Frontier Geosciences Inc.

Mercury Deposition Network

1998 Annual Quality Assurance Report



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I. Introduction

served as the Hg Analytical Lab (HAL) and Site Liaison center for the Mercury Deposition Network (MDN). The Mercury Deposition Network, coordinated through the National Atmospheric Deposition Program (NADP), was designed with the primary objective to quantify the wet deposition of mercury in North America in order to determine long term geographic and temporal distributions. Frontier receives weekly precipitation samples, which are analyzed for total mercury. The analytical technique employed to measure each sample for Total Hg, US EPA Method 1631 modified, was authored by Frontiers Senior Research Scientist and Frontier served as the referee lab for the Method 1631 final validation study. The MDN now incorporates 37 sites from the United States and Canada, a 76% increase of MDN sites since 1996. The MDN is expected to add 10 new sites, bringing the total to almost 50 in 1999.

Mr. Robert Brunette, Project Manager, oversees all aspects of Frontier's involvement in the MDN. He serves as the MDN Liaison, HAL contact for multiple agencies currently sponsoring the MDN, and Vice 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 the work, including MDN site selection and equipment installation, MDN equipment troubleshooting, field and laboratroy training, analysis and report writing as well as MDN research. Dr. Eric Prestbo, who serves as Science Advisor for the HAL, works with Mr. Brunette as an advisor to provide expert chemistry advice for MDN and help direct new initiatives which include Trace Metals in Wet Deposition

and Hg Dry Deposition Studies. Mr. Brunette is assisted by Analytical Laboratory staff who process incoming samples, analyze sample sets, clean glassware, ship weekly field equipment, and perform data entry. Mr. Brunette works closely with Ms. Michelle Gauthier, Laboratory Manager, and Ms. Beverly Heaphey, Quality Assurance Officer, to ensure all quality control parameters are consistently maintained.

Quality control is adhered to both in the laboratory and in the field. The MDN project saw an increase in quality control points from 444 to 624, which corresponds to the increase in MDN sites in 1998 and demonstrates Frontier's commitment to quality assurance. The MDN Site Liaison, Mr. Brunette, with the help of other HAL staff, reviews weekly rain gauge charts and MDN Observer Form (MOFs). Site equipment failures or procedural errors are addressed quickly and directly by the Site Liaison. MDN site equipment failures are minimized as the HAL now maintains an MDN Equipment Depot. The MDN Equipment Depot enables the Site Liaison to send replacement parts to sites within 24 hours of discovering equipment failures. Quick response to field issues overall ensures the continuity of the MDN data base.

Frontier improved quality control on the MDN project in 1998. Not one quality control point exceeded parameters for the entire year (n=624). All blank means were lower in concentration in 1998 than in 1997. For example, the Reagent Blank mean in 1997 was 0.143 ng/L and in 1998 was 0.087ng/L. This is an improvement in reducing mercury concentration in the reagent matrix of 60.8%. All quality control parameter findings improved in 1998 from 1997. The improvements in lab performance are contributed to the efforts of Project Manager, Mr. Robert Brunette working in cooperation with the Quality Assurance Officer, Senior Hg Analyst and Lab Manager.

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 see to implementation; 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.

B. Data Quality Objectives

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

Precision is a measure of data repeatability; it is measured by using 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 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 than the MDL, the situation is examined. Possible contamination sources are researched and identified. Once the problem has been found and corrected, the run continues. Bottle blanks are control charted on an ongoing basis, helping to identify trends or anomalies.

The mean average for 1998 lab sample bottle blanks is 0.03 ng/L (n=67). The standard deviation is 0.019 ng/L. Numbers may be found in tabular format in Appendix A, while control charts are listed in Appendix B.

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. 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 average for 1998 reagent blanks is 0.087 ng/L (n=66). The standard deviation is 0.050 ng/L. Numbers may be found in tabular format in Appendix A, while control charts are listed in Appendix B.

C. Martix Duplicate Samples

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% then the analysis is re-run. If the result is still higher than 25%, then the problem is researched and possible causes are identified and noted on the report.

The mean average for 1998 RPD's is 3.5% (n=183). The standard deviation is 3.6%. All matrix duplicate relative percent difference values fell within the designed parameters in 1998. Numbers may be found in tabular format in Appendix A, while control charts are listed in Appendix B.

D. Certified Reference Material Samples

Certified reference material (CRM) samples are a way 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 problem is identified, corrected and the instrument is recalibrated. If the percent recovery is within the acceptance range, analysis continues. The CRM used is DORM-2, a fish tissue.



The mean average for 1998 CRMs is 94.4% recovery (n=130). The standard deviation is 3.4%. The Certified Reference Material recoveries were all in control, but the mean recovery dropped from approximately 98% to approximately 92% sometime near the end of May, 1998. This observation was noted lab-wide and is attributed to sample digestion of the DORM-2. Although the CRM percent recovery mean dropped, all samples were well within control parameters.

All reference samples fell within the designated parameters in 1998. Numbers may be found in tabular format in Appendix A, while control charts are listed in Appendix B.

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. Does analyte in the sample go through the analytical system the same way analyte in the standards does? And are we able to carry analyte through the analytical system without significant losses?

Matrix spikes falling with 75-125% recovery are considered valid. Matrix spikes falling outside these parameters must be rerun. If the spike continues to fall outside of 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 average for 1998 matrix spikes is 100.2% recovery (n=173). The standard deviation is 6.8%. There was just one incident of a matrix spike falling outside quality control limits. Numbers may be found in tabular format in Appendix A, while control charts are listed in Appendix B.

G. Quarterly Reports

Mr. Brunette prepares a quarterly Quality Control Report, outlining quality control results in tabular format. Trends and anomalies are looked for, and if found, are identified. Possible causes for trends or anomalies must be researched by examining original datasets. Conclusions are summarized and included in the report.

H. Performance Evaluation 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 US EPA, National Water Research Institute (Canada), National Oceanic and Atmospheric Administration, National Research Council (Canada), US Geological Survey, the Institute for National Measurement Standards (Canada), and New York State PE samples. Results from the most recent US EPA Water Pollution Study (WP040) have been included in Appendix C.

IV. 1999 Outlook

he Mercury Deposition Network continues to gain more and more attention as the largest and longest running National scale Hg wet deposition network in North America. This increased exposure has led to expected significant growth in 1999 through 2000. With this growth, the HAL will continue to look for ways of improving this program to ensure it retains the highest of quality.

The following are ways the HAL expects to maintain quality throughout 1999:

- In 1998, Frontier created an Access Data Base which has greatly improved data handling and coordination. The HAL will continue to look for innovative ways to streamline and increase efficiency.
- The HAL is expected to upgrade its MDN facilities in order to stay ahead of projected growth in the Network.
- The HAL will continue Total and Methyl Mercury field studies at WA18 utilizing two co-colocated MDN Aerochemetrics Wet Deposition Samplers.
- The HAL will continue Trace Metals in Wet Deposition studies as well as Dry Deposition Hg studies.
- The HAL will continue Mercury laboratory intercomparison studies in 1999 and endeavor to increase the frequency of these studies.
- The HAL will begin an internal blind MDN sample program.
- Pending an NADP/MDN policy change, the HAL is expected to start a new Field Blank and System Blank program.



