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Report
Alpine Satellite Water Resources
2003 NPRA Lake Monitoring Program

Dear Caryn,

Attached for your use is our report for the 2003 Lake Monitoring Program in the National Petroleum Reserve–Alaska (NPRA) for the Alpine Satellite Development Plan (ASDP). This report details the results of physical measurements and chemical testing at 16 lakes in the NPRA and includes in situ and analytical sampling components. An Access database of the results of all analytical sampling have been provided to Natural Resources Group (NRG) of Minneapolis, Minnesota under separate cover.

We hope that this report is sufficient for your needs. Please feel free to call should you have any questions or comments.

Sincerely,
Michael Baker Jr., Inc.

Michael Alexander, P.E.
Project Manager

Jon Wolf
Project Hydrologist

ASDP Water Resources – 2003 NPRA Lake Monitoring

Introduction and Objective

Water withdrawn from North Slope lakes is used for oil field facility operation, camp operation, and in the winter for exploration and construction activities. As exploration continues to move westward in the NPRA, a number of lakes will be permitted for temporary withdrawal as well as for permanent water supply sources.

This letter report summarizes hydrologic observations, measurements, and sampling results from the lake monitoring and sampling investigation conducted in the eastern NPRA in Fall 2003 by Michael Baker Jr. (Baker). The study was performed at the request of Caryn Rea of ConocoPhillips, Alaska, Inc. (CPAI) and consisted of water quality measurements and analytical sampling at a number of freshwater lakes.

The objective of this investigation was to collect baseline water quality data from a number of NPRA lakes and use the data to establish a database. Such a database will be an invaluable resource in terms of future planning and permitting for water use at NPRA lakes.

Approach

The investigation consisted of a one-time sampling event conducted over a period of two days, September 4 and 5, 2003, at 16 lakes on the eastern margin of the NPRA (Figure 1). Access to the lakes was by helicopter. All monitoring and sample collection was completed from the bank. Monitoring and sampling were conducted at three locations at each lake (Figures 2, 3, 4). The locations were selected such that they were approximately evenly spaced around each lake's perimeter, and represented any different biomes around and within the lake (e.g. grassy shallows, swampy lowlands, relatively deep areas, etc.).

Investigative Methods

In Situ Parameters

A Horiba U-10 in situ water quality meter was used to measure the following in situ water parameters:

- Temperature in degrees Celsius (°C)
- pH in standard units
- Conductivity in millisiemens per centimeter (mS/cm)
- Salinity in milligrams per liter (mg/L)
- Dissolved Oxygen in mg/L

At each site in situ monitoring was conducted just off the bank in an area that maximized depth. Readings were made within the water column at a depth that represented approximately one-half the total depth of the water in each sampling location. Every attempt was made to minimize lake substrate disturbance. If lake sediment was inadvertently disturbed, the location of the sample was moved away from the disturbance.

Prior to the September sampling event, the Horiba U-10 meter was returned to Hannah Instrumentation, a local manufacturer's representative, for complete maintenance servicing performed according to the manufacturer's specifications. The servicing included multiple-point calibration on all probes using span and zero check solutions, cleaning of all probes, and replacement of the semi-permeable membrane on the dissolved oxygen probe. A daily calibration check was performed in the field using the meter's auto-calibrate function and calibration solution provided by the manufacturer.

Analytical Parameters

Water samples for analytical evaluation were collected prior to in situ monitoring. Analytical samples were collected as grab samples in lab-provided containers. Samples were collected within the water column at a depth that represented approximately one-half the total depth of the water in each sampling location.

Each sampling container was labeled with pertinent sampling information and stored in an ice chest for transport to the analytical laboratory under standard chain-of-custody procedures. Refreezable gel packs were used to cool the samples during storage and shipment.

Samples were submitted to SGS-CT&E Environmental Services Inc. for the following analysis:

- Calcium, Magnesium, Sodium, Potassium, Iron, Chloride, Copper, Zinc, Cadmium
- Total Nitrate, Sulfate
- Alkalinity
- Turbidity
- Total Dissolved Solids (TDS)
- Polynuclear Aromatic Hydrocarbons by Selective Ion Monitoring (PAH-SIM)
- Diesel Range Organics (DRO)
- Residual Range Organics (RRO).

Results

Results of the in situ monitoring and analytical sampling of the 2003 NPRA Lake Monitoring Program are summarized in the following tables:

- Table 1 – In Situ Water Quality
- Table 2 – Analytical Results – Dissolved Metals and Anions
- Table 3 – Analytical Results – Alkalinity, Turbidity, TDS, DRO, RRO
- Table 4 – Analytical Results – PAH-SIM

In Situ Parameters

Water Temperature

Water temperatures in the study lakes ranged between 3°C and 6°C. The coolest water temperature, 3.1°C was measured at Lakes L9910, Location 3 and M9913, Location 1. The warmest water temperature, 5.7°C was measured at Lake L9304, Location 1. Lake MB0302 was, on average, the warmest of the 16 lakes with an average water temperature of 5.4°C. Lake L9910 was the coolest with an average water temperature of 3.4°C.

pH

pH in the 16 study lakes ranged between 5 and 8 with the majority of the values falling between 7 and 8. The lowest pH, 5.5 was measured at Lake M0292, Location 1. The highest pH, 8.1, was measured at Lake L9910, Location 3. All lakes except two had average pH values between 7 and 8.

