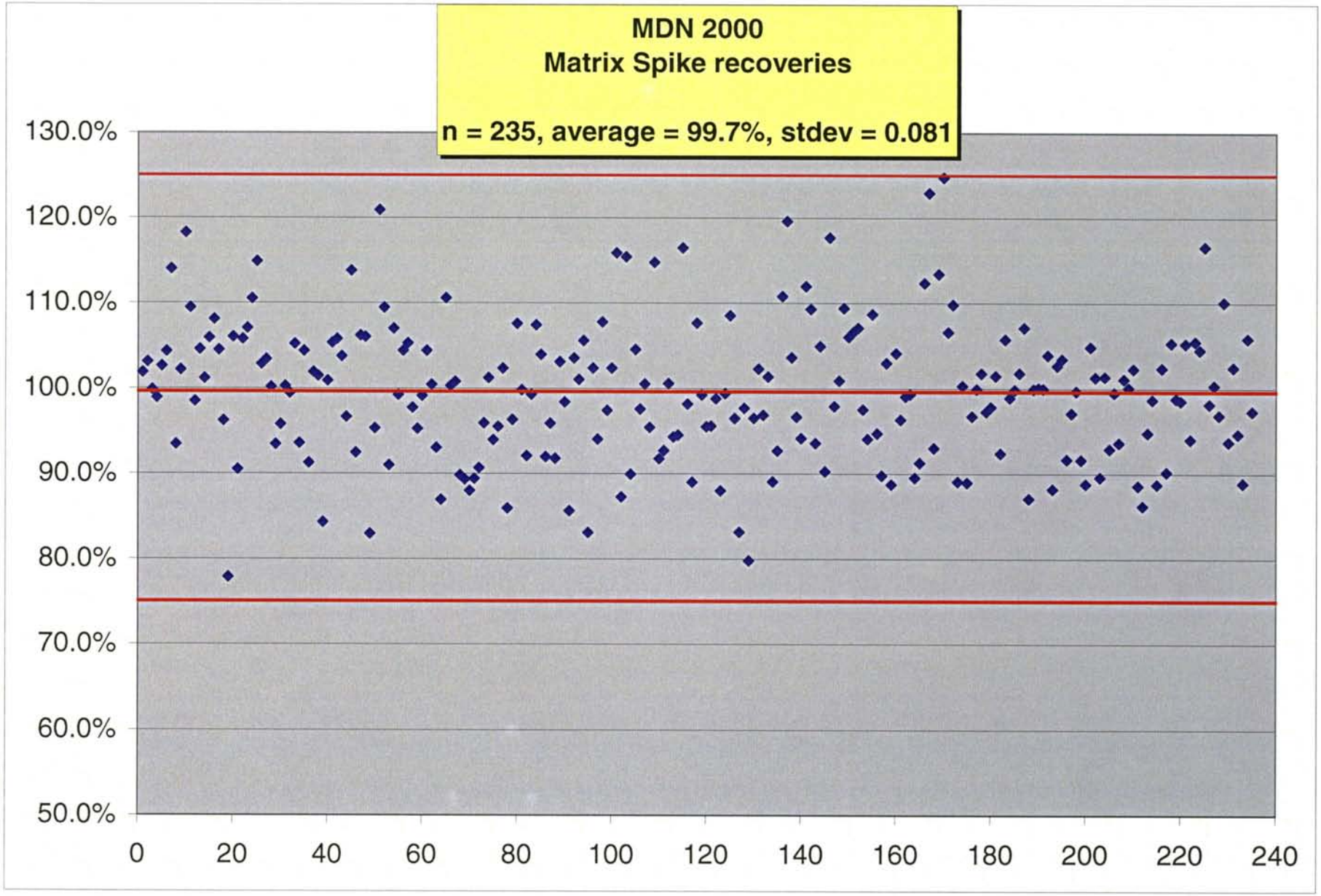
Appendix A:

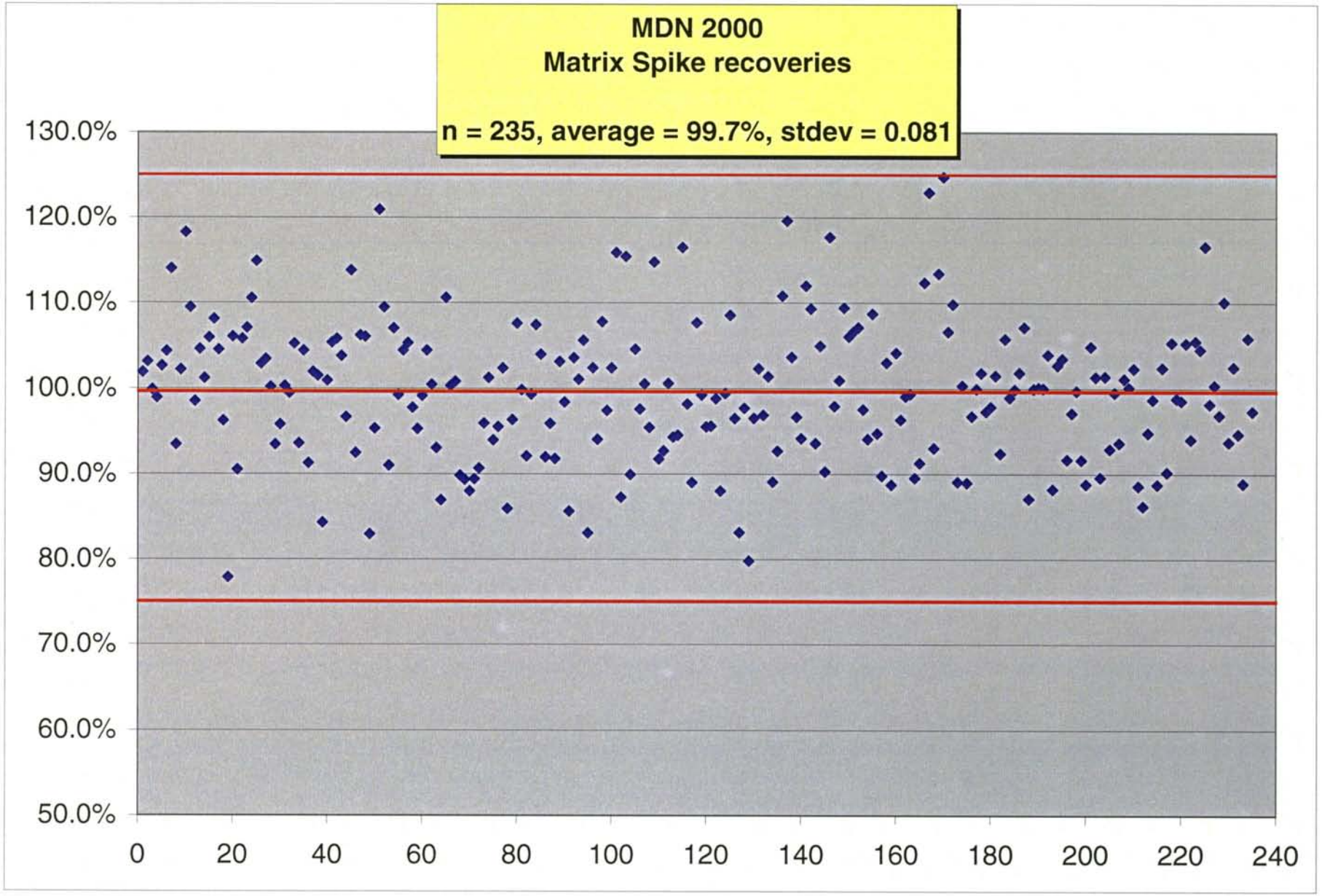
HAL 2000 Annual QA/QC Control Charts


MDN 2000
Tot Hg in Cleaned Bottles (w/20 mL 1% HCL)
n = 72 average = 0.034 ng/Bottle, stdev = 0.020
0.120 ng/Bottle
0.100 ng/Bottle
0.080 ng/Bottle
0.060 ng/Bottle
0.040 ng/Bottle
0.020 ng/Bottle
0.000 ng/Bottle
0
10
20
30
40
50
60
70
80


MDN 2000
THg in 1% BrCl Preservative
n = 242, average = 0.071ng/L. stdev = 0.068
0.60 ng/L
0.50 ng/L
0.40 ng/L
0.30 ng/L
0.20 ng/L
0.10 ng/L
0.00 ng/L
0
50
100
150
200
250