V. Appendix A Quality Control Tables

A. Analytical Run Data

Data Set	FGSSetID	AnalysisDate	InstrumentID	CF	BB	B	BrCI BIK
1998-01	THG41-980109	1/9/98	CVAFS-4	494.5 units/ng	2.11 units	0.99915	0.058 ng/L
1998-02	THG51-980109	1/9/98	CVAFS-5	1202.0 units/ng	3.90 units	0.99992	0.080 ng/L
1998-03	THG41-980126	1/26/98	CVAFS-4	494.9 units/ng	1.75 units	0.99992	0.071 ng/L
1998-04	THG51-980126	1/26/98	CVAFS-5	1239.4 units/ng	2.20 units	0.99993	0.071 ng/L
1998-05	THG51-980209	2/9/98	CVAFS-5	1430.0 units/ng	3.74 units	0.99990	0.081 ng/L
1998-06	THG41-980219	2/19/98	CVAFS-4	454.7 units/ng	2.22 units	1.00000	0.072 ng/L
1998-07	THG51-980219	2/19/98	CVAFS-5	1254.2 units/ng	5.78 units	0.99983	0.087 ng/L
1998-08	THG41-980223	2/23/98	CVAFS-4	443.1 units/ng	2.14 units	0.99965	0.213 ng/L
1998-09	THG41-980304	3/4/98	CVAFS-4	436.9 units/ng	1.79 units	0.99994	0.065 ng/L
1998-10	THG51-980304	3/4/98	CVAFS-5	1121.4 units/ng	1.97 units	0.99999	0.063 ng/L
1998-11	THG51-980317	3/17/98	CVAFS-5	1341.3 units/ng	3.12 units	0.99987	0.079 ng/L
1998-12	THG51-980319	3/19/98	CVAFS-5	1381.6 units/ng	5.44 units	0.99983	0.067 ng/L
1998-13	THG41-980319	3/19/98	CVAFS-4	448.2 units/ng	1.68 units	0.99989	0.054 ng/L
1998-14	THG41-980402	4/2/98	CVAFS-4	407.0 units/ng	4.33 units	0.99940	0.115 ng/L
1998-15	THG51-980402	4/2/98	CVAFS-5	1409.2 units/ng	6.21 units	0.99993	0.139 ng/L
1998-16	THG41-980417	4/17/98	CVAFS-4	417.5 units/ng	1.76 units	0.99995	0.100 ng/L
1998-17	THG51-980417	4/17/98	CVAFS-5	1388.0 units/ng	3.70 units	0.99999	0.117 ng/L
1998-18	THG41-980423	4/23/98	CVAFS-4	412.4 units/ng	2.49 units	0.99916	0.073 ng/L
1998-19	THG51-980423	4/23/98	CVAFS-5	1362.2 units/ng	9.95 units	0.99963	0.060 ng/L
1998-20	THG41-980508	5/8/98	CVAFS-4	404.2 units/ng	2.31 units	0.99975	0.159 ng/L
1998-21	THG51-980508	5/8/98	CVAFS-5	1456.5 units/ng	7.17 units	0.99994	0.192 ng/L
1998-22	THG41-980512	5/12/98	CVAFS-4	389.1 units/ng	1.36 units	0.99931	0.112 ng/L
1998-23	THG41-980526	5/26/98	CVAFS-4	412.3 units/ng	2.90 units	0.99994	0.129 ng/L
1998-24	THG51-980526	5/26/98	CVAFS-5	1386.2 units/ng	7.10 units	0.99988	0.200 ng/L
1998-25	THG41-980601	6/1/98	CVAFS-4	488.3 units/ng	2.06 units	0.99989	0.098 ng/L
1998-26	THG51-980601	6/1/98	CVAFS-5	1559.1 units/ng	12.09 units	0.99986	0.142 ng/L
1998-27	THG51-980608	6/8/98	CVAFS-5	1555.0 units/ng	10.40 units	0.99980	0.091 ng/L
1998-28	THG41-980608	6/8/98	CVAFS-4	440.2 units/ng	1.68 units	0.99988	0.099 ng/L
1998-29	THG51-980615	6/15/98	CVAFS-5	1506.7 units/ng	11.98 units	0.99996	0.249 ng/L
1998-30	THG41-980622	6/22/98	CVAFS-4	400.7 units/ng	2.41 units	0.99903	0.039 ng/L
1998-31	THG51-980629	6/29/98	CVAFS-5	1594.7 units/ng	8.68 units	0.99993	0.103 ng/L
1998-32	THG41-980629	6/29/98	CVAFS-4	420.9 units/ng	1.70 units	0.99983	0.093 ng/L
1998-33	THG51-980716	7/16/98	CVAFS-5	1594.3 units/ng	10.63 units	0.99990	0.099 ng/L
1998-34	THG41-980716	7/16/98	CVAFS-4	447.0 units/ng	2.91 units	0.99996	0.087 ng/L
1998-35	THG51-980721	7/21/98	CVAFS-5	1592.8 units/ng	10.79 units	0.99981	0.041 ng/L
1998-36	THG41-980721	7/21/98	CVAFS-4	421.4 units/ng	2.09 units	0.99993	0.059 ng/L
1998-37	THG51-980728	7/28/98	CVAFS-5	1636.1 units/ng	11.89 units	0.99977	0.058 ng/L
1998-38	THG41-980812	8/12/98	CVAFS-4	393.9 units/ng	1.96 units	0.99985	0.071 ng/L
1998-39	THG51-980812	8/12/98	CVAFS-5	1307.2 units/ng	9.55 units	0.99979	0.160 ng/L
1998-40	THG41-980818	8/18/98	CVAFS-4	368.0 units/ng	3.19 units	0.99974	0.021 ng/L



Data Set	FGSSetID	AnalysisDate	InstrumentID	CF	BB	B	BrCI	BIk
1998-41	THG41-980828	8/28/98	CVAFS-4	383.8 units/ng	3.31 units	0.99983	0.105	ng/L
1998-42	THG51-980904	9/4/98	CVAFS-5	1469.9 units/ng	13.93 units	0.99945	0.041	ng/L
1998-43	THG41-980904	9/4/98	CVAFS-4	559.7 units/ng	3.14 units	0.99981	0.043	ng/L
1998-44	THG41-980908	9/8/98	CVAFS-4	608.6 units/ng	3.39 units	0 99998	0.080	ng/L
1998-45	THG51-980908	9/8/98	CVAFS-5	1426.8 units/ng	19.96 units	0.99990	0.121	ng/L
1998-46	THG51-980918	9/18/98	CVAFS-5	1580.4 units/ng	13.65 units	0.99995	0.110	ng/L
1998-47	THG51-980924	9/24/98	CVAFS-5	1530.1 units/ng	12.83 units	0.99978	0.030	ng/L
1998-48	THG51-980925	9/25/98	CVAFS-5	1561.0 units/ng	6.77 units	0.99947	0.050	ng/L
1998-49	THG41-980925	9/25/98	CVAFS-4	663.3 units/ng	2.24 units	0.99952	0.053	ng/L
1998-50	THG51-981016	10/16/98	CVAFS-5	1550.0 units/ng	6.81 units	0.99968	0.028	ng/L
1998-51	THG41-981016	10/16/98	CVAFS-4	475.2 units/ng	1.94 units	0.99990	0.024	ng/L
1998-52	THG51-981019	10/19/98	CVAFS-5	1537.2 units/ng	12.41 units	0.99729	0.043	ng/L
1998-53	THG41-981019	10/19/98	CVAFS-4	487.8 units/ng	1.81 units	0.99971	0.040	ng/L
1998-54	THG51-981110	11/10/98	CVAFS-5	1588.4 units/ng	12.08 units	0.99931	0.005	ng/L
1998-55	THG51-981112	11/12/98	CVAFS-5	1567.7 units/ng	7.93 units	0.99988	0.061	ng/L
1998-56	THG41-981113	11/13/98	CVAFS-4	418.3 units/ng	1.84 units	0.99965	0.083	ng/L
1998-57	THG51-981120	11/20/98	CVAFS-5	1455.8 units/ng	8.62 units	0.99985	0.161	ng/L
1998-58	THG41-981120	11/20/98	CVAFS-4	450.8 units/ng	2.13 units	0.99980	0.117	ng/L
1998-59	THG51-981125	11/25/98	CVAFS-5	1498.5 units/ng	7.98 units	0.99991		ng/L
1998-60	THG51-981201	12/1/98	CVAFS-5	1413.6 units/ng	6.18 units	0.99965	0.076	ng/L
1998-61	THG41-981201	12/1/98	CVAFS-4	436.6 units/ng	1.89 units	0.99996	0.069	ng/L
1998-62	THG51-981217	12/17/98	CVAFS-5	1148.7 units/ng	8.69 units	0.99843		ng/L
1998-63	THG41-981217	12/17/98	CVAFS-4	392.1 units/ng	3.42 units	0.99945		-
1998-64	THG51-981222	12/22/98	CVAFS-5	1171.7 units/ng	5.55 units	0.99956	0.172	
1998-65	THG51-981231	12/31/98	CVAFS-5	1195.5 units/ng	5.98 units	0.99994	0.040	ng/L
1998-66	THG41-981231	12/31/98	CVAFS-4	487.4 units/ng	2.05 units	0.99969	0.041	ng/L
					Mean	0.99971	0.087	ng/L
					St Dev	0.00041	0.050	ng/L