Conductivity

Conductivities in the 16 study lakes were relatively low, and ranged from 0.154 to 0.049 mS/cm. Conductivity can be used as a rapid estimate of the amount of dissolved solids in water and the above measurements compare well to the relatively low dissolved solid measurements made by the analytical laboratory. The low conductivities also confirm the low salinity concentrations measured at the lakes.

Salinity

Measurements consistently indicated zero percent salinity at all sampling locations in the 16 study lakes.

Dissolved Oxygen

Each of the study lakes was highly oxygenated as would be expected during the open water months when the water surface is in contact with the atmosphere and the lakes are relatively well mixed due to wind action. Dissolved oxygen (DO) concentrations ranged from 6.8 to 12.30 mg/L.

ANALYTICAL PARAMETERS

Dissolved Metals

The metals program included laboratory analysis of calcium, magnesium, sodium, potassium, iron, copper, zinc, and cadmium. All metals analyses were completed as dissolved metals and thus samples were collected in preserved glassware.

With one exception, iron, copper, zinc, and cadmium concentrations were found to be below their various detection limits. Lake L9824, Location 2 was the exception with a cadmium concentration of 0.003 mg/L. Cadmium concentrations at sample locations 1 and 3 in Lake L9824 were below the detection limit of 0.002 mg/L for cadmium. The maximum contaminant level for cadmium in public drinking water systems is 0.005 mg/L (ADEC, 2002).

Calcium concentrations ranged from 6.1 to 20.1 mg/L while magnesium concentrations ranged from 1.6 to 4.2. The total concentration of these two analytes expressed as calcium carbonate is often referred to as hardness. Sodium and potassium concentrations were typically low, and ranged from 2.6 to 17.8 and less than the detection limit of 1.0 to 1.2 mg/L, respectively.

Anions

Chloride concentrations ranged from 37.9 mg/L (Lake L9304, Location 2) to 6.4 mg/L (Lake L9824, Locations 1 and 2). Sulfate ranged from non-detect (detection limit = 0.1 mg/L) to 2.5 mg/L. With one exception, total nitrate concentrations were non detect (detection limit = 1.0 mg/L). A total nitrate concentration of 1.52 mg/L was measured at Lake M0292, Location 3.

Alkalinity

Alkalinity can be defined as the capacity of water to react with and neutralize acid. It is expressed in terms of an equivalent amount of calcium carbonate (CaCO₃). Alkalinity levels in the 16 study lakes suggest that the lakes are relatively well buffered. Alkalinities ranged from 23 mg/L (Lake MB0302, Locations 1 & 2 and Lake L9824, Location 2) to 68 mg/L (Lake MB0301, Location 3).

Total Dissolved Solids

As previously discussed, TDS concentrations were relatively low ranging from non-detect (detection limit = 50 mg/L) at locations at three study lakes to 139 mg/L at Lake MB0301, Location 3. Low TDS concentrations are expected in waters having relatively low conductivities and little or no salinity.

Polynuclear Aromatic Hydrocarbons by Selective Ion Monitoring

PAH-SIM analysis tests for the 16 primary aromatic hydrocarbon compounds. With one exception, all target compounds at all lakes were non-detect at their various detection limits. The single exception was the compound naphthalene, which was found at concentrations ranging from 0.05 to 0.76 ug/L at one or more locations in 9 of the 16 study lakes, a total of 15 occurrences. Naphthalene is a compound that occurs in the atmosphere as a result of anthropogenic activities. It is also an analyte quantified by both volatile and semi-volatile analysis and thus is prone to cross contamination. Internal laboratory quality control data indicate that the naphthalene detections in the NPRA samples resulted from cross contamination that occurred during the sample extraction process at the lab.

