Moosomin Reservoir Water Quality Report 2005 – 2006

Prepared for
The Pipestone Creek Watershed Committee Inc.

Monitoring and Assessment Branch
Stewardship Division
February 2007

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Acknowledgements

Volunteers are essential to the water quality monitoring program as they provide local knowledge, and assist with sample collection and transportation. In 2005 and 2006, Norm Schmidt, Dean Godon, Terry Latham and Al Ferguson assisted Saskatchewan Watershed Authority technologist Kevin O'Neill with sampling at Moosomin Reservoir.

1.0 Introduction

The protection of water quality in the Moosomin Reservoir is of interest to the provincial government, stakeholders and residents of southeastern Saskatchewan. Public attention and concern about water quality in Moosomin Reservoir and the need to share information among stakeholders led the Saskatchewan Watershed Authority and local residents to establish a stewardship group, the *Pipestone Watershed Committee Inc*. In 2001, a monitoring program began at the Moosomin Reservoir. This program has been successful due to cooperation between local stewardship group volunteers (a subcommittee of the *Pipestone Watershed Committee Inc*.) and the Saskatchewan Watershed Authority. Together, water samples are collected from designated reservoir stations which are sent to the Saskatchewan Disease Control Laboratory and Saskatchewan Research Council for analysis. The Saskatchewan Watershed Authority is responsible for preparing water quality reports for the *Pipestone Watershed Committee Inc.*

2.0 Background

Geology, hydrogeology, general description

Moosomin Reservoir is located in the Aspen Parkland Ecoregion of Saskatchewan on the Gainsborough plains that extends from Moose Mountain east and south to the Manitoba and United States borders. Annual cropland presently covers approximately eighty percent of the area in this ecoregion (Saskatchewan Environment and Resource Management 1998). The rest of the land is comprised of native aspen parkland and tame perennial forages.

Moosomin Reservoir is a man-made reservoir approximately 10 kilometers south of Moosomin, Saskatchewan. The reservoir, located on the Pipestone Creek, is approximately 10 kilometers long and at its widest point is half a kilometer wide (Figure 1). It is used for a number of recreational activities including fishing, boating and swimming. Most of the development around Moosomin Reservoir is located within the Moosomin and District Regional Park on the west side of the reservoir. The reservoir has average and maximum depths of 4.7 meter and 7.9 meter respectively. During summer, Saskatchewan Watershed Authority temperature profiles indicate Moosomin Reservoir is well mixed. This means temperature and dissolved oxygen are similar through the depth of the reservoir.[*]

[*] Actual data tables available upon request.