B. Bottle Blanks

Quarter	Data Set	Sample ID	BottleBlk
1-1998	1998-02	MDN587	0.030 ng/Bottle
1-1998	1998-02	MDN499	0.029 ng/Bottle
2 2 2 2 2			
1-1998	1998-03	MDN525	
1-1998	1998-03	MDN473	0.029 ng/Bottle
1-1998	1998-06	MDN030	0.030 ng/Bottle
1-1998	1998-07	MDN568	0.027 ng/Bottle
1-1998	1998-07	MDN533	0.028 ng/Bottle
1-1998	1998-07	MDN576	0.034 ng/Bottle
1-1998	1998-09	MDN536	0.030 ng/Bottle
8 - 8 - 8 - 8 - 8			
1-1998	1998-10	MDN478	0.037 ng/Bottle
1-1998	1998-11	MDN455	0.028 ng/Bottle
1-1998	1998-11	MDN563	0.030 ng/Bottle
1-1998	1998-11	MDN567	0.036 ng/Bottle
2-1998	1998-15	MDN109	0.029 ng/Bottle
2-1998	1998-16	MDN001	0.029 ng/Bottle
2-1998	1998-17	MDN205	0.020 ng/Bottle
			THE RESERVE TO SECURITY OF THE PARTY OF THE
2-1998	1998-18	MDN516	0.031 ng/Bottle
2-1998	1998-19	MDN572	0.051 ng/Bottle
2-1998	1998-21	MDN528	0.049 ng/Bottle
2-1998	1998-23	MDN222	0.042 ng/Bottle
2-1998	1998-23	MDN539	0.034 ng/Bottle
2-1998	1998-23	MDN328	0.036 ng/Bottle
A THE RESERVE			No contract of the Contract of
2-1998	1998-23	MDN403	0.025 ng/Bottle
2-1998	1998-29	MDN205	0.048 ng/Bottle
2-1998	1998-29	MDN023	0.041 ng/Bottle
2-1998	1998-29	MDN087	0.046 ng/Bottle
2-1998	1998-30	MDN227	0.040 ng/Bottle
2-1998	1998-30	MDN530	0.071 ng/Bottle
2-1998	1998-32	MDN219	0.032 ng/Bottle
3-1998			
	1998-33	MDN343	0.043 ng/Bottle
3-1998	1998-34	MDN341	0.077 ng/Bottle
3-1998	1998-37	MDN634	0.036 ng/Bottle
3-1998	1998-37	MDN329	0.043 ng/Bottle
3-1998	1998-37	MDN387	0.071 ng/Bottle
3-1998	1998-38	MDN040	0.017 ng/Bottle
3-1998	1998-38	MDN311	0.050 ng/Bottle
			ATTORNEY TO ME HESSENSON
3-1998	1998-39	MDN616	0.022 ng/Bottle
3-1998	1998-41	MDN837	0.082 ng/Bottle
3-1998	1998-42	MDN403	0.019 ng/Bottle
3-1998	1998-42	MDN451	0.019 ng/Bottle
3-1998	1998-43	MDN328	0.015 ng/Bottle
3-1998	1998-47	MDN355	0.010 ng/Bottle
3-1998	1998-47	MDN512	0.003 ng/Bottle
3-1998	1998-48	MDN354	0.010 ng/Bottle
3-1998	1998-48	MDN004	0.022 ng/Bottle
4-1998	1998-50	MDN238	0.018 ng/Bottle
4-1998	1998-50	MDN320	0.014 ng/Bottle
4-1998	1998-51	MDN552	0.011 ng/Bottle
4-1998	1998-52	MDN051	0.009 ng/Bottle
4-1998	1998-52	MDN812	0.049 ng/Bottle
4-1998	1998-53	MDN931	0.014 ng/Bottle
4-1998	1998-53	MDN630	0.007 ng/Bottle
1 2 2 2 3			ELDERGE LAND LEGISLATION
4-1998	1998-53	MDN204	0.009 ng/Bottle
4-1998	1998-53	MDN857	0.013 ng/Bottle
4-1998	1998-55	MDN857	0.073 ng/Bottle
4-1998	1998-55	MDN817	0.070 ng/Bottle
4-1998	1998-57	MDN508	0.002 ng/Bottle
4-1998	1998-58	MDN248	0.050 ng/Bottle
4-1998	1998-58	MIDN050	0.023 ng/Bottle
4-1998	1998-58	MDN852	0.008 ng/Bottle
			The property of the property of the property of the party
4-1998	1998-64	MDN563	0.012 ng/Bottle
4 4 4 4 4 4	1998-64	MDN912	0.008 ng/Bottle
4-1998			O OOO na/Pottle
4-1998 4-1998	1998-64	MDN821	0.009 ng/Bottle
		MDN821 MDN897	0.008 ng/Bottle
4-1998	1998-64		
4-1998 4-1998 4-1998	1998-64 1998-65 1998-65	MDN897 MDN312	0.008 ng/Bottle 0.031 ng/Bottle
4-1998 4-1998 4-1998 4-1998	1998-64 1998-65 1998-65 1998-66	MDN897	0.008 ng/Bottle 0.031 ng/Bottle 0.020 ng/Bottle
4-1998 4-1998 4-1998	1998-64 1998-65 1998-65	MDN897 MDN312 MDN827 MDN565	0.008 ng/Bottle 0.031 ng/Bottle 0.020 ng/Bottle 0.017 ng/Bottle
4-1998 4-1998 4-1998 4-1998	1998-64 1998-65 1998-65 1998-66	MDN897 MDN312 MDN827	0.008 ng/Bottle 0.031 ng/Bottle 0.020 ng/Bottle