MDN 2000
SRM Recovery
n = 161, average = 98.1%, stdev = 0.055
130.0%
120.0%
110.0%
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
0
25
50
75
100
125
150
175


MDN 2000
Matrix Spike recoveries
n = 235, average = 99.7%, stdev = 0.081
130.0%
120.0%
110.0%
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
0
20
40
60
80
100
120
140
160
180
200
220
240


MDN 2000
Matrix Spike recoveries
n = 235, average = 99.7%, stdev = 0.081
130.0%
120.0%
110.0%
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
0
20
40
60
80
100
120
140
160
180
200
220
240

Appendix B:

HAL 2000 Quarterly QA/QC Summary Tables

MDN Quarterly Analysis QC Summary

Quarter 1 of 2000

Analysis		Calibration	BrCl Blk	SRM		Duplicates		Spikes		Bottle Blanks	
		R	Conc	Conc	%Rec	Bottle ID	RPD	Bottle ID	Rec.	Bottle ID	Conc
2000-001	1/10/2000 CVAFS-5	0.99877	0.132 ng/L	DORM-2 4.63 ng/mL	99.8%	MDN198	3.7%	MDN198	101.9%	MDN735	0.038 ng/Bottle
						MDN861	1.7%	MDN861	103.1%		
				DORM-2 4.33 ng/mL	93.4%	MDN965	12.5%	MDN965	99.9%		
2000-002	1/10/2000 CVAFS-4	0.99767	0.041 ng/L	DORM-2 4.16 ng/mL	89.7%	MDN637	3.2%	MDN637	98.9%	MDN658	0.008 ng/Bottle
						MDN890	1.6%	MDN890	102.6%		
				DORM-2 4.47 ng/mL	96.4%	MDN986	0.2%	MDN986	104.3%		
2000-003	1/14/2000 CVAFS-4	0.99915	0.116 ng/L	DORM-2 4.19 ng/mL	90.2%	MDN0184	1.0%	MDN0184	114.0%		
						MDN0930	8.2%	MDN0930	93.5%		
				DORM-2 4.55 ng/mL	98.0%	MDN0968	0.1%	MDN0968	102.2%		
2000-004	1/14/2000 CVAFS-5	0.99827	0.152 ng/L	DORM-2 4.63 ng/mL	99.7%	MDN0274	3.8%	MDN0274	118.2%	MDN0784	0.030 ng/Bottle
						MDN0413	8.5%	MDN0413	109.5%	MDN0807	0.016 ng/Bottle
				DORM-2 4.57 ng/mL	98.5%	MDN0479	10.0%	MDN0479	98.5%		
2000-005	1/21/2000 CVAFS-4	0.99979	0.247 ng/L	DORM-2 4.44 ng/mL	95.8%	MDN0137	1.0%	MDN0086	104.6%		
								MDN0137	101.2%		
2000-006	1/24/2000 CVAFS-4	0.99954	0.079 ng/L	DORM-2 4.44 ng/mL	95.7%	MDN0018	0.3%	MDN0018	105.9%	MDN1746	0.034 ng/Bottle
						MDN0171	4.6%	MDN0171	108.1%	MDN0718	0.074 ng/Bottle
				DORM-2 4.31 ng/mL	92.9%	MDN0844	0.5%	MDN0844	104.5%		
2000-007	1/24/2000 CVAFS-5	0.99856	0.110 ng/L	DORM-2 4.44 ng/mL	95.7%	MDN0138	9.3%	MDN0138	96.2%		
						MDN0176	7.4%	MDN0176	77.9%		
				DORM-2 4.12 ng/mL	88.7%	MDN0412	5.1%	MDN0412	106.0%		
2000-008	2/4/2000 CVAFS-5	0.99928	0.081 ng/L	DORM-2 4.53 ng/mL	97.6%	MDN0755	7.9%	MDN0755	90.5%	MDN0139	0.019 ng/Bottle
						MDN0820	10.6%	MDN0820	105.8%	MDN1750	0.019 ng/Bottle
				DORM-2 4.42 ng/mL	95.2%	MDN0912	6.8%	MDN0912	107.1%		
2000-009	2/4/2000 CVAFS-4	0.99710	0.065 ng/L	DORM-2 4.53 ng/mL	97.6%	MDN0143	5.7%	MDN0143	110.5%	MDN0400	0.031 ng/Bottle
						MDN0667	5.4%	MDN0667	114.9%	MDN0447	0.031 ng/Bottle
				DORM-2 4.52 ng/mL	97.5%	MDN0681	3.9%	MDN0681	102.9%	MDN0184	0.024 ng/Bottle
2000-010	2/11/2000 CVAFS-4	0.99979	0.056 ng/L	DORM-2 4.33 ng/mL	93.4%	MDN0734	1.3%	MDN0734	103.4%		
						MDN1748	3.3%	MDN1748	100.2%		
				DORM-2 4.37 ng/mL	94.3%	MDN1752	0.8%	MDN1752	93.5%		
2000-011	2/14/2000 CVAFS-5	0.99988	0.065 ng/L	DORM-2 4.35 ng/mL	93.7%	MDN0173	1.0%	MDN0173	95.8%	MDN0485	0.008 ng/Bottle
						MDN0693	6.9%	MDN0693	100.3%	MDN0638	0.030 ng/Bottle
				DORM-2 4.25 ng/mL	91.6%	MDN0696	3.2%	MDN0696	99.5%		

MDN Quarterly Analysis QC Summary

Quarter 1 of 2000

2000-012	2/18/2000 CVAFS-5	0.99931	0.080 ng/L	DORM-2 4.71 ng/mL	101.4%	MDN0742 MDN0895	5.7% 1.3%	MDN0742 MDN0895	105.2% 93.6%	MDN0736	0.032 ng/Bottle
				DORM-2 4.40 ng/mL	94.9%	MDN0935	3.1%	MDN0935	104.4%		
2000-013	2/18/2000 CVAFS-4	0.99978	0.054 ng/L	DORM-2 4.42 ng/mL	95.2%	MDN0965 MDN1741	1.2% 2.3%	MDN0965 MDN1741	91.3% 101.9%	MDN0399	0.042 ng/Bottle
				DORM-2 4.47 ng/mL	96.4%	MDN1745	7.1%	MDN1745	101.5%		
2000-014	3/10/2000 CVAFS-4	0.99803	0.056 ng/L	DORM-2 4.12 ng/mL	88.9%	MDN0274 MDN0489	3.4% 10.9%	MDN0274 MDN0489	84.3% 100.9%	MDN0785 MDN0857	0.098 ng/Bottle 0.049 ng/Bottle
				DORM-2 4.40 ng/mL	94.9%	MDN0660	2.3%	MDN0660	105.4%		
2000-015	3/10/2000 CVAFS-5	0.99945	0.084 ng/L	DORM-2 4.52 ng/mL	97.5%	MDN0758 MDN0867	0.4% 0.5%	MDN0758 MDN0867	105.8% 103.8%		
				DORM-2 4.48 ng/mL	96.5%	MDN0963	0.6%	MDN0963	96.7%		
2000-016	3/15/2000 CVAFS-5	0.99965	0.157 ng/L	DORM-2 4.54 ng/mL	97.8%	MDN0197 MDN0299	6.0% 0.2%	MDN0197 MDN0299	113.8% 92.5%	MDN0148 MDN0275	0.014 ng/Bottle 0.051 ng/Bottle
				DORM-2 4.35 ng/mL	93.7%	MDN0910	7.8%	MDN0910	106.2%		
2000-017	3/15/2000 CVAFS-4	0.99988	0.107 ng/L	DORM-2 3.95 ng/mL	85.2%	MDN0445 MDN0743	0.2% 5.1%	MDN0445 MDN0743	106.0% 83.0%	MDN0845	0.015 ng/Bottle
				DORM-2 4.18 ng/mL	90.0%	MDN0951	0.2%	MDN0951	95.3%		
2000-018	3/27/2000 CVAFS-5	0.99835	0.067 ng/L	NIST 1641d 7.67 ng/mL	96.5%	MDN0490	5.6%	MDN0490	109.5%		
				NIST 1641d 9.37 ng/mL	117.9%						
2000-019	3/27/2000 CVAFS-4	0.99365	0.045 ng/L	NIST 1641d 7.13 ng/mL	89.7%	MDN0419	14.6%	MDN0419	91.0%		
				NIST 1641d 9.88 ng/mL	124.3%						
Quarterly Mean: **Std Dev:**		**0.99873** **±0.00148**	**0.095 ng/L** **±0.051**		**96.1%** **±7.0%**		**4.3%** **±3.7%**		**101.3%** **±7.9%**		**0.033 ng/Bottle** **±0.022**