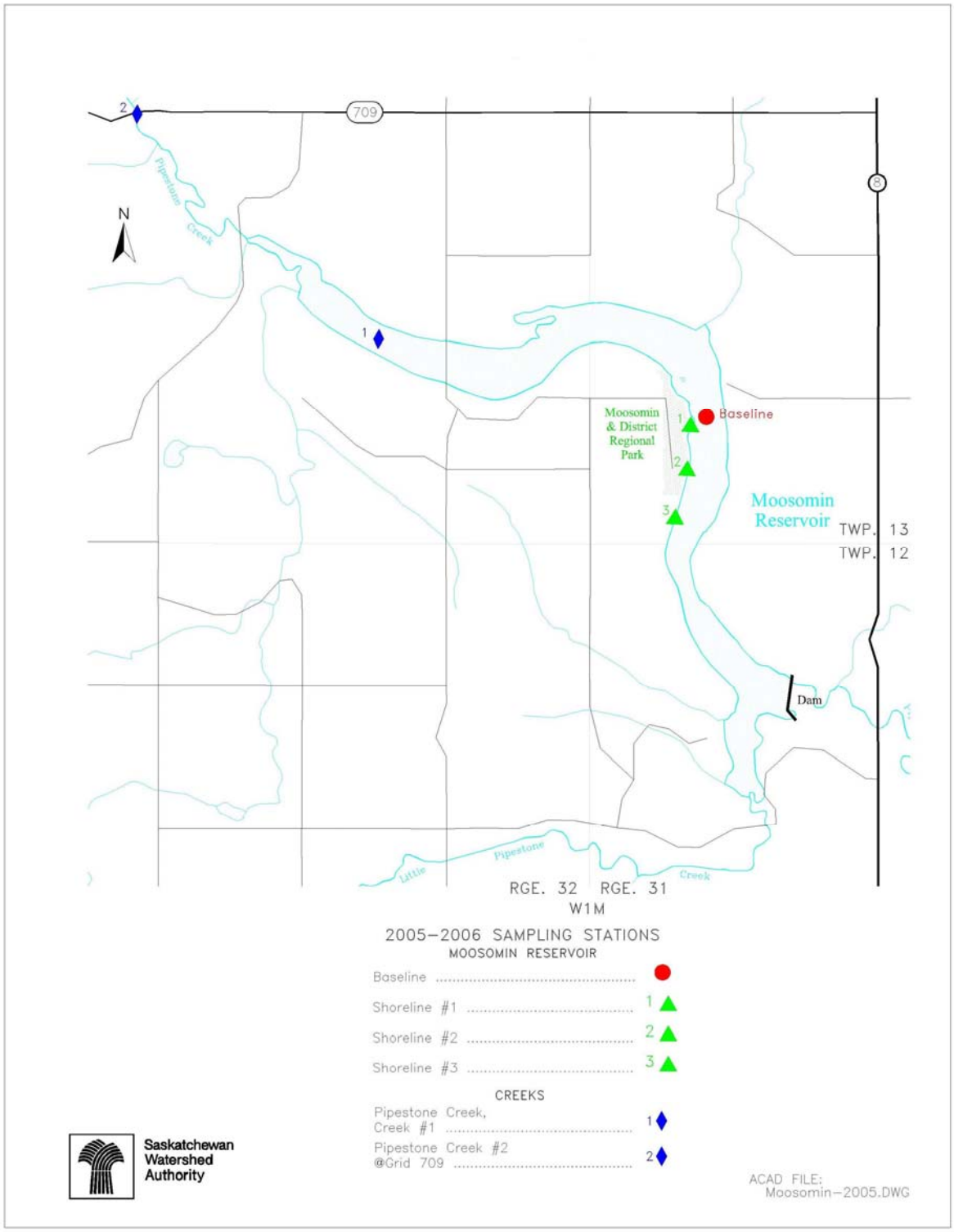

Figure 1– Baseline and shoreline stations sampled at Moosomin Reservoir in 2005 and 2006.

3.0 Water Quality Sampling

The purpose of the Moosomin Reservoir water quality monitoring program is to understand the characteristics of the reservoir, assess reservoir water quality over time, work towards a better understanding of watershed health, and assist in public education and understanding about how activities around the reservoir can affect water quality. Moosomin Reservoir is sampled four times during the summer months and twice during the winter months.

Baseline Station: A baseline station at a deep water station was chosen to represent typical water quality conditions in the reservoir. This baseline station is sampled on all six sample dates during the year.

Shoreline Stations: The locations of the shoreline stations, chosen by the volunteer stewards in consultation with Saskatchewan Watershed Authority, were selected for two reasons: 1) they are located close to recreational beaches; and 2) they are areas of the reservoir which potentially receive inputs from campsite and cottage use. The water quality results for these shoreline stations are compared to Saskatchewan's *Surface Water Quality Objectives for Recreation and Aesthetics* (Interim Edition, July 2006) and Saskatchewan's Water Quality Index.

4.0 Water Quality Results and Discussion

4.1 Baseline Station – Water Quality Index

The Water Quality Index (WQI) provides a means of assessing the overall quality of water in Moosomin Reservoir. The index combines key chemical and biological factors used to define water quality and summarizes them in a single value. These key factors include major ions, nutrients, heavy metals, pesticides, bacteria and algae, dissolved oxygen and pH. Overall, the water quality index shows consistent scores ranging from *fair* to *good* from 2001 to 2006 with no trends towards worsening or improvement of water quality (Figure 2).

The results for the baseline station of Moosomin Reservoir for 2005 and 2006 were similar to past years. There were no new parameters exceeded for 2005 or 2006. Major ions were within the objectives used for the WQI. Total phosphorus exceeded the guideline chosen by Saskatchewan Watershed Authority all year, while ammonia only exceeded the guideline in late summer. Arsenic was the only heavy metal used in the WQI that exceeded the guideline, but only in late summer of both years. Pesticides were below the laboratory detection limit for all years since 2001. Bacteria levels have remained within the provincial guideline since 2001. Chlorophyll *a* exceeded the WQI objective once in the summer of 2005 and three times in the summer of 2006. Dissolved oxygen fell below the objective in late winter of 2005 only, and pH remained within the objective. WQI scores are determined by the frequency and amount that an objective is exceeded, therefore fewer parameters exceeding the WQI objectives combined with a slightly lower magnitude of exceedances led to a somewhat higher score for 2006 than 2005, which means the water quality is better than in past years.