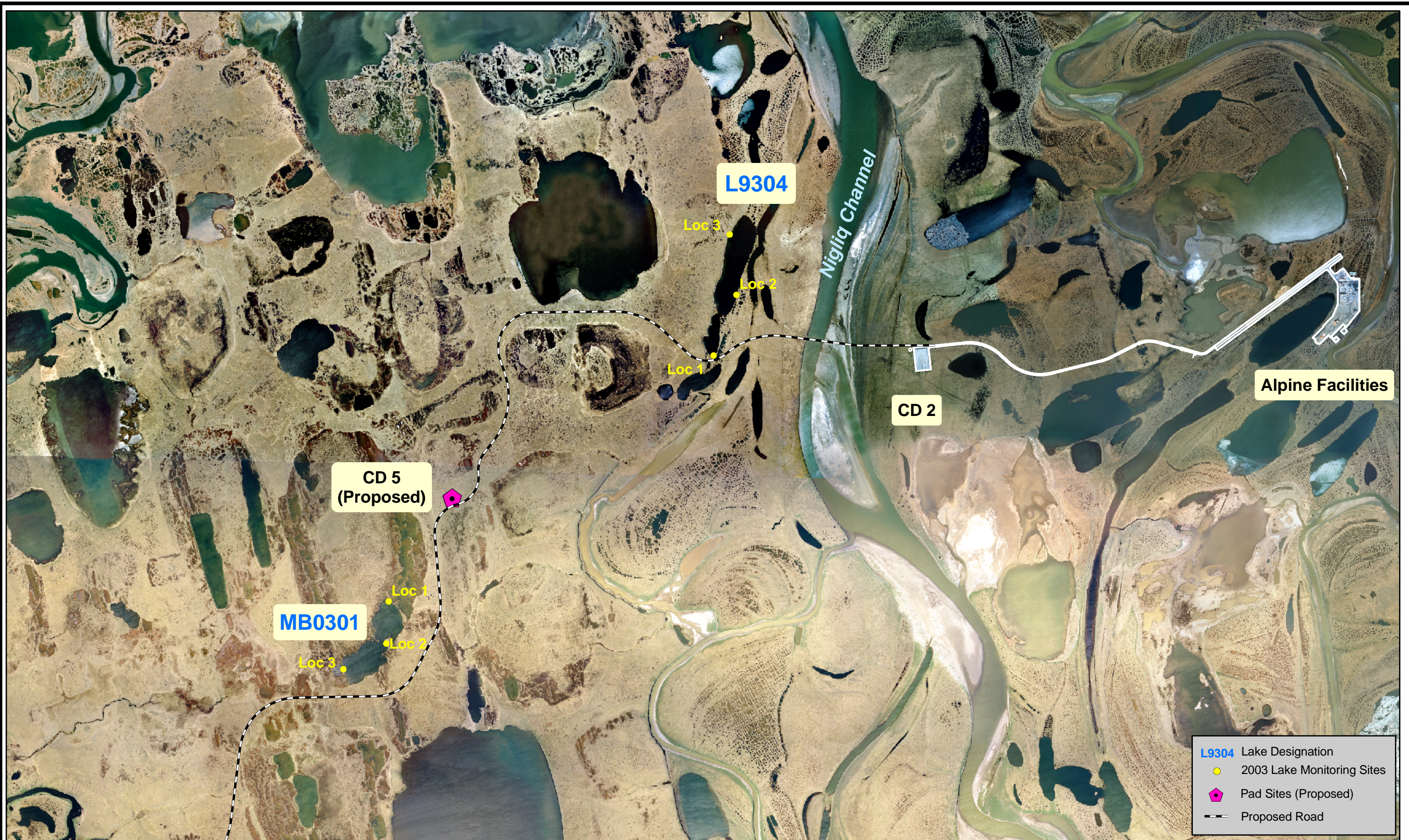
Diesel and Residual Range Organics

DRO and RRO compounds were not found above detection limits in any of the 16 study lakes.

References

Alaska Department of Environmental Conservation (ADEC), 2002. *18 AAC 80. Drinking Water Regulations*. September 21, 2002.









**2003 NPRA LAKE MONITORING PROGRAM
SAMPLING LOCATIONS**

Table 1 - In Situ Water Quality

September 2003

Lake Number	Sample Location	Sample Date & Time	Sample Location Coordinates (NAD83)	Depth at Sample Location (ft)	In Situ Parameters				
					Temp. (°C)	pH	Conductivity (mS/cm)	Salinity (%)	Dissolved Oxygen (mg/L)
L9304	1	9/4/03, 10:25	70° 20' 17.8" 151° 06' 13.6"	1.0	5.7	6.3	0.153	0.0	11.90
	2	9/4/03, 10:40	70° 20' 38.7" 151° 05' 51.5"	1.3	5.2	7.4	0.152	0.0	11.53
	3	9/4/03, 10:55	70° 20' 59.7" 151° 05' 58.4"	1.0	4.7	7.7	0.154	0.0	11.31
MB0301	1	9/4/03, 11:05	70° 18' 51.8" 151° 11' 38.1"	2.3	4.9	7.9	0.152	0.0	10.58
	2	9/4/03, 11:20	70° 18' 36.8" 151° 11' 39.2"	1.3	4.8	7.9	0.156	0.0	11.88
	3	9/4/03, 11:30	70° 18' 28.1" 151° 12' 23.4"	2.0	5.0	7.9	0.157	0.0	10.91
L9824	1	9/4/03, 11:45	70° 17' 02.6" 151° 15' 47.9"	2.1	5.2	7.6	0.049	0.0	11.73
	2	9/4/03, 11:50	70° 17' 04.1" 151° 16' 13.7"	2.1	5.5	7.5	0.051	0.0	11.13
	3	9/4/03, 12:00	70° 17' 09.1" 151° 16' 40.9"	0.5	5.3	7.2	0.074	0.0	10.18
L9821	1	9/4/03, 12:10	70° 17' 11.8" 151° 20' 20.3"	1.4	4.6	7.9	0.143	0.0	11.92
	2	9/4/03, 12:20	70° 16' 59.0" 151° 21' 05.0"	1.2	4.6	7.9	0.144	0.0	11.80
	3	9/4/03, 12:30	70° 17' 24.9" 151° 21' 15.2"	1.5	4.9	8.0	0.145	0.0	10.07