C. SRMs

Quarter	MDN Data Set ID	DormConc	Recov	Quarter	MDN Data Set ID	DormCons	Recov
1-1998	1998-01	4.68 ng/mL	100.9%	2-1998	1998-30	4.15 ng/mL	89.4%
1-1998	1998-01	4.60 ng/mL	99.1%	2-1998	1998-31	4.27 ng/mL	92.1%
1-1998	1998-02	4.46 ng/mL	96.1%	2-1998	1998-31	4:27 ng/mL	92.0%
1-1998	1998-02	4.59 ng/mL	98.9%	2-1998 2-1998	1998-32 1998-32	4:30 ng/mL 4:15 ng/mL	92.6% 89.3%
1-1998	1998-03	4.80 ng/mL	99.1%	3-1998	1998-33	4:19 ng/mL	90.2%
1-1998	1998-03	4.52 ng/miL	97.5%	3-1998	1998-33	4.28 ng/mL	92.3%
1-1998	1998-04	4.57 ng/mL	98.5%	3-1998	1998-34	4:19 ng/mt.	90.3%
1-1998	1998-04	4.58 ng/mL	98.8%	3-1998	1998-34	4.22 ng/mL	91.0%
1-1998	1998-05	4.56 ng/mL	98.4%	3-1998	1998-35	4.24 ng/mL	91.4%
1-1998		4.57 ng/mL	98.4%	3-1998 3-1998	1998-35 1998-36	4.30 ng/mL 4.21 ng/mL	92.6%
	1998-05		98.7%	3-1998	1998-36	4.24 ng/mL	91.5%
1-1998	1998-06	4.58 ng/mL	G12.05.15	3-1998	1998-37	4.22 ng/mL	90.9%
1-1998	1998-06	4.59 ng/mL	99.0%	3-1998	1998-37	4.29 ng/mL	92.4%
1-1998	1998-07	4.62 ng/mL	99.6%	3-1998	1998-38	4.24 ng/mL	91.3%
1-1998	1998-07	4.47 ng/mL	96.4%	3-1998	1998-38	4.22 ng/mL	90.9%
1-1998	1998-08	4.62 ng/mL	99.7%	3-1998 3-1998	1998-39 1998-39	4.22 ng/mL 4.31 ng/mL	90.9%
1-1998	1998-08	4.32 ng/mL	93.0%	3-1998	1998-40	4.42 ng/mi.	95.3%
1-1998	1998-09	4.54 ng/mL	97.9%	3-1998	1998-40	4.22 ng/mt.	90.9%
1-1998	1998-09	4.52 ng/mL	97.4%	3-1998	1998-41	4:24 ng/mL	91.4%
1-1998	1998-10	4.58 ng/mL	98.7%	3-1998	1998-41	4.20 ng/mL	90.6%
1-1998	1998-10	4.58 ng/mL	98.8%	3-1998	1998-42	4.28 ng/mL	92.3%
1-1998	1998-11	4.54 ng/mL	97.8%	3-1998 3-1998	1998-42 1998-43	4.41 ng/mL 4.21 ng/mL	95.0% 90.8%
1-1998	1998-11	4.54 ng/mL	97.8%	3-1998	1998-43	4.21 ng/mL	90.7%
1-1998	1998-12	4.53 ng/mL	97.7%	3-1998	1998-44	4.30 ng/mL	92.6%
1-1998	1998-12	4.56 ng/mL	98.3%	3-1998	1998-44	4.23 ng/mL	91.2%
1-1998	1998-13	4.47 ng/mL	96.3%	3-1998	1998-45	4.31 ng/mL	92.9%
1-1998	1998-13	4:51 ng/mL	97.2%	3-1998	1998-45	4:28 ng/mL	92.3%
2-1998	1998-14	4.65 ng/mL	100.1%	3-1998 3-1998	1998-46 1998-46	4.35 ng/mt. 4.23 ng/mt.	93.8%
2-1998	1998-14	4.43 ng/mL	95.4%	3-1998	1998-47	4.46 ng/mL	96.2%
2-1998	1998-15	4.54 ng/mL	97.9%	3-1998	1998-47	4 38 ng/mL	94.4%
2-1998	1998-15	4.51 ng/mL	97.2%	3-1998	1998-48	4.38 ng/mL	94.3%
2-1998	1998-16	4.43 ng/mL	95.4%	3-1998	1998-48	4.09 ng/mL	88.2%
2-1998	1998-16	4.51 ng/mL	97.2%	3-1998	1998-49	4.30 ng/mL	92.7% 87.9%
2-1998	1998-17	4.40 ng/mL	94.7%	3-1998 4-1998	1998-49	4.08 ng/mL 4.25 ng/mL	91.6%
2-1998	1998-17	4.51 ng/mL	97.1%	4-1998	1998-50	4.33 ng/mL	93.4%
2-1998	1998-18	4.60 ng/mL	99.1%	4-1998	1998-51	4.30 ng/mL	92.7%
2-1998	1998-18	4.91 ng/mL	105.9%	4-1998	1998-51	4.37 ng/mL	94.2%
2-1998		TOTAL VALUE I	98.4%	4-1998	1998-52	4.28 ng/mL	91.3%
	1998-19		96.3%	4-1998	1998-52 1998-53	4.12 ng/mL 4.21 ng/mL	88.9% 90.7%
2-1998	1998-19	4:47 ng/mL		4-1998 4-1998	1998-53	4.26 ng/mL	91.9%
2-1998	1998-20	4.50 ng/mL	97.0%	4-1998	1998-54	4.52 ng/mL	97.3%
2-1998	1998-20	4.51 ng/mL	97.2%	4-1998	1998-54	4.23 ng/mL	91.2%
2-1998	1998-21	4.51 ng/mL	97.2%	4-1998	1998-55	4.36 ng/ml.	93.9%
2-1998	1998-21	4.58 ng/mL	98.6%	4-1998	1998-55	4.28 ng/mL	92.3%
2-1998	1998-22	4.69 ng/mL	101.2%	4-1998 4-1998	1998-56 1998-56	4.42 ng/mL 4.38 ng/mL	95.3% 94.4%
2-1998	1998-22	4.46 ng/mL	96.1%	4-1998	1998-57	4.29 ng/ml.	92.5%
2-1998	1998-23	4.46 ng/mL	96.2%	4-1998	1998-57	4.39 ng/ml.	94.6%
2-1998	1998-23	4.48 ng/mL	96.5%	4-1998	1998-58	4.38 ng/mL	94.5%
2-1998	1998-24	4.53 ng/mL	97.6%	4-1998	1998-58	4.27 ng/ml.	92.0%
2-1998	1998-24	4.67 ng/mL	100.7%	4-1998	1998-59	4.39 ng/mL	94.5%
2-1998	1998-25	4.23 ng/mL	91.2%	4-1998	1998-59 1998-60	4.35 ng/ml. 4.40 ng/ml.	93.8%
2-1998	1998-25	4.22 ng/mL	90.9%	4-1998 4-1998	1998-60	4.39 ng/mL	94.6%
2-1998	1998-26	4.20 ng/mL	90.6%	4-1998	1998-61	4 15 ng/mL	89.4%
2-1998	1998-26	4.28 ng/mL	92.3%	4-1998	1998-61	4.38 ng/mL	94.3%
2-1998	1998-27	4.26 ng/mL	91.9%	4-1998	1998-62	4.42 ng/mL	95.3%
2-1998	1998-27	4.30 ng/mL	92.6%	4-1998	1998-63	4.35 ng/mL	93.8%
2-1998	1998-28	4.27 ng/mL	92.1%	4-1998 4-1998	1998-64 1998-64	4 24 ng/mL 4.44 ng/mL	91.5% 95.6%
2-1998	1998-28	4.20 ng/mL	90.4%	4-1998	1998-65	4.32 ng/mL	93.0%
2-1998	1998-29	4.24 ng/mL	91.4%	4-1998	1998-65	4.30 ng/mL	92.6%
2-1998	1998-29	4.24 ng/mL	91.4%	4-1998	1998-66	4.37 ng/mL	94.2%
2-1998	1998-30	4.05 ng/mL	87.2%	4-1998	1998-66	4:34 ng/mL	93.6%
7. 15.55					Mean	4.38 ng/mL	94.4%
					St Dev	0.16 ng/mL	3.4%