MDN Quarterly Analysis QC Summary

Quarter 2 of 2000

Analysis		Calibration	BrCl Blk	SRM		Duplicates		Spikes		Bottle Blanks	
		R	Conc	Conc	%Rec	Bottle ID	RPD	Bottle ID	Rec.	Bottle ID	Conc
2000-020	4/5/2000 CVAFS-4	0.99975	0.103 ng/L	NIST 1641d 7.48 ng/mL	94.0%	MDN0770	6.3%	MDN0770	107.0%	MDN0988	0.063 ng/Bottle
						MDN0875	3.5%	MDN0875	99.3%		
				NIST 1641d 7.65 ng/mL	96.2%	MDN0945	3.6%	MDN0945	104.4%		
2000-021	4/14/2000 CVAFS-5	0.99869	0.086 ng/L	NIST 1641d 7.81 ng/mL	98.2%	MDN0134	3.0%	MDN0134	105.3%	MDN0281	0.019 ng/Bottle
						MDN0268	1.8%	MDN0268	97.8%		
				NIST 1641d 8.10 ng/mL	101.9%	MDN1754	1.6%	MDN1754	95.3%		
2000-022	4/14/2000 CVAFS-4	0.99585	0.050 ng/L	NIST 1641d 7.98 ng/mL	100.4%	MDN0496	1.0%	MDN0496	99.1%	MDN0487	0.018 ng/Bottle
						MDN0969	2.9%	MDN0969	104.4%	MDN0442	0.064 ng/Bottle
				NIST 1641d 7.25 ng/mL	91.2%	MDN1745	0.5%	MDN1745	100.4%		
2000-023	4/17/2000 CVAFS-5	0.99879	0.080 ng/L	NIST 1641d 7.77 ng/mL	97.8%	MDN0161	3.8%	MDN0161	93.1%	MDN0427	0.016 ng/Bottle
						MDN0950	12.0%	MDN0950	87.0%		
				NIST 1641d 8.29 ng/mL	104.2%	MDN1744	7.5%	MDN1744	110.6%		
2000-024	4/17/2000 CVAFS-4	0.99991	0.062 ng/L	NIST 1641d 7.23 ng/mL	91.0%	MDN0144	12.4%	MDN0144	100.3%		
						MDN0269	0.2%	MDN0269	100.8%		
				NIST 1641d 7.07 ng/mL	88.9%	MDN0865	4.1%	MDN0865	89.8%		
2000-025	4/21/2000 CVAFS-5	0.99750	0.162 ng/L	NIST 1641d 8.62 ng/mL	108.4%	MDN0119	0.8%	MDN0119	89.4%		
						MDN0259	15.2%	MDN0259	88.0%		
				NIST 1641d 7.78 ng/mL	97.9%	MDN0842	3.1%	MDN0842	89.4%		
2000-026	4/21/2000 CVAFS-4	0.99973	0.080 ng/L	NIST 1641d 7.18 ng/mL	90.3%	MDN0121	0.3%	MDN0121	90.7%		
						MDN0255	4.2%	MDN0255	95.9%		
				NIST 1641d 7.24 ng/mL	91.1%						
2000-027	5/4/2000 CVAFS-4	0.99916	0.098 ng/L	NIST 1641d 7.86 ng/mL	98.9%	MDN0777	7.3%	MDN0777	101.2%	MDN0085	0.034 ng/Bottle
						MDN0784	2.7%	MDN0784	94.0%		
				NIST 1641d 7.08 ng/mL	89.0%	MDN0836	1.8%	MDN0836	95.5%		
2000-028	5/4/2000 CVAFS-5	0.99657	0.119 ng/L	NIST 1641d 8.24 ng/mL	103.6%	MDN0393	4.0%	MDN0393	102.4%	MDN0681	0.019 ng/Bottle
						MDN0849	1.4%	MDN0849	85.9%		
				NIST 1641d 6.97 ng/mL	87.7%	MDN1760	3.0%	MDN1760	96.3%		
2000-029	5/5/2000 CVAFS-5	0.99923	0.093 ng/L	NIST 1641d 7.77 ng/mL	97.8%	MDN0292	6.8%	MDN0292	107.6%	MDN0150	0.014 ng/Bottle
						MDN0394	11.0%	MDN0394	99.8%	MDN0657	0.013 ng/Bottle
				NIST 1641d 8.08 ng/mL	101.7%	MDN0710	6.3%	MDN0710	92.1%		
2000-030	5/12/2000 CVAFS-4	0.99987	0.082 ng/L	NIST 1641d 7.97 ng/mL	100.2%	MDN0125	2.5%	MDN0125	99.3%	MDN0144	0.045 ng/Bottle
						MDN0720	12.2%	MDN0720	107.4%	MDN0132	0.030 ng/Bottle
				NIST 1641d 7.83 ng/mL	98.4%	MDN0941	6.6%	MDN0941	104.0%		

MDN Quarterly Analysis QC Summary

Quarter 2 of 2000

2000-031	5/12/2000 CVAFS-5	0.99923	0.155 ng/L	NIST 1641d 7.82 ng/mL 98.4% NIST 1641d 7.92 ng/mL 99.6%	MDN0838 MDN0847 MDN0910	9.6% 1.2% 5.9%	MDN0838 MDN0847 MDN0910	92.0% 95.9% 91.8%	MDN0255	0.031 ng/Bottle
2000-032	5/19/2000 CVAFS-6	0.99980	0.091 ng/L	NIST 1641d 8.49 ng/mL 106.8% NIST 1641d 8.21 ng/mL 103.2%	MDN0146 MDN0639 MDN0771	2.9% 3.6% 3.4%	MDN0146 MDN0639 MDN0771	103.1% 98.4% 85.6%	MDN0828	0.034 ng/Bottle
2000-033	6/2/2000 CVAFS-4	0.99995	0.114 ng/L	NIST 1641d 7.83 ng/mL 98.5% NIST 1641d 8.18 ng/mL 102.9%	MDN0750 MDN0861 MDN0943	0.4% 6.9% 11.3%	MDN0750 MDN0861 MDN0943	103.5% 101.1% 105.6%	MDN0801	0.065 ng/Bottle
2000-034	6/5/2000 CVAFS-4	0.99967	0.064 ng/L	NIST 1641d 8.08 ng/mL 101.7% NIST 1641d 7.96 ng/mL 100.1%	MDN0429 MDN0479 MDN0981	21.5% 6.1% 7.1%	MDN0429 MDN0479 MDN0981	83.1% 102.4% 94.0%		
2000-035	6/9/2000 CVAFS-5	0.99948	0.035 ng/L	NIST 1641d 7.86 ng/mL 98.8% NIST 1641d 7.77 ng/mL 97.7%	MDN0188 MDN0638 MDN0663	1.2% 2.3% 1.3%	MDN0188 MDN0638 MDN0663	107.8% 97.4% 102.4%		
2000-036	6/9/2000 CVAFS-4	0.99971	0.050 ng/L	NIST 1641d 8.16 ng/mL 102.7% NIST 1641d 8.03 ng/mL 101.0%	MDN0278 MDN0286 MDN0955	10.7% 7.6% 12.4%	MDN0278 MDN0286 MDN0955	115.9% 87.3% 115.4%	MDN0182 MDN0415	0.051 ng/Bottle 0.040 ng/Bottle
2000-037	6/21/2000 CVAFS-4	0.99965	-0.032 ng/L	NIST 1641d 7.81 ng/mL 98.3% NIST 1641d 8.21 ng/mL 103.3%	MDN0287 MDN0399 MDN0494	2.0% 4.1% 5.9%	MDN0287 MDN0399 MDN0494	90.0% 104.6% 97.6%	MDN0428 MDN0787	0.021 ng/Bottle 0.026 ng/Bottle
2000-038	6/28/2000 CVAFS-5	0.99929	0.144 ng/L	NIST1641d 7.91 ng/mL 99.5% NIST1641d 8.86 ng/mL 111.4%	MDN0894 MDN0982	6.0% 5.8%	MDN0982	100.5%	MDN0185	0.021 ng/Bottle
2000-039	6/28/2000 CVAFS-4	0.99606	0.138 ng/L	NIST1641d 8.02 ng/mL 100.9% NIST1641d 7.88 ng/mL 99.1%	MDN0166 MDN0190 MDN0681	11.7% 14.9% 5.2%	MDN0166 MDN0190 MDN0681	95.4% 114.8% 91.8%	MDN0797 MDN0804	0.026 ng/Bottle 0.068 ng/Bottle
Quarterly Mean: **Std Dev:**		**0.99890** **±0.00131**	**0.089 ng/L** **±0.045**	**98.8%** **±5.3%**		**5.6%** **±4.5%**		**98.4%** **±7.6%**		**0.034 ng/Bottle** **±0.018**