Table 1 - In Situ Water Quality (Continued)

September 2003

Lake Number	Sample Location	Sample Date & Time	Sample Location Coordinates (NAD83)	Depth at Sample Location (ft)	In Situ Parameters				
					Temp. (°C)	pH	Conductivity (mS/cm)	Salinity (%)	Dissolved Oxygen (mg/L)
L9819	1	9/4/03, 15:20	70° 16' 32.7" 151° 21' 03.0"	0.8	5.3	7.8	0.096	0.0	11.57
	1 Dup	9/4/03, 15:25	70° 16' 32.7" 151° 21' 03.0"	0.8	--	--	--	--	--
	2	9/4/03, 15:30	70° 15' 50.7" 151° 20' 37.2"	0.9	5.1	7.9	0.096	0.0	12.05
	2 Dup	9/4/03, 15:35	70° 15' 50.7" 151° 20' 37.2"	0.9	--	--	--	--	--
	3	9/4/03, 15:40	70° 16' 07.4" 151° 21' 56.6"	1.0	5.5	7.9	0.096	0.0	11.05
	3 Dup	9/4/03, 15:45	70° 16' 07.4" 151° 21' 56.6"	1.0	--	--	--	--	--
MB0302	1	9/4/03, 16:00	70° 16' 56.9" 151° 26' 10.1"	2.9	5.3	7.6	0.076	0.0	10.92
	1 Dup	9/4/03, 16:05	70° 16' 56.9" 151° 26' 10.1"	2.9	--	--	--	--	--
	2	9/4/03, 16:10	70° 16' 49.8" 151° 26' 18.0"	0.8	5.4	7.4	0.074	0.0	9.33
	2 Dup	9/4/03, 16:15	70° 16' 49.8" 151° 26' 18.0"	0.8	--	--	--	--	--
	3	9/4/03, 16:20	70° 17' 01.8" 151° 26' 36.0"	0.9	5.5	7.6	0.072	0.0	10.77
M9924	1	9/5/03, 09:10	70° 16' 00.5" 151° 30' 39.6"	1.9	4.4	8.0	0.144	0.0	10.41
	2	9/5/03, 09:20	70° 15' 51.3" 151° 30' 27.6"	0.8	3.5	8.0	0.137	0.0	12.15
	3	9/5/03, 09:30	70° 15' 55.1" 151° 31' 14.9"	0.9	4.1	7.4	0.105	0.0	8.68
L9910	1	9/5/03, 09:40	70° 17' 12.6" 151° 32' 10.2"	1.3	3.5	7.8	0.101	0.0	12.22
	2	9/5/03, 09:50	70° 17' 35.0" 151° 30' 22.1"	1.3	3.6	7.8	0.110	0.0	12.04
	3	9/5/03, 10:00	70° 17' 36.6" 151° 32' 11.4"	0.7	3.1	8.1	0.112	0.0	12.11

Table 1 - In Situ Water Quality (Continued)

September 2003

Lake Number	Sample Location	Sample Date & Time	Sample Location Coordinates (NAD83)	Depth at Sample Location (ft)	In Situ Parameters				
					Temp. (°C)	pH	Conductivity (mS/cm)	Salinity (%)	Dissolved Oxygen (mg/L)
M9913	1	9/5/03, 10:15	70° 15' 09.8" 151° 32' 41.5"	0.7	3.1	7.7	0.085	0.0	10.78
	2	9/5/03, 10:30	70° 15' 06.4" 151° 32' 07.4"	1.3	3.9	7.5	0.087	0.0	11.73
	3	9/5/03, 10:40	70° 15' 02.9" 151° 32' 37.8"	1.1	4.0	7.5	0.092	0.0	10.45
M9912	1	9/5/03, 10:50	70° 15' 01.0" 151° 33' 01.8"	1.0	4.5	7.5	0.077	0.0	11.73
	2	9/5/03, 11:00	70° 15' 12.4" 151° 33' 20.5"	1.1	4.7	7.4	0.076	0.0	11.36
	3	9/5/03, 11:05	70° 15' 11.1" 151° 33' 50.4"	1.3	4.9	7.3	0.075	0.0	9.12
M0292	1	9/5/03, 11:50	70° 15' 14.7" 151° 34' 51.7"	0.8	4.6	5.5	0.083	0.0	12.15
	2	9/5/03, 12:00	70° 15' 03.5" 151° 35' 08.3"	0.8	4.5	6.9	0.085	0.0	12.10
	3	9/5/03, 12:10	70° 15' 12.7" 151° 35' 29.5"	1.3	5.2	7.3	0.085	0.0	10.35
M0293	1	9/5/03, 12:15	70° 15' 09.8" 151° 36' 27.7"	0.9	3.5	7.5	0.065	0.0	12.24
	2	9/5/03, 12:20	70° 14' 56.5" 151° 36' 19.4"	1.6	3.4	7.4	0.061	0.0	11.64
	3	9/5/03, 12:30	70° 15' 04.0" 151° 36' 59.4"	0.9	4.1	7.3	0.065	0.0	10.53
M0294	1	9/5/03, 14:40	70° 14' 44.0" 151° 36' 06.7"	0.8	5.0	7.6	0.057	0.0	12.02
	2	9/5/03, 14:50	70° 14' 35.4" 151° 36' 19.1"	1.6	5.1	7.4	0.059	0.0	9.51
	3	9/5/03, 15:00	70° 14' 39.0" 151° 36' 46.7"	1.4	5.4	7.5	0.059	0.0	9.73