D. Dups

Quarter	MDN Data Set ID	Sample ID	%Diff
1-1998	1998-01	M0N0570	2.3%
1-1998	1998-01	MUNSBOD	23.2%
1-1998	1998-02	MON100D	6.5%
1-1998	1998-02	MON221D	7.6%
1-1998	1998-02	MDN515D	3.6%
1-1998	1998-03	MON464D	0.7%
1-1998	1998-03 1998-03	MDN601D	2.3%
1-1998	1998-04	MENOS1D	1.0%
1-1998	1998-04	MDN067D	1.1%
1-1998	1998-04	MONESTO	1.1%
1-1998	1998-05	MUNETID	1.0%
1-1998	1998-05	MDN554D	3.8%
1-1998	1998-06	MONS970	2.2%
1-1998	1998-06	MON607D	3.1%
1-1998	1998-07	MDN474D MDN677D	2.0%
1-1298	1998-08	MDN677D MDN668D	6.7%
1-1998	1998-08	MBN0880 MBN5020 MBN220D	2.1%
1-1998	1998-08	MDN5020	2.5%
1-1998	1998-09	MON220G	2.7%
1-1998	1998-09	MONDOOD	1.7%
1-1998	1998-09	MONSTAD	1.7%
1-1998	1998-10	MON505D MON505D MON501D MON614D MON104D	2.8%
1-1998	1998-10	MEN477D	7.8%
1-1998	1998-10	MSN477D MON58HD MON489D	1.5%
1-1998	1998-11 1998-11	MUNASSO	5.2% 0.6%
1-1998	1998-11	MUN622D MUN686D	1.1%
1-1998	1998-12	RECONOCERC	2.5%
1-1998	1998-12	MONO480	2.8%
1-1998	1998-12	MON250D MON251D MON233D	0.3%
1-1998	1998-12	MONESTO	1.9%
1-1998	1998-13	MON450D	0.7%
1-1998	1998-13	MDN450D	3.1%
1-1998	1998-13	MDN534D MDN501D	2.7%
2-1998	1998-14 1998-14	MENSIAD	2.0% 9.2%
2-1998	1998-14	MONSHOO	1.7%
2-1998	1998-15	MONSSOC	1.8%
2-1998	1998-15	MONSSED MONSSED	0.1%
2-1998	1998-15	MONGSTO	1.2%
2-1998	1998-16	MON105D	1.9%
2-1998	1998-17	M8N4630	6.9%
2-1998	1998-17	MON574D	1.1%
2-1998	1998-18	MON290C	3.8%
2-1998	1998-18	MONSTAD	3.9%
2-1998	1998-19	MON464D	6.7%
2-1998	1998-19	MCN465D	6.0%
2-1998	1998-19	MONSORO	3.1%
2-1998	1998-20	MON928D O888/IOM	1.5% 6.1%
2-1998	1998-21	MONORPE	3.6%
2-1998	1998-21	MON455D	7.8%
2-1998	1998-22	MONOTED	1.2%
2-1998	1998-22	MUNICAL	6.0%
2-1998	1998-22	MONEDED	0.8%
2-1998	1998-23	MON255D	4.3%
2-1998	1998-23	MDN544D	1.7%
2-1996	1998-24	MGN094D	3.0%
2-1998	1998-24	MONITORINA	13.0%
2-1998	1998-25	MONSSOD	1.7%
2-1998	1998-25	MONEZID	0.6%
2-1998	1998-28	MON2250	1.4%
2-1998	1998-26	MDN2330 MDN5540	5.1%
2-1998	1998-28	MEN654D MEN488D	0.7%
2-1998	1998-27	MDN584D	1.9%
2-1998	1998-27	MDN606D	11.5%
2-1998	1998-28	MON251D	1.0%
2-1998	1998-28	MDN476D MDN512D	1.5%
2-1998	1998-28	MDN512D MDN522D	0.9%
2-1998	1998-29	MONSSED	4.9%
2-1998	1998-30	MDN488D	23.6%
2-1998	1998-30	MDN478D MDN244D	2.1%
2-1998	1998-31	MDN264D	3.2%
2-1998	1998-31	MDN45TD	5.9%
2-1998	1998-32	Nameronato	1.6%