MDN Quarterly Analysis QC Summary

Quarter 3 of 2000

Analysis		Calibration	BrCl Blk	SRM		Duplicates		Spikes		Bottle Blanks	
		R	Conc	Conc	%Rec	Bottle ID	RPD	Bottle ID	Rec.	Bottle ID	Conc
2000-040	7/3/2000 CVAFS-5	0.99697	0.062 ng/L	NIST1641d 8.09 ng/mL	101.8%	MDN0913	2.6%	MDN0913	92.7%	MDN0718	0.033 ng/Bottle
						MDN0945	15.6%	MDN0945	100.6%		
				NIST1641d 8.02 ng/mL	100.8%	MDN1756	1.6%	MDN1756	94.3%		
2000-041	7/3/2000 CVAFS-4	0.99991	0.026 ng/L	NIST1641d 7.57 ng/mL	95.2%	MDN0126	4.9%	MDN0126	94.5%		
						MDN0130	9.0%	MDN0130	116.5%		
				NIST1641d 8.08 ng/mL	101.6%	MDN0150	6.6%	MDN0150	98.2%		
2000-042	7/20/2000 CVAFS-4	0.99966	0.050 ng/L	NIST1641d 7.77 ng/mL	97.8%	MDN0742	2.4%	MDN0742	89.0%		
						MDN0793	14.0%	MDN0793	107.7%		
				NIST1641d 7.49 ng/mL	94.2%	MDN0958	3.5%	MDN0958	99.2%		
2000-043	7/21/2000 CVAFS-4	0.99949	0.051 ng/L	NIST1641d 7.90 ng/mL	99.4%	MDN0774	1.6%	MDN0774	95.5%	MDN0154	0.031 ng/Bottle
						MDN0816	3.0%	MDN0816	95.6%		
				NIST1641d 7.43 ng/mL	93.5%	MDN0910	2.1%	MDN0910	98.8%		
2000-044	7/21/2000 CVAFS-5	0.99665	0.202 ng/L	NIST1641d 7.27 ng/mL	91.5%	MDN0724	12.0%	MDN0724	88.0%	MDN0953	0.053 ng/Bottle
						MDN0759	2.5%	MDN0743	99.4%		
				NIST1641d 7.83 ng/mL	98.5%	MDN0946	16.4%	MDN0759	108.5%		
								MDN0946	72.9%		
2000-045	7/25/2000 CVAFS-4	0.99712	-0.033 ng/L	NIST1641d 7.48 ng/mL	94.0%					MDN0182	0.299 ng/Bottle
2000-046	7/25/2000 CVAFS-5	0.99905	0.013 ng/L	NIST1641d 7.17 ng/mL	90.2%	MDN0193	1.5%	MDN0193	83.2%		
						MDN0276	4.0%	MDN0276	97.7%		
				NIST1641d 7.28 ng/mL	91.6%	MDN0792	9.9%	MDN0792	79.8%		
2000-047	7/27/2000 CVAFS-5	0.99913	0.076 ng/L	NIST1641d 8.02 ng/mL	100.9%	MDN0449	1.8%	MDN0449	96.5%	MDN1738	0.044 ng/Bottle
						MDN0745	6.5%	MDN0745	102.3%	MDN0495	0.024 ng/Bottle
				NIST1641d 7.85 ng/mL	98.8%	MDN0770	1.3%	MDN0770	96.9%	MDN0147	0.048 ng/Bottle
2000-048	8/4/2000 CVAFS-5	0.99918	0.167 ng/L	NIST1641d 8.02 ng/mL	100.9%	MDN0149	3.5%	MDN0149	101.4%		
						MDN0777	4.4%	MDN0777	89.1%		
				NIST1641d 7.84 ng/mL	98.6%	MDN0856	2.5%	MDN0856	92.7%		
2000-049	8/4/2000 CVAFS-4	0.99777	0.115 ng/L	NIST1641d 9.60 ng/mL	120.7%	MDN0295	1.7%	MDN0295	110.8%	MDN0698	0.057 ng/Bottle
						MDN0414	4.8%	MDN0414	119.6%		
				NIST1641d 8.51 ng/mL	107.1%						
2000-050	8/11/2000 CVAFS-5	0.99688	0.262 ng/L	NIST1641d 8.25 ng/mL	103.8%	MDN0709	15.5%	MDN0709	103.6%	MDN1734	0.077 ng/Bottle
						MDN0722	4.0%	MDN0722	96.7%	MDN0145	0.036 ng/Bottle
				NIST1641d 7.88 ng/mL	99.1%	MDN1732	9.1%	MDN1732	94.2%		

MDN Quarterly Analysis QC Summary

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2000-051	8/11/2000 CVAFS-4	0.99901	0.144 ng/L	NIST1641d 8.15 ng/mL 102.5%	MDN0165	2.8%	MDN0165	111.9%	MDN0961	0.029 ng/Bottle
					MDN0692	4.9%	MDN0692	109.3%		
				NIST1641d 7.85 ng/mL 98.8%	MDN0811	4.3%	MDN0811	93.6%		
2000-052	8/18/2000 CVAFS-5	0.99971	0.092 ng/L	NIST1641d 7.91 ng/mL 99.5%	MDN0020	0.4%	MDN0020	104.9%		
					MDN0190	4.4%	MDN0190	90.3%		
				NIST1641d 7.97 ng/mL 100.3%	MDN0749	2.0%	MDN0749	117.7%		
2000-053	8/18/2000 CVAFS-4	0.99938	0.037 ng/L	NIST1641d 7.32 ng/mL 92.1%	MDN0189	0.5%	MDN0189	97.9%	MDN0449	0.076 ng/Bottle
					MDN0439	2.1%	MDN0439	100.9%	MDN0276	0.060 ng/Bottle
				NIST1641d 7.86 ng/mL 98.9%	MDN0765	0.5%	MDN0765	109.4%		
2000-054	8/24/2000 CVAFS-4	0.99986	0.033 ng/L	NIST1641d 7.93 ng/mL 99.8%	MDN0257	0.1%	MDN0257	106.0%	MDN0956	0.068 ng/Bottle
					MDN0695	0.4%	MDN0695	106.6%		
				NIST1641d 7.84 ng/mL 98.6%	MDN0945	2.8%	MDN0945	107.1%		
2000-055	8/24/2000 CVAFS-5	0.99980	0.040 ng/L	NIST1641d 7.91 ng/mL 99.5%	MDN0137	0.4%	MDN0137	97.5%		
					MDN0804	4.3%	MDN0804	94.1%		
				NIST1641d 8.10 ng/mL 101.9%	MDN1733	1.7%				
2000-056	9/1/2000 CVAFS-5	0.99920	0.063 ng/L	NIST1641d 7.83 ng/mL 98.5%	MDN0635	6.1%	MDN0635	108.7%	MDN1742	0.015 ng/Bottle
					MDN0833	0.7%	MDN0833	94.7%		
				NIST1641d 7.49 ng/mL 94.2%	MDN1760	0.9%	MDN1760	89.8%		
2000-057	9/1/2000 CVAFS-4	0.99847	0.032 ng/L	NIST1641d 7.25 ng/mL 91.2%	MDN0146	0.1%	MDN0146	103.0%		
					MDN0266	3.8%	MDN0266	88.7%		
				NIST1641d 7.85 ng/mL 98.7%	MDN1736	0.9%	MDN1736	104.1%		
2000-058	9/8/2000 CVAFS-4	0.99958	0.039 ng/L	NIST1641d 7.95 ng/mL 100.0%	MDN0155	43.7%	MDN0155	96.3%		
					MDN0871	1.5%	MDN0871	99.1%		
				NIST1641d 7.48 ng/mL 94.1%	MDN0977	1.3%	MDN0977	99.3%		
2000-059	9/8/2000 CVAFS-5	0.99968	0.037 ng/L	NIST1641d 7.72 ng/mL 97.1%	MDN0162	4.0%	MDN0162	89.5%	MDN0771	0.017 ng/Bottle
					MDN0183	3.7%	MDN0183	91.3%		
				NIST1641d 8.09 ng/mL 101.7%	MDN0633	5.8%	MDN0633	112.3%		
2000-062	9/18/2000 CVAFS-4	0.99759	0.010 ng/L	NIST1641d 8.13 ng/mL 102.2%	MDN0745	24.8%	MDN0745	122.9%		
					MDN0795	5.2%	MDN0792	93.0%		
				NIST1641d 8.13 ng/mL 102.3%	MDN0853	2.6%	MDN0795	113.4%		
							MDN0853	124.7%		
2000-063	9/18/2000 CVAFS-5	0.99868	0.026 ng/L	NIST1641d 7.44 ng/mL 93.6%	MDN0143	2.0%	MDN0143	106.6%	MDN0488	0.017 ng/Bottle
					MDN0171	0.3%	MDN0171	109.8%		
				NIST1641d 8.30 ng/mL 104.4%	MDN0718	2.7%	MDN0718	89.1%		