Table 1 - In Situ Water Quality (Continued)

September 2003

Lake Number	Sample Location	Sample Date & Time	Sample Location Coordinates (NAD83)	Depth at Sample Location (ft)	In Situ Parameters				
					Temp. (°C)	pH	Conductivity (mS/cm)	Salinity (%)	Dissolved Oxygen (mg/L)
M9914	1	9/5/03, 15:10	70° 13' 54.2" 151° 37' 10.0"	1.9	4.8	7.5	0.062	0.0	11.86
	2	9/5/03, 15:15	70° 13' 54.6" 151° 38' 31.8"	0.5	5.5	7.3	0.062	0.0	9.34
	3	9/5/03, 15:25	70° 14' 12.5" 151° 38' 12.2"	1.9	5.3	7.1	0.059	0.0	11.16
R0071	1	9/5/03, 15:30	70° 13' 37.4" 151° 38' 39.6"	0.6	5.3	6.1	0.075	0.0	9.58
	2	9/5/03, 15:40	70° 13' 30.4" 151° 39' 38.1"	1.1	5.2	6.8	0.076	0.0	8.83
	3	9/5/03, 15:50	70° 13' 21.5" 151° 38' 47.1"	0.7	4.2	7.3	0.097	0.0	10.66
M0024	1	9/5/03, 16:00	70° 12' 51.7" 151° 38' 29.2"	1.1	5.3	7.5	0.077	0.0	12.30
	2	9/5/03, 16:05	70° 12' 27.9" 151° 38' 42.5"	1.6	4.9	7.5	0.077	0.0	10.60
	3	9/5/03, 16:15	70° 12' 43.7" 151° 39' 54.3"	1.3	5.4	7.6	0.075	0.0	11.22

Table 2 - Analytical Results, Dissolved Metals and Anions

September 2003

Lake Number	Sample Location	Sample		Dissolved Metals by SW 6020								Anions by EPA 300		
		Date/ Time	Depth (ft)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Iron (mg/L)	Copper (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Total Nitrate (mg/L)
L9304	1	9/4/03, 10:25	1.0	9.3	3.9	17.8	1.1	U (1.0)	U (0.006)	U (0.025)	U (0.002)	37.5	2.5	U (1.0)
	2	9/4/03, 10:40	1.3	8.0	3.3	15.7	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	37.9	2.4	U (1.0)
	3	9/4/03, 10:55	1.0	9.3	3.7	17.8	1.0	U (1.0)	U (0.006)	U (0.025)	U (0.002)	38.0	2.5	U (1.0)
MB0301	1	9/4/03, 11:05	2.3	18.0	4.2	8.1	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	25.2	0.3	U (1.0)
	2	9/4/03, 11:20	1.3	19.2	4.0	7.3	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	24.8	0.3	U (1.0)
	3	9/4/03, 11:30	2.0	19.1	4.0	7.4	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	24.7	0.27	U (1.0)
L9824	1	9/4/03, 11:45	2.1	6.1	1.7	2.7	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	6.4	U (0.1)	U (1.0)
	2	9/4/03, 11:50	2.1	6.2	1.7	2.6	U (1.0)	U (1.0)	U (0.006)	U (0.025)	0.003	6.4	U (0.1)	U (1.0)
	3	9/4/03, 12:00	0.5	8.3	2.6	3.8	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	10.0	U (0.1)	U (1.0)
L9821	1	9/4/03, 12:10	1.4	19.5	3.6	7.3	1.2	U (1.0)	U (0.006)	U (0.025)	0.003	19.4	1.0	U (1.0)
	2	9/4/03, 12:20	1.2	20.1	3.5	7.1	1.1	U (1.0)	U (0.006)	U (0.025)	U (0.002)	19.3	1.1	U (1.0)
	3	9/4/03, 12:30	1.5	20.0	3.5	6.8	1.1	U (1.0)	U (0.006)	U (0.025)	U (0.002)	19.3	1.3	U (1.0)

Notes

U = Analyte not detected at detection limit shown in parenthesis

Table 2 - Analytical Results, Dissolved Metals and Anions (Continued)