Substitute Sub		100 01 01 01 0		w muse
2-1998	2-1998	MDN Data Set ID	MINDSON AND AND AND AND AND AND AND AND AND AN	SDIII
3-1998	2-1998	1998-32	MONSE7D	1.1%
3-1998			MDN074D	
3-1998		1998-33	MDN577D	
3-1998			MONOGED	
3-1998			MONADED	
3-1998			MDNBSSD	
3-1998			MDN22HD	
3-1998	3-1998	1998-35	MON471D	5.8%
3-1998			MDNOSED	
3-1998	3-1998	1998-36	MDNG22D MDNS87D	
3-1998 1998-38 MCNAT73D 2.7% 3-1998 1998-38 MCNAT73D 2.7% 3-1998 1998-38 MCNAT73D 2.7% 3-1998 1998-39 MCNAT73D 2.7% 3-1998 1998-39 MCNAT73D 2.2% 3-1998 1998-39 MCNAT73D 2.2% 3-1998 1998-39 MCNAT73D 2.2% 3-1998 1998-39 MCNAT73D 2.2% 3-1998 1998-40 MCNAT73D 2.2% 3-1998 1998-41 MCNAT73D 2.7% 3-1998 1998-41 MCNAT73D 2.7% 3-1998 1998-42 MCNAT73D 2.7% 3-1998 1998-42 MCNAT73D 2.7% 3-1998 1998-42 MCNAT73D 2.7% 3-1998 1998-42 MCNAT73D 2.7% 3-1998 1998-43 MCNAT73D 2.7% 3-1998 1998-44 MCNAT73D 1.5% 3-1998 1998-45 MCNAT73D 0.7% 3-1998 1998-44 MCNAT73D 0.7% 3-1998 1998-45 MCNAT73D 1.5% 3-1998 1998-46 MCNAT73D 1.5% 3-1998 1998-47 MCNAT73D 1.7% 3-1998 1998-48 MCNAT73D 0.7% 3-1998 1998-48 MCNAT73D 1.5% 3-1998 1998-47 MCNAT73D 1.7% 3-1998 1998-48 MCNAT73D 1.5% 3-1998 1998-48 MCNAT73D 1.5% 3-1998 1998-47 MCNAT73D 1.7% 3-1998 1998-48 MCNAT73D 1.7% 3-1998 1998-47 MCNAT73D 1.7% 3-1998 1998-48 MCNAT73D 1.7% 3-1998 1998-47 MCNAT73D 2.7% 4-1998 1998-50 MCNAT73D 2.7% 4-1998 1998-51 MCNAT73D 2.7% 4-1998 1998-52 MCNAT73D 2.7% 4-1998 1998-53 MCNAT73D 2.7% 4-1998 1998-54 MCNAT73D 1.7% 4-1998 1998-55 MCNAT73D 2.7% 4-1998 1998-55 MCNAT73D 2.7% 4-1998 1998-56 MCNAT73D 1.7% 4-1998 1998-57 MCNAT73D 1.7% 4-1998 1998-58 MCNAT73D 1.7% 4-1998 1998-59 M	3-1998	1998-37	MDN054D	
3-1998	3-1998	1998-37	MCINGEGO	
3-1998 1998-38 MDNA73D 0.7% 3-1998 1998-39 MDNA73D 0.7% 3-1998 1998-39 MDNA73D 3.2% 3-1998 1998-39 MDNA73D 3.2% 3-1998 1998-40 MDNA73D 3.2% 3-1998 1998-40 MDNA73D 3.2% 3-1998 1998-40 MDNA73D 3.2% 3-1998 1998-40 MDNA73D 3.2% 3-1998 1998-41 MDNA73D 0.2% 3-1998 1998-42 MDNA73D 0.2% 3-1998 1998-42 MDNA73D 1.6% 3-1998 1998-42 MDNA73D 1.6% 3-1998 1998-42 MDNA73D 1.6% 3-1998 1998-43 MDNA73D 1.6% 3-1998 1998-44 MDNA73D 0.1% 3-1998 1998-44 MDNA73D 0.1% 3-1998 1998-44 MDNA73D 0.1% 3-1998 1998-45 MDNA73D 0.1% 3-1998 1998-46 MDNA73D 1.6% 3-1998 1998-47 MDNA73D 1.6% 3-1998 1998-48 MDNA73D 1.6% 3-1998 1998-47 MDNA73D 1.7% 3-1998 1998-48 MDNA73D 2.7% 4-1998 1998-59 MDNA77D 0.0% 4-	3-1998		MONSOGO	
3-1998 1998-38 MDNR3CD 0.0% 3-1998 1998-39 MDNR3CD 1.4% 3-1998 1998-39 MDNR3CD 3.2% 3-1998 1998-40 MDNR3CD 3.2% 3-1998 1998-40 MDNR3CD 3.4% 3-1998 1998-41 MDNR3CD 7.7% 3-1998 1998-41 MDNR3CD 2.2% 3-1998 1998-42 MDNR3CD 1.6% 3-1998 1998-42 MDNR3CD 1.6% 3-1998 1998-42 MDNR3CD 1.6% 3-1998 1998-43 MDNR3CD 1.6% 3-1998 1998-44 MDNR3CD 1.6% 3-1998 1998-43 MDNR3CD 1.5% 3-1998 1998-44 MDNR3CD 1.5% 3-1998 1998-43 MDNR3CD 1.5% 3-1998 1998-44 MDNR3CD 1.5% 3-1998 1998-45 MDNR3CD 1.5% 3-1998 1998-47 MDNR3CD 2.3% 3-1998 1998-46 MDNR3CD 0.5% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-49 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-49 MDNR3CD 1.7% 3-1998 1998-49 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-47 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-49 MDNR3CD 1.7% 3-1998 1998-48 MDNR3CD 1.7% 3-1998 1998-49 MDNR3CD 1.7% 3-1998 1998-49 MDNR3CD 1.7% 3-1998 1998-49 MDNR3CD 1.7% 3-1998 1998-59 MDNR3CD 1.7% 4-1998 1998-59 MDNR3CD 1.7% 4-		1998-38	MDN473D	0.7%
3-1998	3-1998	1998-38	MONSOO	0.0%
3-1998 1998-40 MDNASS 3.4% 3-1998 1998-40 MDNASS 3.4% 3-1998 1998-41 MDNOSD 2.7% 3-1998 1998-41 MDNOSD 2.5% 3-1998 1998-41 MDNOSD 2.5% 3-1998 1998-42 MDNOSD 2.5% 3-1998 1998-42 MDNOSD 2.5% 3-1998 1998-42 MDNOSD 2.5% 3-1998 1998-43 MDNASS 2.0% 3-1998 1998-43 MDNASS 2.0% 3-1998 1998-44 MDNOSD 2.5% 3-1998 1998-44 MDNOSD 2.5% 3-1998 1998-45 MDNOSD 1.5% 3-1998 1998-46 MDNOSD 1.7% 3-1998 1998-46 MDNOSD 2.5% 3-1998 1998-47 MDNOSD 2.5% 3-1998 1998-48 MDNOSD 2.5% 3-1998 1998-47 MDNOSD 2.5% 3-1998 1998-48 MDNOSD 2.5% 3-1998 1998-49 MDNOSD 2.5% 3-1998 1998-47 MDNOSD 2.5% 3-1998 1998-48 MDNOSD 2.5% 3-1998 1998-49 MDNOSD 2.5% 3-1998 1998-55 MDNOSD 2.5% 4-1998 1998-55 MDNOSD 2.1% 4-1998 1998-54 MDNOSD 2.1% 4-1998 1998-55 MDNOSD 2.1% 4-1998 1998-55 MDNOSD 1.1% 4-1998 1998-55 MDNOSD 1.1% 4-1998 1998-55 MDNOSD 1.1% 4-1998 1998-55 MDNOSD 1.1% 4-1998 1998-56 MDNOSD 1.1% 4-1998 1998-57 MDNOSD 1.1% 4-1998 1998-58 MDNOSD 1.1% 4-1998 1998-59 MDNOSD		1998-39	MDNR27D	1.4%
3-1998 1998-40 MDNASTU 7.7% 3-1998 1998-40 MDNASTU 7.7% 3-1998 1998-41 MDNASSU 2.2% 3-1998 1998-41 MDNASSU 2.2% 3-1998 1998-42 MDNASSU 2.3% 3-1998 1998-42 MDNASSU 1.0% 3-1998 1998-42 MDNASSU 1.0% 3-1998 1998-43 MDNASSU 1.5% 3-1998 1998-43 MDNASSU 1.5% 3-1998 1998-44 MDNASSU 2.5% 3-1998 1998-44 MDNASSU 2.5% 3-1998 1998-45 MDNASSU 2.5% 3-1998 1998-45 MDNASSU 2.5% 3-1998 1998-46 MDNASSU 2.5% 3-1998 1998-47 MDNASSU 1.7% 3-1998 1998-47 MDNASSU 1.7% 3-1998 1998-47 MDNASSU 1.7% 3-1998 1998-48 MDNASSU 2.5% 3-1998 1998-47 MDNASSU 2.5% 3-1998 1998-48 MDNASSU 2.5% 3-1998 1998-49 MDNASSU 2.5% 3-1998 1998-47 MDNASSU 2.5% 3-1998 1998-48 MDNASSU 2.5% 3-1998 1998-49 MDNASSU 2.5% 3-1998 1998-49 MDNASSU 2.5% 3-1998 1998-49 MDNASSU 2.5% 3-1998 1998-49 MDNASSU 2.5% 4-1998 1998-50 MDNASSU 2.5% 4-1998 1998-51 MDNASSU 2.5% 4-1998 1998-52 MDNASSU 2.5% 4-1998 1998-52 MDNASSU 2.5% 4-1998 1998-54 MDNASSU 2.5% 4-1998 1998-55 MDNASSU 2.5% 4-1998 1998-55 MDNASSU 2.5% 4-1998 1998-55 MDNASSU 2.5% 4-1998 1998-55 MDNASSU 1.5% 4-1998 1998-56 MDNASSU 1.5% 4-1998 1998-60 MDNASSU 1.5% 4-	3-1998	1998-39	MONSOSO	5.2%
3-1998 1998-40 MCMASTD 7.7% 1998 1998-41 MCMASTD 2.7% 1998 1998-41 MCMASTD 2.2% 1998-41 MCMASTD 1.0% 1998-42 MCMASTD 1.0% 1998-42 MCMASTD 1.0% 1998-42 MCMASTD 1.0% 1998-43 MCMASTD 1.0% 1998-43 MCMASTD 1.0% 1998-43 MCMASTD 1.5% 1998-1998-43 MCMASTD 1.5% 1998-1998-44 MCMASTD 1.5% 1998-43 MCMASTD 1.5% 1998-44 MCMASTD 1.5% 1998-44 MCMASTD 1.5% 1998-45 MCMASTD 1.5% 1998-45 MCMASTD 1.5% 1998-47 MCMASCD 1.7% 1998-1998-47 MCMASCD 1.7% 1998-49 MCMASCD 1.5% 1998-59 MCMASCD 1.5	3-1998	1998-40	MDNSSED	
3-1998 1998-41 MDNRSD 2.1% 3-1998 1998-42 MDNRSD 2.1% 3-1998 1998-42 MDNRSD 10.9% 3-1998 1998-42 MDNRSD 10.9% 3-1998 1998-43 MDNRSD 1.6% 3-1998 1998-43 MDNRSD 2.5% 3-1998 1998-43 MDNRSD 2.5% 3-1998 1998-43 MDNRSD 2.5% 3-1998 1998-44 MDNRSD 2.5% 3-1998 1998-45 MDNRSD 1.6% 3-1998 1998-46 MDNRSD 2.5% 3-1998 1998-47 MDNRSD 2.5% 3-1998 1998-46 MDNRSD 2.5% 3-1998 1998-47 MDNRSD 1.7% 3-1998 1998-47 MDNRSD 1.7% 3-1998 1998-47 MDNRSD 1.7% 3-1998 1998-47 MDNRSD 2.5% 3-1998 1998-48 MDNRSD 2.5% 3-1998 1998-47 MDNRSD 2.5% 3-1998 1998-48 MDNRSD 2.5% 3-1998 1998-48 MDNRSD 2.5% 3-1998 1998-49 MDNRSD 2.5% 3-1998 1998-49 MDNRSD 2.5% 4-1998 1998-50 MDNRSD 2.5% 4-1998 1998-51 MDNRSD 2.5% 4-1998 1998-51 MDNRSD 2.5% 4-1998 1998-52 MDNRSD 2.5% 4-1998 1998-54 MDNRSD 2.5% 4-1998 1998-55 MDNRSD 1.1% 4-1998 1998-55 MDNRSD 1.1% 4-1998 1998-54 MDNRSD 1.1% 4-1998 1998-55 MDNRSD 1.1% 4-1998 1998-56 MDNRSD 1.1% 4-1998 1998-66 MDNRSD 1.1% 4-1998 1998-68 MDNRSD 1.1% 4-1998 1998-68 MDNR	3-1998	1998-40	MONSS7D	7.7%
3-1998	3-1998	1998-41	MONOOBD	
3-1998			MONES SO	
3-1998	3-1998	1998-42	MONOE7D	
3-1998 1998-43 MCNRIED 2.0% MCNRIED 15% 1998-45 MCNRIED 1.5% MCNRIED 1.5% 1998-44 MCNRIED 1.1% M	3-1998	1998-42	MONDSAD	1.6%
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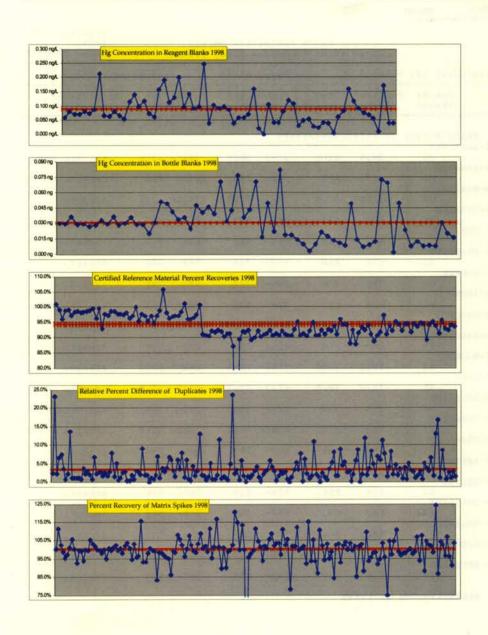
D. Spikes