MDN Quarterly Analysis QC Summary

Quarter 3 of 2000

2000-064	9/29/2000 CVAFS-4	0.99955	0.041 ng/L	NIST1641d 7.73 ng/mL	97.3%	MDN0148 MDN0688	0.9% 5.2%	MDN0148 MDN0688	100.3% 89.0%	MDN0125	0.024 ng/Bottle
				NIST1641d 7.32 ng/mL	92.0%	MDN0916	0.3%	MDN0916	96.7%		
2000-065	9/29/2000 CVAFS-5	0.99942	0.041 ng/L	NIST1641d 7.80 ng/mL	98.1%	MDN0127 MDN0180	3.7% 8.0%	MDN0127 MDN0180	99.9% 101.8%	MDN0447 MDN0128	0.023 ng/Bottle 0.019 ng/Bottle
				NIST1641d 7.24 ng/mL	91.1%	MDN0753	9.6%	MDN0753	97.3%		
Quarterly Mean:		**0.99882**	**0.068 ng/L**		**98.5%**		**5.0%**		**99.8%**		**0.052 ng/Bottle**
Std Dev:		**±0.00106**	**±0.067**		**±5.2%**		**±6.6%**		**±9.7%**		**±0.061**

MDN Quarterly Analysis QC Summary

Quarter 4 of 2000

Analysis		Calibration	BrCl Blk	SRM		Duplicates		Spikes		Bottle Blanks	
		R	Conc	Conc	%Rec	Bottle ID	RPD	Bottle ID	Rec.	Bottle ID	Conc
2000-066	10/7/2000 CVAFS-4	0.99959	0.038 ng/L	NIST1641d 8.44 ng/mL	106.1%	MDN0179	0.6%	MDN0179	97.8%	MDN0758	0.046 ng/Bottle
						MDN0191	1.6%	MDN0191	101.5%		
				NIST1641d 7.44 ng/mL	93.6%	MDN0284	2.0%	MDN0284	92.4%		
2000-067	10/7/2000 CVAFS-5	0.99941	0.047 ng/L	NIST1641d 8.56 ng/mL	107.7%	MDN0698	9.2%	MDN0698	105.8%	MDN0859	0.012 ng/Bottle
						MDN0846	3.7%	MDN0846	98.9%		
				NIST1641d 7.38 ng/mL	92.8%	MDN0864	8.3%	MDN0864	99.9%		
2000-068	10/13/200 CVAFS-5	0.99974	0.028 ng/L	NIST1641d 7.95 ng/mL	100.0%	MDN0485	1.3%	MDN0485	101.8%	MDN0390	0.022 ng/Bottle
						MDN0806	1.5%	MDN0806	107.1%	MDN0256	0.020 ng/Bottle
				NIST1641d 8.09 ng/mL	101.8%	MDN1746	0.9%	MDN1746	87.1%		
2000-069	10/13/200 CVAFS-4	0.99986	0.036 ng/L	NIST1641d 7.88 ng/mL	99.1%	MDN0147	0.1%	MDN0147	99.9%	MDN0870	0.024 ng/Bottle
						MDN0651	6.6%	MDN0651	100.1%		
				NIST1641d 7.92 ng/mL	99.6%	MDN0665	1.0%	MDN0665	100.0%		
2000-070	10/20/200 CVAFS-5	0.99958	0.040 ng/L	NIST1641d 7.93 ng/mL	99.7%	MDN0272	2.5%	MDN0272	103.9%	MDN0075	0.316 ng/Bottle
						MDN0810	1.5%	MDN0810	88.2%		
				NIST1641d 7.94 ng/mL	99.8%	MDN0932	3.1%	MDN0932	102.7%		
2000-071	10/20/200 CVAFS-4	0.99990	0.025 ng/L	NIST1641d 7.71 ng/mL	97.0%	MDN0140	5.8%	MDN0140	103.5%		
						MDN0287	0.1%	MDN0287	91.7%		
				NIST1641d 7.78 ng/mL	97.9%	MDN0676	2.0%	MDN0676	97.1%		
2000-072	10/27/200 CVAFS-4	0.99989	0.083 ng/L	NIST1641d 7.66 ng/mL	96.3%	MDN0192	0.3%	MDN0192	99.7%		
						MDN0855	1.4%	MDN0855	91.6%		
				NIST1641d 7.41 ng/mL	93.2%	MDN0943	0.3%	MDN0943	88.8%		
2000-073	10/27/200 CVAFS-5	0.99971	0.056 ng/L	NIST1641d 7.86 ng/mL	98.9%	MDN0722	2.0%	MDN0722	104.9%	MDN0697	0.022 ng/Bottle
						MDN0773	1.2%	MDN0773	101.3%		
				NIST1641d 7.92 ng/mL	99.6%	MDN0791	1.6%	MDN0791	89.6%		
2000-074	11/3/2000 CVAFS-5	0.99994	0.054 ng/L	NIST1641d 7.90 ng/mL	99.4%	MDN0283	2.9%	MDN0283	101.4%	MDN0930	0.012 ng/Bottle
						MDN0942	0.3%	MDN0942	92.9%		
				NIST1641d 7.82 ng/mL	98.4%	MDN0951	2.6%	MDN0951	99.5%		
2000-075	11/3/2000 CVAFS-4	0.99995	0.072 ng/L	NIST1641d 7.69 ng/mL	96.7%	MDN0130	3.2%	MDN0130	93.6%		
						MDN0166	3.6%	MDN0166	101.1%		
				NIST1641d 7.92 ng/mL	99.6%	MDN0668	0.6%	MDN0668	100.1%		
2000-076	11/10/200 CVAFS-4	0.99947	0.021 ng/L	NIST1641d 7.75 ng/mL	97.4%	MDN0488	1.6%	MDN0488	102.3%		
						MDN0688	1.5%	MDN0688	88.6%		
				NIST1641d 7.38 ng/mL	92.8%	MDN0833	3.6%	MDN0833	86.2%		