Lake Number	Sample Location	Sample		Dissolved Metals by SW 6020								Anions by EPA 300		
		Date/Time	Depth (ft)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Iron (mg/L)	Copper (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Total Nitrate (mg/L)
L9819	1	9/4/03, 15:20	0.8	13.4	3.2	4.5	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.9	0.3	U (1.0)
	1 Dup	9/4/03, 15:25	0.8	12.6	2.9	4.3	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.9	0.3	U (1.0)
	2	9/4/03, 15:30	0.9	13.3	2.9	4.4	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.8	0.4	U (1.0)
	2 Dup	9/4/03, 15:35	0.9	12.8	2.9	4.3	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.8	0.3	U (1.0)
	3	9/4/03, 15:40	1.0	12.5	2.9	4.3	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.9	0.4	U (1.0)
	3 Dup	9/4/03, 15:45	1.0	11.8	2.9	4.3	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.7	0.3	U (1.0)
MB0302	1	9/4/03, 16:00	2.9	6.5	2.0	5.6	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.3	U (0.1)	U (1.0)
	1 Dup	9/4/03, 16:05	2.9	6.5	2.0	5.6	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.4	U (0.1)	U (1.0)
	2	9/4/03, 16:10	0.8	7.0	2.2	5.9	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.6	U (0.1)	U (1.0)
	2 Dup	9/4/03, 16:15	0.8	7.0	2.1	5.8	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.5	U (0.1)	U (1.0)
	3	9/4/03, 16:20	0.9	6.4	2.1	5.6	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.3	U (0.1)	U (1.0)
M9924	1	9/5/03, 09:10	1.9	13.1	3.0	5.6	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	16.3	0.2	U (1.0)
	2	9/5/03, 09:20	0.8	17.3	3.7	6.9	1.1	U (1.0)	U (0.006)	U (0.025)	U (0.002)	19.4	0.3	U (1.0)
	3	9/5/03, 09:30	0.9	16.9	3.6	6.5	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	19.6	0.3	U (1.0)

Notes

U = Analyte not detected at detection limit shown in parenthesis

Table 2 - Analytical Results, Dissolved Metals and Anions (Continued)

Lake Number	Sample Location	Sample		Dissolved Metals by SW 6020								Anions by EPA 300		
		Date/Time	Depth (ft)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Iron (mg/L)	Copper (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Total Nitrate (mg/L)
L9910	1	9/5/03, 09:40	1.3	13.2	2.1	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	14.7	0.2	U (1.0)
	2	9/5/03, 09:50	1.3	17.0	2.1	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.4	0.3	U (1.0)
	3	9/5/03, 10:00	0.7	15.0	2.0	3.7	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	13.0	0.3	U (1.0)
M9913	1	9/5/03, 10:15	0.7	10.9	2.6	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.3	0.1	U (1.0)
	2	9/5/03, 10:30	1.3	10.6	2.6	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.6	U (0.1)	U (1.0)
	3	9/5/03, 10:40	1.1	8.7	2.2	3.5	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	16.1	U (0.1)	U (1.0)
M9912	1	9/5/03, 10:50	1.0	8.2	2.2	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.9	U (0.1)	U (1.0)
	2	9/5/03, 11:00	1.1	8.3	2.2	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.7	U (0.1)	U (1.0)
	3	9/5/03, 11:05	1.3	8.6	2.4	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.8	U (0.1)	U (1.0)
M0292	1	9/5/03, 11:50	0.8	8.6	2.3	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	18.7	U (0.1)	U (1.0)
	2	9/5/03, 12:00	0.8	8.9	2.2	4.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	18.4	U (0.1)	U (1.0)
	3	9/5/03, 12:10	1.3	8.9	2.2	4.1	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	18.0	0.1	1.52
M0293	1	9/5/03, 12:15	0.9	6.6	1.7	3.0	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	10.1	U (0.1)	U (1.0)
	2	9/5/03, 12:20	1.6	6.1	1.6	2.8	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	9.7	0.1	U (1.0)
	3	9/5/03, 12:30	0.9	7.2	1.8	3.4	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	10.2	0.1	U (1.0)

Notes

U = Analyte not detected at detection limit shown in parenthesis

Table 2 - Analytical Results, Dissolved Metals and Anions (Continued)

Lake Number	Sample Location	Sample		Dissolved Metals by SW 6020								Anions by EPA 300		
		Date/Time	Depth (ft)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Iron (mg/L)	Copper (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Total Nitrate (mg/L)
M0294	1	9/5/03, 14:40	0.8	7.0	1.7	3.0	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	9.5	0.1	U (1.0)
	2	9/5/03, 14:50	1.6	7.2	1.8	3.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	9.6	0.1	U (1.0)
	3	9/5/03, 15:00	1.4	7.4	1.8	3.1	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	9.5	U (0.1)	U (1.0)
M9914	1	9/5/03, 15:10	1.9	7.5	1.8	3.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	9.7	0.1	U (1.0)
	2	9/5/03, 15:15	0.5	7.2	1.8	3.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	9.7	0.1	U (1.0)
	3	9/5/03, 15:25	1.9	7.8	1.8	3.2	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	9.8	0.1	U (1.0)
R0071	1	9/5/03, 15:30	0.6	9.7	2.2	3.6	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	12.1	U (0.1)	U (1.0)
	2	9/5/03, 15:40	1.1	8.5	2.2	3.6	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	11.5	0.3	U (1.0)
	3	9/5/03, 15:50	0.7	11.6	2.8	4.1	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	15.2	U (0.1)	U (1.0)
M0024	1	9/5/03, 16:00	1.1	8.6	2.1	3.9	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	14.5	0.1	U (1.0)
	2	9/5/03, 16:05	1.6	9.7	2.5	4.1	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	14.8	0.1	U (1.0)
	3	9/5/03, 16:15	1.3	8.7	2.2	4.0	U (1.0)	U (1.0)	U (0.006)	U (0.025)	U (0.002)	14.5	0.1	U (1.0)