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1-1998	MDN Data Set ID 1998-01	MON057S	%Rec 100.4%
1-1998	1998-01	MONSEOS	111.3%
1-1998	1998-01	MON588S	102.7%
1-1998	1998-02	MDN1005	99.0%
1-1998	1998-02	MONTOOS	95.6%
1-1998	1998-02	MDN221S	97.5%
1-1998	1998-02	MON5159	101.3%
1-1998	1998-03	MDN464S	105.8%
1-1998	1998-03	MON670S MON601S	100.3% 92.8%
1-1998	1998-04	MONISTS	99.6%
1-1998	1998-04	MDN0678 MDN6315 MDN2175	99.2%
1-1998	1998-04	MDN6315	94.3%
1-1998	1998-05	MDN2175	100.0%
1-1998	1998-05	MONSOIS	99.8%
1-1998	1998-05	MBN6545	105.6%
1-1998	1998-06	MBN5975 MBN6075	103.2%
1-1998	1998-06 1998-07	MDN474S	101.9%
1-1998	1998-07	MON577S	99.7%
1-1998	1998-08	MON0635	98.1%
1-1998	1998-08	HERMOSOG	100.1%
1-1998	1998-08	MON6025	95.4%
1-1998	1998-09	MBN5025 MDN2206	100.7%
1-1998	1998-09	MONSOS	99.5%
1-1998	1998-09	MON614S	101.2%
1-1998	1998-10	MDN184S MDN477S	102.6%
1-1998	1998-10 1998-10	MONS88S	99.5%
1-1998	1998-11	MDN4635	98.1%
1-1998	1998-11	MDN5225	102.2%
1-1998	1998-11	MON585S	104.2%
1-1998	1998-12	MDN250S	100.6%
1-1998	1998-12	MON5815 MON2335	94.9%
1-1998	1998-13	MON233S	103.4%
1-1998	1998-13	MEN534S MEN501S	96.0%
2-1998	1998-14 1998-14	MON5145	96.6% 115.7%
2-1998	1998-14	MONSESS.	93.5%
2-1998	1998-15	MDN553S	93.5%
2-1998	1998-15	MONSSES	98.1%
2-1998	1998-15	MDN587S	100.8%
2-1998	1998-16	MON061S	99.6%
2-1998	1998-16	MONTOS	99.2%
2-1998	1998-17	MDN4635	83.4%
2-1998	1998-17 1998-18	MDN5745 MDN2905	98.7% 98.2%
2-1998	1998-18	MDN5335	97.0%
2-1998	1998-18	MON578S	95.8%
2-1998	1998-19	MDN464S	95.3%
2-1998	1998-19	MDN4866	86.2%
2-1998	1998-19	MDN586S	99.2%
2-1998	1998-20	MEINOSSS	98.7%
2-1998	1998-20	MONB888	107.9%
2-1998	1998-21 1998-21	MON0235 MDN4555	105.9%
2-1998	1998-22	MDN015S	96.3%
2-1998	1998-22	MDN2245	100.3%
2-1998	1998-22	MDN253S	107.6%
2-1998	1998-23	MDN2078	102.6%
2-1998	1998-23	MDN253S	99.1%
2-1998	1998-23	MDN544S	98.5%
2-1998	1998-24	MDN0945 MDN2315	103.3%
2-1998	1998-24 1998-25	MDN0688	108.9%
2-1998	1998-25	MDN559S	102.4%
2-1998	1998-25	MDN571S	98.9%
2-1998	1998-26	MDN2265	111.3%
2-1998	1998-26	MDN2345	95.6%
2-1998	1998-26	MDN5548	101.3%
2-1998	1998-27	MDN463S	117.0%
2-1998	1998-27	MDN584S MDN606S	101.6% 89.7%
2-1998	1998-27 1998-28	MDN251S	101.1%
2-1998	1998-28	MDN476S	90.0%
2-1998	1998-28	M0N5128	98.9%
2-1998	1998-29	MDN522S	99.7%
2-1998	1998-29	MDN5635	102.5%
2-1998	1998-30	MDN468S	120.6%
2-1998	1998-30	MDN4788 MDN2445	114.9%
2-1998	1998-31 1998-31	MDN2545	99.9% 113.5%
2-1998	1998-31	MDN457S	99.9%