MDN Quarterly Analysis QC Summary

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2000-077	11/10/200	0.99963	0.020 ng/L	NIST1641d	7.97 ng/mL	100.3%	MDN0126	5.0%	MDN0126	94.8%	
	CVAFS-5						MDN0775	2.7%	MDN0775	98.7%	
				NIST1641d	7.75 ng/mL	97.5%	MDN0862	3.0%	MDN0862	88.7%	
2000-078	11/17/200	0.99964	0.035 ng/L	NIST1641d	8.10 ng/mL	101.9%	MDN0742	0.1%	MDN0742	102.4%	
	CVAFS-5						MDN0928	1.5%	MDN0928	90.2%	
2000-079	11/17/200	0.99957	0.063 ng/L	NIST1641d	8.00 ng/mL	100.6%	MDN0747	1.2%	MDN0747	105.3%	MDN0632 0.027 ng/Bottle
	CVAFS-4						MDN0800	1.2%	MDN0800	98.8%	MDN0134 0.019 ng/Bottle
				NIST1641d	7.71 ng/mL	97.0%	MDN0963	3.2%	MDN0963	98.5%	
2000-080	12/7/2000	0.99786	-0.011 ng/L	NIST1641d	7.62 ng/mL	95.8%	MDN0639	1.1%	MDN0639	105.2%	MDN0278 0.038 ng/Bottle
	CVAFS-5						MDN0666	1.6%	MDN0666	94.0%	
				NIST1641d	8.20 ng/mL	103.1%	MDN0950	3.0%	MDN0950	105.5%	
2000-081	12/7/2000	0.99611	0.057 ng/L	NIST1641d	7.66 ng/mL	96.3%	MDN0664	12.0%	MDN0664	104.5%	MDN0849 0.032 ng/Bottle
	CVAFS-4						MDN0866	5.5%	MDN0866	116.6%	
				NIST1641d	8.48 ng/mL	106.7%					
2000-082	12/15/200	0.99808	0.008 ng/L	NIST1641d	7.82 ng/mL	98.3%	MDN0398	3.7%	MDN0398	98.2%	
	CVAFS-5						MDN0832	1.1%	MDN0832	100.3%	
				NIST1641d	7.90 ng/mL	99.4%	MDN0910	5.6%	MDN0910	96.9%	
2000-083	12/15/200	0.99921	-0.001 ng/L	NIST1641d	7.79 ng/mL	98.0%	MDN0259	7.3%	MDN0259	110.1%	
	CVAFS-4						MDN0414	0.3%	MDN0414	93.7%	
				NIST1641d	7.50 ng/mL	94.4%	MDN0641	3.7%	MDN0641	102.5%	
2000-084	12/22/200	0.99912	0.063 ng/L	NIST1641d	8.00 ng/mL	100.6%	MDN0196	0.4%	MDN0196	94.7%	MDN0811 0.048 ng/Bottle
	CVAFS-5						MDN0669	4.6%	MDN0669	88.9%	
2000-085	12/22/200	0.99948	0.032 ng/L	NIST1641d	7.43 ng/mL	93.5%	MDN0170	2.0%	MDN0170	105.8%	MDN0833 -0.001 ng/Bottle
	CVAFS-4						MDN0656	7.0%	MDN0656	97.3%	
Quarterly Mean:		**0.99929**	**0.038 ng/L**			**98.7%**		**2.8%**		**98.4%**	**0.046 ng/Bottle**
Std Dev:		**±0.00093**	**±0.024**			**±3.6%**		**±2.5%**		**±6.3%**	**±0.079**

Appendix C:

Examples Of Performance Evaluation Sample Results

1. New York Dept. Of Health - Non-Potable Water - 7/2000

2. Analytical Products Group - WP June 2000

WADSWORTH CENTER
NEW YORK STATE DEPARTMENT OF HEALTH
ENVIRONMENTAL LABORATORY APPROVAL PROGRAM

Proficiency Test Report

Lab 11662 FRONTIER GEOSCIENCES INC EPA Lab Id WA01127

Shipment 223 Non Potable Water Chemistry
Shipment Date : 24-Jan-2000

Analyte	Sample ID	Result	Mean/Target	Satisfactory Limits	Method	Score
Approval Category : **Non Potable Water**						
Sample: **Mercury**						
Mercury, Total 125 passed out of 137 reported results.	2311	23.6	24.9	18.8 - 31.1	Not Specified	Satisfactory
Sample: **Metals I and II**						
Barium, Total 127 passed out of 135 reported results.	2311	1330	1190	1020 - 1360	EPA 200.8	Satisfactory
Cadmium, Total 158 passed out of 164 reported results.	2311	126	120	102 - 137	EPA 200.8	Satisfactory
Chromium, Total 149 passed out of 170 reported results.	2311	92.2	89.9	76.1 - 104	EPA 200.8	Satisfactory
Copper, Total 154 passed out of 166 reported results.	2311	215	201	179 - 222	EPA 200.8	Satisfactory
Nickel, Total 151 passed out of 166 reported results.	2311	731	707	631 - 783	EPA 200.8	Satisfactory
Lead, Total 157 passed out of 180 reported results.	2311	198	200	170 - 230	EPA 200.8	Satisfactory
Selenium, Total 125 passed out of 136 reported results.	2311	409	390	315 - 464	EPA 200.8	Satisfactory
Zinc, Total 152 passed out of 161 reported results.	2311	671	603	530 - 676	EPA 200.8	Satisfactory

Printed on 05/03/00

Analytical Products Group, Inc.

PERFORMANCE REPORT

WP Performance Summary

June 2000

APG Customer Code: 4701

Frontier Geosciences Inc.
Suite B
414 Pontius Avenue North
Seattle, WA 98109

Laboratory of
EXCELLENCE

Performance Summary

WP June 2000
Study Closing Date 07/28/2000

Product: Trace Metals

Analyte	Product Level	Analyte Code	Reported Value	Assigned Value	Acceptance Range	Z-Score	Test Method	Evaluation
Aluminum	WP	1	1830	1870	1610-2130	0.47	ICP-MS 1638	Acceptable
Antimony	WP	16	172	185	120-226	0.057	ICP-MS 1638	Acceptable
Arsenic	WP	2	243	225	186-266	1.28	ICP-MS 1638	Acceptable
Barium	WP		967	983	866-1100	0.43	ICP-MS 1638	Acceptable
Beryllium	WP	3	192	187	158-211	0.79	ICP-MS 1638	Acceptable
Boron	WP		841	872	781-1030	1.55	ICP-MS 1638	Acceptable
Cadmium	WP	4	60.9	59.2	49.7-68.4	0.58	ICP-MS 1638	Acceptable
Chromium	WP	6	202	209	180-238	0.73	ICP-MS 1638	Acceptable
Cobalt	WP	5	74.8	75	64.4-85.1	0.029	ICP-MS 1638	Acceptable
Copper	WP	7	123	122	108-137	0.21	ICP-MS 1638	Acceptable
Iron	WP	8	1770	1750	1550-1970	0.14	COLORMETRIC	Acceptable
Lead	WP	12	409	398	345-450	0.63	ICP-MS 1638	Acceptable
Manganese	WP	10	3540	3750	3380-4170	1.74	ICP-MS 1638	Acceptable
Mercury	WP	9	13.4	13.5	10.1-16.9	0.089	CV-AFS 1631	Acceptable
Molybdenum	WP	74	494	519	446-593	1.06	ICP-MS 1638	Acceptable
Nickel	WP	11	631	631	568-706	0.26	ICP-MS 1638	Acceptable
Selenium	WP	13	672	626	496-726	1.6	ICP-MS 1638	Acceptable
Silver	WP	17	402	393	337-450	0.43	ICP-MS 1638	Acceptable
Strontium	WP	75	94.0	93.2	78.9-107	0.21	ICP-MS 1638	Acceptable
Thallium	WP	18	156	161	128-190	0.29	ICP-MS 1638	Acceptable
Titanium	WP	76	142	151	129-171	1.16	ICP-MS 1638	Acceptable
Vanadium	WP	14	1610	1510	1360-1650	2.03	ICP-MS 1638	Check for Error
Zinc	WP	15	203	188	162-215	1.6	ICP-MS 1638	Acceptable

Appendix D:

Examples Of Laboratory Intercomparison Studies – 2000

1. National Water Research Institute – Ecosystem Performance Evaluation QA Program – Study FP77 – Fall 2000

2. Florida Dept. Of Environmental Protection – Mercury Intercomparison Study October 1999 – April 2000

3. Results Of USGS Analytical Evaluation Program For Standard Reference Samples Distribution in March 2000.

Environment Canada Environnement Canada

Canada

ECOSYSTEM PERFORMANCE EVALUATION QA PROGRAM

STUDY FP77 - TRACE ELEMENTS FALL 2000

J. BLUM and H. ALKEMA

NLET-TN00-013

NATIONAL WATER RESEARCH INSTITUTE

INSTITUT NATIONAL DE RECHERCHE SUR LES EAUX

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	95.00	10.556	9					CVAA
F003	102.50	11.389	9					Acid Dig'n, CVAAS
F006	20.50	2.278	9	L L	BIASED LOW	-13.74	-0.0077	AA - SnCl2
F009	92.00	10.222	9	H				ICP-MS
F010	68.50	8.562	8	EH				Cold vapor AA
F015	134.00	14.889	9	EHH	BIASED HIGH*	0.09	0.0285	CVAF
F019	34.00	4.250	8	ELVL	BIASED LOW	11.42	-0.0549	Cold Vapour
F024	134.00	14.889	9	H H H H EH	BIASED HIGH	31.88	-0.0206	CVAA
F025	92.00	9.200	10	EH L				CVAA
F032	78.50	7.850	10					CVAAS
F036	129.00	12.900	10	ELVHH VH				AFS
F038	60.50	6.722	9					CVAAS
F042	51.00	5.100	10	VL	BIASED LOW	-12.22	0.0024	AFS
F062	22.50	4.500	5	VL L EL				Cold Vapour AAS
F069	20.50	6.833	3		INSUFFICIENT DATA			CVAA
F095	124.00	13.778	9					Cold Vapour Fluor
F138	74.50	7.450	10	H VL				1631
F159	62.00	12.400	5	EHEH EHEL EL				ASTM D 3223
F163	66.00	6.600	10					
F172	118.00	14.750	8	VH H	BIASED HIGH*	2.80	0.0304	CVAA