Notes

U = Analyte not detected at detection limit shown in parenthesis

Table 3 - Analytical Results, Alkalinity, Turbidity, TDS, DRO, RRO September 2003

Lake Number	Sample Location	Sample		Alkalinity (mg/L)	Total Dissolved Solids (mg/L)	Diesel Range Organics (mg/L)	Residual Range Organics (mg/L)
		Date/Time	Depth (ft)				
L9304	1	9/4/03, 10:25	1.0	35	118	U (0.330)	U (0.549)
	2	9/4/03, 10:40	1.3	37	120	U (0.316)	U (0.526)
	3	9/4/03, 10:55	1.0	38	110	U (0.300)	U (0.500)
MB0301	1	9/4/03, 11:05	2.3	62	135	U (0.316)	U (0.526)
	2	9/4/03, 11:20	1.3	67	130	U (0.300)	U (0.500)
	3	9/4/03, 11:30	2.0	68	139	U (0.319)	U (0.532)
L9824	1	9/4/03, 11:45	2.1	24	55	U (0.313)	U (0.521)
	2	9/4/03, 11:50	2.1	23	65	U (0.309)	U (0.515)
	3	9/4/03, 12:00	0.5	35	70	U (0.315)	U (0.515)
L9821	1	9/4/03, 12:10	1.4	66	131	U (0.333)	U (0.556)
	2	9/4/03, 12:20	1.2	66	109	U (0.323)	U (0.538)
	3	9/4/03, 12:30	1.5	66	133	U (0.326)	U (0.543)
L9819	1	9/4/03, 15:20	0.8	42	101	U (0.300)	U (0.500)
	1 Dup	9/4/03, 15:25	0.8	42	95	U (0.313)	U (0.521)
	2	9/4/03, 15:30	0.9	46	96	U (0.330)	U (0.549)
	2 Dup	9/4/03, 15:35	0.9	46	94	U (0.306)	U (0.510)
	3	9/4/03, 15:40	1.0	43	74	U (0.345)	U (0.575)
	3 Dup	9/4/03, 15:45	1.0	43	63	U (0.341)	U (0.568)

Notes

U = Analyte not detected at detection limit shown in parenthesis

Table 3 - Analytical Results, Alkalinity, Turbidity, TDS, DRO, RRO (Continued) September 2003

Lake Number	Sample Location	Sample		Alkalinity (mg/L)	Total Dissolved Solids (mg/L)	Diesel Range Organics (mg/L)	Residual Range Organics (mg/L)
		Date/Time	Depth (ft)				
MB0302	1	9/4/03, 16:00	2.9	23	79	U (0.313)	U (0.521)
	1 Dup	9/4/03, 16:05	2.9	23	63	U (0.309)	U (0.515)
	2	9/4/03, 16:10	0.8	23	83	U (0.337)	U (0.562)
	2 Dup	9/4/03, 16:15	0.8	23	56	U (0.353)	U (0.588)
	3	9/4/03, 16:20	0.9	24	65	U (0.300)	U (0.500)
M9924	1	9/5/03, 09:10	1.9	44	96	U (0.326)	U (0.543)
	2	9/5/03, 09:20	0.8	61	106	U (0.326)	U (0.543)
	3	9/5/03, 09:30	0.9	61	116	U (0.323)	U (0.538)
L9910	1	9/5/03, 09:40	1.3	46	81	U (0.353)	U (0.588)
	2	9/5/03, 09:50	1.3	56	86	U (0.309)	U (0.515)
	3	9/5/03, 10:00	0.7	60	90	U (0.300)	U (0.500)
M9913	1	9/5/03, 10:15	0.7	38	86	U (0.316)	U (0.526)
	2	9/5/03, 10:30	1.3	33	69	U (0.316)	U (0.526)
	3	9/5/03, 10:40	1.1	33	65	U (0.300)	U (0.500)
M9912	1	9/5/03, 10:50	1.0	27	69	U (0.297)	U (0.495)
	2	9/5/03, 11:00	1.1	27	71	U (0.319)	U (0.532)
	3	9/5/03, 11:05	1.3	26	U (50)	U (0.309)	U (0.515)
M0292	1	9/5/03, 11:50	0.8	28	76	U (0.316)	U (0.526)
	2	9/5/03, 12:00	0.8	27	75	U (0.297)	U (0.495)
	3	9/5/03, 12:10	1.3	30	83	U (0.300)	U (0.500)

Notes

U = Analyte not detected at detection limit shown in parenthesis

Table 3 - Analytical Results, Alkalinity, Turbidity, TDS, DRO, RRO (Continued) September 2003