Querter 2-1998	MDN Date Set ID	Remple_ID	%Rec 95.9%
2-1998	1998-32	MONGOSS	97.9%
2-1998	1998-32	MDN5875 MDN0745	99.7% 111.5%
3-1998	1998-33	MDN6808	104.7%
3-1998	1998-33	MDN5778 MDN0005	101.4% 94.2%
3-1998	1998-34	MER4005	102.2%
3-1998	1998-34	MONSOAS MONSOAS	100.8%
3-1998	1998-35	MIDNI285	108.9%
3-1998	1998-35	MONATIS	102.1%
3-1998	1998-36	MDN0358 MDN5228	103.6%
3-1998	1998-36 1998-37	MDN5579 MDN5545	97.3%
3-1998	1998-37	MENDEDE	102.7%
3-1998	1998-37	MDN5738	106.1% 78.2%
3-1998	1998-38	MDN4788	101.9%
3-1998	1998-38	MON5308 MDN2278	101.9%
3-1998	1998-39	MONGOS	112.0% 99.7%
3-1998	1998-39	MONDEZS MONDESS	100.6%
3-1998	1998-40 1998-40	MON5378	101.8% 92.3%
3-1998	1998-41	MDN0088 MDN2385	115.4%
3-1998	1998-41	MDN2395 MDN3626	93.8% 105.5%
3-1998	1998-42	MDN087S	93.8%
3-1998	1998-42	MONSES MONSES	87.2% 110.5%
3-1998	1998-43	MONSES MONSES	102.3%
3-1998	1998-43	MONS128	94.6%
3-1998	1995-44	MDN610S MDN056S	95.2%
3-1998	1998-44 1998-45	MDN1088 MDN4888	99.0%
3-1998	1998-45	MONOTIS	84.5% 102.5%
3-1998	1998-46	MONOSES MONZOOS	103.2%
3-1998	1998-46 1998-47	MONOBOS	93.1%
3-1998	1998-47	MON5275 MDN630S	104.3%
3-1998	1998-47	MDN048S	100.0%
3-1998	1998-48	MONSIOS MONSSES	99.6%
3-1998	1998-48	MON456S	101.9% 85.2%
3-1998	1998-49	MDN478S	101.7%
4-1998	1998-50 1998-50	MONITHS MONBATS	103.1%
4-1998	1998-51	MON0158 MON5975 MON641S	109.6%
4-1998	1998-51	MONBALS	93,7% 95.9%
4-1998	1998-52	MONZOSS	98.3%
4-1998	1998-52 1998-52	MDN814S	98.5% 92.0%
4-1998	1998-53	- EXPOSITIONAL D	94.9%
4-1998	1998-53	MDN6268 MDN840S	103.5% 95.9%
4-1998	1998-54	MONSTAS	75.0%
4-1998	1998-54 1998-55	MDN8228 MDN5468	104.7% 97.4%
4-1998	1998-55	MONGO78	104.6%
4-1998	1998-56	MDN0216 MDN4725	110.7%
4-1998	1998-56	MDNS968	97.2%
4-1998	1998-57	MON108S MON483S	98.0% 98.3%
4-1998	1998-57 1998-58	MD113498	99.6%
4-1998	1998-58	MONSS1S MONSSSS	100.3%
4-1998	1998-59	MON871S	97.8%
4-1998	1998-60	MONOSES	107.1%
4-1998	1998-60 1998-60	MONSHES MONSHES	94.2%
4-1998	1998-61	MONOBOS	88.2%
4-1998	1998-61 1998-61	MONSORS MONSORS	104.8%
4-1998	1998-62	MDN2918	102.0%
4-1998	1998-62	MONSOTS	98.4%
4-1998	1998-63	MON813S	86.9%
4-1998	1998-64	MONOBOS MONSESS	104.3%
4-1998	1998-64	MON545S	98.5%
4-1998	1998-65 1998-65	MDN8298 MDN8298	108.9%
4-1998	1998-66	MON4816	91.3%
4-1998	1998-66	MONESES	103.8%
		Mean St Dev	100.2%



VI. Appendix B Quality Control Charts





VII. Appendix C US EPA WP 040 Results

WA01127

		mance Evaluation Report	Fage: 1
	USEFA	water Follution Study %PC4C	Date: 1980V98
articipant ID:	WA01127	Type: CTHES S	sequesting Office: FL

Sample Number	Reported Value	Tru∈ Valu∈≑			War:		Fvaluat	
TRACE METAL	S IN FICH	GHAMS/I	775					
1-YTOWINOW	2520	7105		2000	2020	2256	-1 -	
01	2620	3105	2740-	3440	2830-	33:0	Cx. I	CI FII
2-ARSENIC	152	160	120			400		4 7761
01	153	160	128-	190	136-	183	Acceb	
3-BERYLLIUM	27 20	26.0	22 4		20 2	11.4		
02	37.30	36.9	33.1-	42.2	34.2-	41	Accep	
4-CADMIUM	***							
01	182	170	147-	193	152-	187	sccep	t .
S-COBALT							Grant State	
01	527	503	449-	561	464-	547	Accep	t •
6-CHROMIUM						704	200000000	
01	679	650	579-	726	598-	706	1cc€b.	
7-COPPER		NAME OF TAXABLE PARTY.		200		202	W-AL-	25
01	750	700	654-	781	67C-	765	Acc€p.	t.
08-IRON		(2-2-2-1	12000	2020	Marketon (22-2	100 10	
01	916	834	744-	93€	768-	912	Ck. f	or frr.
9-MERCURY		-	721 UU 21		2 222	4 40		
01	1.10	1.15	0.813-	- 1.47	0.895	- 1.39	vcceb.	
O-MANGANESE	2000	12002		12x 22x2x	2020	200		
01	244	240	216-	259	222-	254	Accep	t •
11-NICKEL	4947	Carrier 1	7215452	575705	Service Services	500000		
01	2620	2501	234C-	2860	2400-	2790	Accep	t.
2-LEAD	40.0	7270 1427	HER 125		30.19	44 T		
01	71.5	70.6	61.7-	E-E3	64.4-	80.6	1cceb.	t.
3-SELENIUM	.22							
01	305	260	189-	297	202-	284	sct A	ccert.
4-VANADIUM								
01	4530	4202	388C-	4640	398C-	455C	Acc€¢	t .
5-ZINC								
01	583	631	563-	709	581-	690	Accep	t •
6-ANT I HONY						20200		
02	515	499	381-	590	407-	564	Accep	t •
7-SILVER	****				navara v			
02	834	851	736-	930	760-	906	vcceb.	t.
8-THALLIUM	202	Carteria.						
02	863	841	747-	970	775-	942	Acc€ P	t.
4-HOLYBDENUM	1740 77 77 22							
02	18.4	18-2	14-	22	15-	21	Acc€p	t.
5-STRONTIUM	400.00							
02	324	301	263-	342	273-	332	Accep	t.
6-TITANIUH								
02	166	160	142-	177	147-	173	Accep	120

MISCELLANEOUS ANALYTES

Performance Evaluation Report USEFA Mater Follution Study FF040

Ferort: IECCS Fage: 2 Tate: 15kov98

Sample Reported True Acceptance Warning Ferformence
Number Value Value Limits Limits Evaluation articipant IE: WA01127 /2-NON-FILTERABLE RESIDUF(IF MG/I)
01 65.0 64.0 12.4-80.7 20.9-72.1 Accept. PROCESSOR END OF DATA FOR WACTIZE CONCORDED THEFE SIGNIFICANT DIGITS.

hased on gravimetric calculations, or a reference value when necessary.