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 10.00

OVERALL AVERAGE
RANK IS 9.343

FPHG STUDY 0077 DATA SUMMARY 2000-11-27 PAGE 1

PARAMETER: 80095 Mercury ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA

NWRI Ecosystem Interlab QA for Mercury

LOWER LIMIT OF BASIC ACCEPTABLE ERROR= 0.0200 BASIC ACCEPTABLE ERROR= 0.0200 CONCENTRATION ERROR INCREMENT= 0.1250

SAMPLE LAB NO	1= HG77-1 REPORTED VALUE	2= HG77-2 REPORTED VALUE	3= HG77-3 REPORTED VALUE	4= HG77-4 REPORTED VALUE	5= HG77-5 REPORTED VALUE	6= HG77-6 REPORTED VALUE	7= HG77-7 REPORTED VALUE	8= HG77-8 REPORTED VALUE	9= HG77-9 REPORTED VALUE	10= HG77-10 REPORTED VALUE
F002	<0.02	0.06	0.110	0.170	0.120	0.190	0.270	0.340	0.360	0.470
F003	<0.005	0.053	0.112	0.164	0.120	0.195	0.277	0.343	0.376	0.488
F006	<0.02	0.04	0.09	0.13	0.09	0.16	0.22 L	0.28	0.28 L	0.41
F009	<0.02	0.04	0.10	0.17	0.09	0.19	0.29	0.36	0.42 H	0.54
F010	0.2 EH	<0.1	0.1	0.2	0.1	0.2	0.3	0.3	0.3	
F015	<0.05	0.08 EH	0.15 H	0.18	0.14	0.23	0.29	0.36	0.37	0.51
F019	<0.03	<0.03 EL	0.06 VL	0.14	0.08	0.16	0.23	0.30	0.34	0.48
F024	<0.05	0.07	0.15 H	0.18	0.14	0.24 H	0.34 H	0.39 H	0.29	0.72 EH
F025	0.05 EH	0.05	0.11	0.12 L	0.13	0.17	0.29	0.35	0.4	0.46
F032	0.002	0.049	0.105	0.156	0.114	0.188	0.262	0.326	0.358	0.468
F036	0.0014	0.065	0.126	0.175	0.135	0.094 EL	0.370 VH	0.389 H	0.404	0.587 VH
F038	<0.01	0.05	0.10	0.15	0.11	0.18	0.24	0.32	0.35	0.46
F042	0.0003	0.0504	0.1053	0.1508	0.1036	0.1774	0.2379	0.306	0.2429VL	0.4507
F062	<0.1	<0.1	<0.1	<0.1 VL	<0.1	0.2	0.2 L	0.2 EL	0.3	0.4
F069	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.302	0.351	0.450
F095	<0.02	0.06	0.11	0.18	0.13	0.22	0.31	0.36	0.38	0.49
F138	0.0005	0.046	0.144 H	0.103 VL	0.107	0.193	0.243	0.304	0.351	0.492
F159	<0.20	<0.20	0.24 EH	0.48 EH	<0.20	<0.20	0.51 EH	<0.20 EL	0.31	0.34 EL
F163	0.0009	0.049	0.107	0.159	0.11	0.189	0.252	0.316	0.318	0.423
F172	<0.1	<0.1	0.2 VH	0.2	0.1	0.2	0.3	0.4 H	0.4	0.5
MEDIAN OR *TARGET CONC.	*0.0030	0.0502	0.1100	0.1670	0.1100	0.1900	0.2770	0.3260	0.3510	0.4700
1CRIT	0.0200	0.0238	0.0312	0.0384	0.0312	0.0412	0.0521	0.0582	0.0614	0.0763
N	5	11	16	16	14	16	17	17	18	17
MEAN	0.0110	0.0548	0.1200	0.1641	0.1114	0.1902	0.2778	0.3321	0.3466	0.4752
3STDEV	-	0.0222	0.0818	0.0657	0.0414	0.0546	0.1166	0.0949	0.1142	0.1334

.0506 .1060 0.1539 0.1114 0.1746 0.2637 0.3282 0.3596 0.4315

Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

October 26, 1999

Dear Laboratory Director:

Attached are results from the recent Florida Mercury Intercomparison Study, FMIP-0999 (Attachment 1). A list of participating laboratories and associated contacts are included in Attachment 2.

A single surface water sample from site U3 in Water Conservation Area 2A of the Florida Everglades was used for this study. Paul Parks of the Florida Department of Environmental Protection (FDEP) Mercury Coordinator's Office collected the sample on September 9. Using a Nytex filter on the suction side of the sampling pump, aliquots were collected into three new Nalgene LDPE 20L bottles with screw tops. Samples were stored in coolers without ice or any additional preservation.

Sample bottles were transported to Tallahassee and stored at room temperature until September 20, when they were moved to the FDEP Bureau of Laboratories' mercury clean room. The FDEP laboratory staff conducted all subsequent sample handling. Two of the three 20L bottles were filtered through a 0.45 micron filter into a new Nalgene LDPE 50L bottle. Following filtration, this 50L bottle was equipped with a motorized stirrer with a stainless steel shaft and propeller to maintain homogeneity during subsampling of the aliquots.

Individual sample bottles were provided by the participating laboratories, except for Florida International University, for whom FDEP provided cleaned bottles. The sample bottles to be filled were placed in random order and filled sequentially by thirds. The samples bottles were placed in the coolers provided by the participating laboratories and shipped to each laboratory by overnight express. Each laboratory was notified of this shipment via telephone on the day of shipment. The laboratories were asked to analyze each of six replicates for total mercury and, if it was an analyte that the laboratory normally measured, methlymercury. The FDEP laboratory was aware that each sample to be tested was from a single water sample, although other laboratories were unaware of this.

Results as reported by each laboratory are presented in Table 1. Summary statistics for each laboratory are presented in Table 2. A graphical presentation of the results using median-quartile box-plots is included in Figures 1 and 2. If you have any questions about this study, please contact me at (850) 921-9776, or by email at Rebecca.Northup@dep.state.fl.us

Sincerely,

Rebecca Northup, Environmental Manager
Environmental Assessment Section
Bureau of Laboratories
Division of Resource Assessment and Management

Attachments

Cc: Tom Atkeson/FDEP
Paul Parks/FDEP
Bill Coppenger/FDEP

Attachment 1

Table 1. **Reported Analytical Results from Florida Mercury Intercomparison Study FMIP-0999.**

Laboratory	Total Mercury (ng/L)	Methylmercury (ng/L)
LAB #1	4.35	1.02
	4.46	1.09
	4.56	0.98
	4.56	1.08
	4.56	0.95
	4.53	1.03
LAB #2	4.92	0.71
	4.56	0.73
	4.43	0.77
	5.02	0.87
	4.68	0.72
	4.59	0.79
LAB #3	4.82	0.77
	4.83	0.78
	4.85	0.75
	4.82	0.76
	4.88	0.76
	4.87	0.75
LAB #4	3.05	
	2.81	
	3.16	
	2.84	
	2.86	
	2.82	
Frontier Geosciences #5	5.02	1.03
	4.72	1.16
	4.68	1.27
	4.95	1.17
	4.88	1.12
	4.57	1.30
LAB #6	4.22	
	4.71	
	4.57	
	4.79	
	4.37	
	4.78	
LAB #6	5.01	1.05
	4.48	1.05
	4.60	1.05
	4.89	1.18
	4.88	1.16
	4.99	1.19

Figure 1. Median Boxplots of Total Mercury by Laboratory.