Lake Number	Sample Location	Sample		Alkalinity (mg/L)	Total Dissolved Solids (mg/L)	Diesel Range Organics (mg/L)	Residual Range Organics (mg/L)
		Date/Time	Depth (ft)				
M0293	1	9/5/03, 12:15	0.9	30	54	U (0.313)	U (0.521)
	2	9/5/03, 12:20	1.6	25	U (50)	U (0.323)	U (0.538)
	3	9/5/03, 12:30	0.9	30	53	U (0.300)	U (0.500)
M0294	1	9/5/03, 14:40	0.8	25	69	U (0.333)	U (0.556)
	2	9/5/03, 14:50	1.6	27	U (50)	U (0.316)	U (0.526)
	3	9/5/03, 15:00	1.4	25	58	U (0.306)	U (0.510)
M9914	1	9/5/03, 15:10	1.9	27	61	U (0.316)	U (0.526)
	2	9/5/03, 15:15	0.5	28	60	U (0.306)	U (0.510)
	3	9/5/03, 15:25	1.9	28	U (50)	U (0.300)	U (0.500)
R0071	1	9/5/03, 15:30	0.6	34	79	U (0.300)	U (0.500)
	2	9/5/03, 15:40	1.1	34	65	U (0.300)	U (0.500)
	3	9/5/03, 15:50	0.7	44	89	U (0.300)	U (0.500)
M0024	1	9/5/03, 16:00	1.1	31	65	U (0.300)	U (0.500)
	2	9/5/03, 16:05	1.6	32	68	U (0.300)	U (0.500)
	3	9/5/03, 16:15	1.3	33	59	U (0.300)	U (0.500)

Notes

U = Analyte not detected at detection limit shown in parenthesis

Table 4 - Analytical Results, PAH-SIM

Lake Number	Sample Location	Detection Limit (ug/L)	Polynuclear Aromatic Hydrocarbons by Selective Ion Monitoring (ug/L)															
			Acenaphthylene	Acenaphthene	Fluorene	Naphthalene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)Anthracene	Chrysene	Benzo(b)Fluoranthene	Benzo(k)fluoranthene	Benzo(a)Pyrene	Indeno(1,2,3-c,d) pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
L9304	1	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0495	U	U	U	0.37 ¹	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MB0301	1	0.0543	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0526	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
L9824	1	0.0500	U	U	U	0.25 ¹	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0562	U	U	U	0.24 ¹	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0495	U	U	U	0.14 ¹	U	U	U	U	U	U	U	U	U	U	U	U
L9821	1	0.0610	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0575	U	U	U	0.14 ¹	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
L9819	1	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	1 Dup	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0538	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2 Dup	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0532	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3 Dup	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

Notes

- 1. Probable cross contamination in extraction procedure. Method blank was non-detect for naphthalene
 - 2. Probable cross contamination in extraction procedure. Method blank was contaminated with naphthalene
- U = Analyte not detected at detection limit shown in third column

Table 4 - Analytical Results, PAH-SIM (Continued)

September 2003

Lake Number	Sample Location	Detection Limit (ug/L)	Polynuclear Aromatic Hydrocarbons by Selective Ion Monitoring (ug/L)															
			Acenaphthylene	Acenaphthene	Fluorene	Naphthalene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)Anthracene	Chrysene	Benzo(b)Fluoranthene	Benzo(k)fluoranthene	Benzo(a)Pyrene	Indeno(1,2,3-c,d) pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
MB0302	1	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	1 Dup	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2 Dup	0.0532	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0500	U	U	U	0.05	U	U	U	U	U	U	U	U	U	U	U	U
M9924	1	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
L9910	1	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0538	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0500	U	U	U	0.76 ²	U	U	U	U	U	U	U	U	U	U	U	U
M9913	1	0.0510	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0526	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0521	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
M9912	1	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0543	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0495	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

Notes

1. Probable cross contamination in extraction procedure. Method blank was non-detect for naphthalene
 2. Probable cross contamination in extraction procedure. Method blank was contaminated with naphthalene
- U = Analyte not detected at detection limit shown in third column

Table 4 - Analytical Results, PAH-SIM (Continued)

Lake Number	Sample Location	Detection Limit (ug/L)	Polynuclear Aromatic Hydrocarbons by Selective Ion Monitoring (ug/L)															
			Acenaphthylene	Acenaphthene	Fluorene	Naphthalene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)Anthracene	Chrysene	Benzo(b)Fluoranthene	Benzo(k)fluoranthene	Benzo(a)Pyrene	Indeno(1,2,3-c,d) pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
M0292	1	0.0538	U	U	U	0.19 ²	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0500	U	U	U	0.08 ²	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0556	U	U	U	0.15 ²	U	U	U	U	U	U	U	U	U	U	U	U
M0293	1	0.0549	U	U	U	0.06 ²	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0521	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0556	U	U	U	0.06 ²	U	U	U	U	U	U	U	U	U	U	U	U
M0294	1	0.0510	U	U	U	0.08 ²	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0510	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0505	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
M9914	1	0.0532	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0515	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
R0071	1	0.0538	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0500	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
M0024	1	0.0515	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
	2	0.0495	U	U	U	0.14 ²	U	U	U	U	U	U	U	U	U	U	U	U
	3	0.0500	U	U	U	0.28 ²	U	U	U	U	U	U	U	U	U	U	U	U

Notes

1. Probable cross contamination in extraction procedure. Method blank was non-detect for naphthalene
 2. Probable cross contamination in extraction procedure. Method blank was contaminated with naphthalene
- U = Analyte not detected at detection limit shown in third column