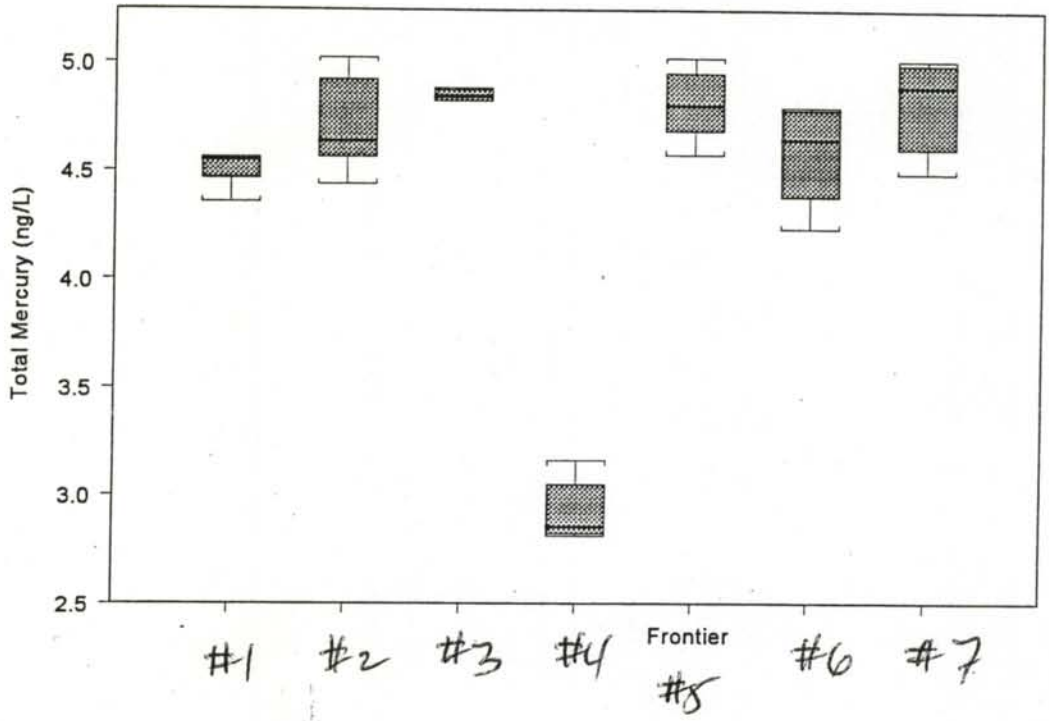
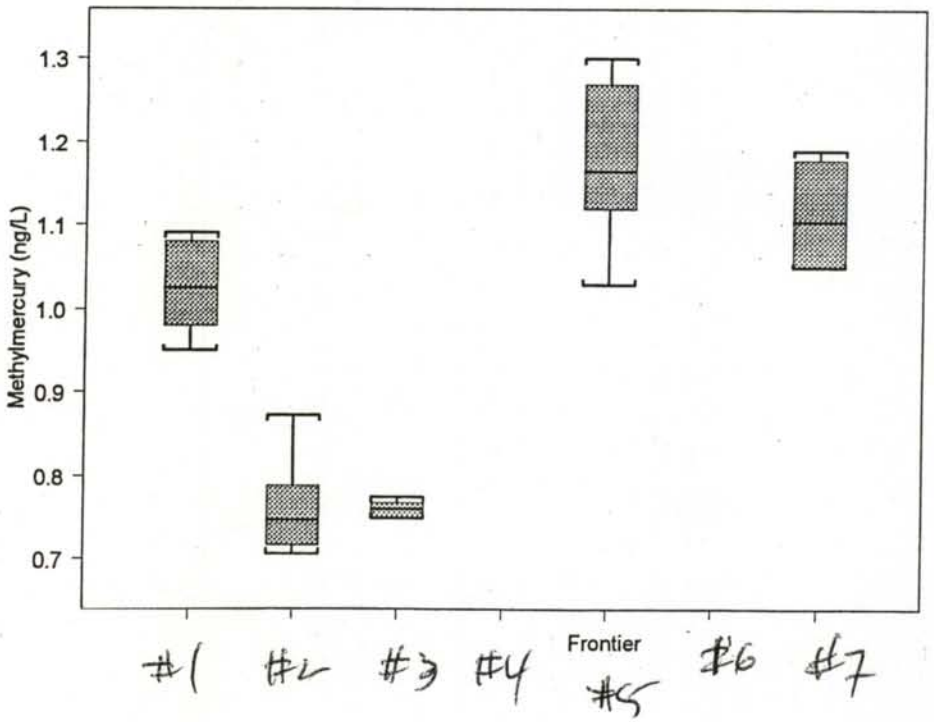


Figure 2. Median Boxplots of Methylmercury by Laboratory



USGS
science for a changing world

U.S. Department of the Interior
U.S. Geological Survey

Results of the U.S. Geological Survey's Analytical Evaluation Program for Standard Reference Samples Distributed in March 2000

Open-File Report 00-398

LAB #245

SUMMARY

N =	1	3	37	4
Minimum =	1.95	1.91	1.07	1.34
Maximum =		2.10	2.51	1.96
Median =			1.90	
F-pseudosigma =			0.21	

0. Other
6. ICP/MS
8. AA: cold vapor
9. Atomic fluoresence

MPV = 1.92
F-pseudosigma = 0.16
N = 45
Uh = 2.01
Lh = 1.80

Lab	Rating	Z-value	0	6	8	9
1	3	0.51	--	--	2.00	--
3	4	-0.13	--	--	1.90	--
10	2	1.14	--	--	2.10	--
11	2	-1.08	--	--	1.75	--
12	2	1.14	--	--	2.10	--
13	4	-0.06	--	--	1.91	--
32	2	1.14	--	2.10	--	--
46	4	-0.32	--	--	1.87	--
47	4	0.19	--	--	--	1.95
50	4	-0.06	--	1.91	--	--
54	4	-0.13	--	--	1.90	--
59	4	0.06	--	--	1.93	--
70	2	1.33	--	--	2.13	--
81	3	-0.82	--	--	1.79	--
86	0	-3.67	--	--	--	1.34
87	3	0.51	--	--	2.00	--
89	2	-1.01	--	--	1.76	--
96	2	1.08	--	--	2.09	--
97	0	3.74	--	--	2.51	--
105	0	2.28	--	--	2.28	--
109	4	0.25	--	--	1.96	--
127	2	1.08	--	--	2.09	--
134	3	0.59	--	--	2.01	--
142	4	0.00	--	--	1.92	--
144	4	-0.32	--	--	1.87	--
145	0	-5.38	--	--	1.07	--
146	1	-1.58	--	--	1.67	--
147	4	0.19	--	--	--	1.95
149	4	-0.13	--	--	1.90	--
154	4	-0.13	--	--	1.90	--
193	3	-0.51	--	--	1.84	--
212	1	-1.58	--	--	1.67	--
213	0	-2.66	--	--	1.50	--
234	1	-1.71	--	--	1.65	--
245	4	-0.19	--	--	1.89	--
247	1	1.77	--	--	2.20	--
259	4	0.00	--	--	1.92	--
265	4	0.19	--	1.95	--	--
277	2	-1.20	--	--	1.73	--
284	3	0.95	--	--	2.07	--
292	1	-2.03	--	--	1.60	--
298	4	0.19	1.95	--	--	--
304	4	0.25	--	--	--	1.96
307	0	2.60	--	--	2.33	--
330	3	-0.76	--	--	1.80	--

Fe ? (
K 1.26 mg/L
Li 17.8 µg/L

M-154 (major constituents)

Analyte	MPV	E=
Alkalinity as $CaCO_3$	112 mg/L	
B	284 µg/L	
Ca	67.5 mg/L	
Cl	141 mg/L	
DSRD	701 mg/L	
F	2.18 mg/L	
K	9.08 mg/L	
Mg	15.1 mg/L	

N-65 (nutrient constituents)

Analyte	MPV	E=
NH_3 as N	0.124 mg/L	
NH_3+OrgN as N	0.159 mg/L	
NO_3 as N	0.037 mg/L	
total P as P	0.119 mg/L	
PO_4 as P	0.112 mg/L	

P-34 (low ionic strength const

Analyte	MPV	E=
Acidity	4.6 mg/L	
Ca	1.63 mg/L	
Cl	4.18 mg/L	
F	0.161 mg/L	
K	0.238 mg/L	
Mg	0.592 mg/L	

Hg-30 (mercury)

Analyte	MPV	E=
Hg	1.92 µg/L	