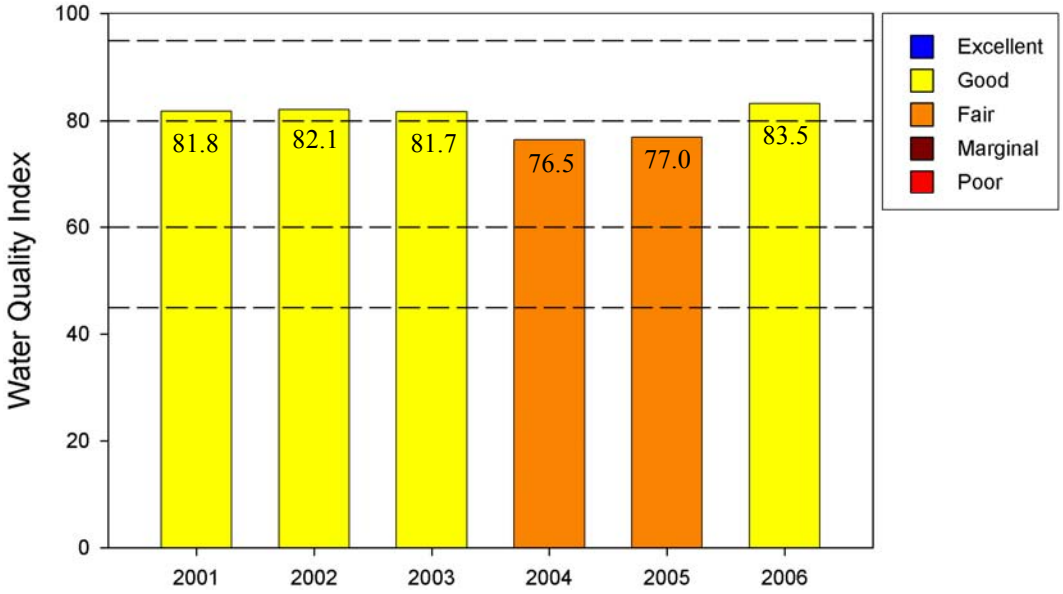

Figure 2– Water Quality Index (WQI) scores for baseline station from 2001 to 2006. Yellow bars indicate *good* water quality while orange bars indicate *fair* water quality according to the WQI. Dashed lines indicate divisions between water quality classes at 45, 60, 80 and 95.

The main factor contributing to the lower WQI scores in 2004 and 2005 are nutrient-related (phosphorus and ammonia). Although nutrients are necessary for foodweb functioning (and healthy fish populations), excess nutrients can lead to decreased dissolved oxygen and water clarity as well as potential for certain toxins to be produced by cyanobacteria (blue-green algae). Nutrients may enter the reservoir from upstream tributaries after rainstorms, from die-offs of aquatic plants or algae, direct runoff of lawn fertilizer, or from leaky septic systems. Nutrient recycling from within the reservoir may also be a significant source of nutrients in Moosomin Reservoir. Mixing due to wind action may also re-suspend nutrients that had settled on the reservoir bottom.

Maintaining sufficient oxygen concentrations is critical for survival of fish and other aquatic life in the reservoir. The objective used to evaluate the concentration of oxygen dissolved in water is 5.5 mg/L, with values less than this failing the objective. In general, oxygen concentrations are higher in the summer when the reservoir is open to the atmosphere and aquatic plants produce oxygen. During winter, dissolved oxygen concentrations are depleted through the decomposition of organic material. At the same time, oxygen exchange with the atmosphere and sunlight to plants are limited by ice and snow. Towards the end of winter in March 2005, oxygen concentrations did not meet this objective, although they did earlier that winter and in March 2006.

Saskatchewan's *Surface Water Quality Objectives* do not include an objective for total phosphorus, but it is an important indicator of nutrient loading. Saskatchewan Watershed Authority has adopted an objective of 0.1 mg/L total phosphorus. This objective was

exceeded on all six sample dates with values ranging from 0.15 mg/L in February and March and 0.42 mg/L in August 2005.

Chlorophyll *a* concentrations are used to estimate the amount of algae in aquatic systems. In Moosomin Reservoir, chlorophyll *a* concentrations reached 356 µg/L in August. Due to increased light, nutrient concentration and temperature, the time of year when algal biomass in Moosomin Reservoir reaches the highest concentrations is in late summer. In winter when algae and plants do not receive sufficient sunlight through the ice, they die-off and decompose. Decomposition consumes oxygen from the water, leading to decreased dissolved oxygen. Under low oxygen conditions, increased phosphorus available for plant growth in the spring and summer results in further nutrient enrichment of lakes. The more nutrient-rich a lake becomes, the more likely it is to have overgrowth of algae and aquatic plants. This overgrowth has the potential to affect the aesthetic properties of the lake such as decreased clarity and recreational uses of the lake. Plant overgrowth may also contribute to low oxygen concentrations in the winter when plants die and decompose. Decomposing organic material also produces ammonia as a byproduct.

Unionized ammonia concentrations increase with corresponding increases in reservoir temperature and/or pH. In nutrient-rich lakes, ammonia concentration can reach levels toxic to fish and aquatic life when favorable conditions such as decomposing organic matter, high temperatures or high pH are present. In 2005, total ammonia concentrations in Moosomin Reservoir exceeded the temperature- and pH-dependant objective in July, August and September.

Arsenic is a natural element widely found in soil, bedrock and water. It may enter water supplies through discharge of industrial wastewater and agricultural pollution, or the dissolution of natural arsenic particles in rain, snow or groundwater. Sometimes natural erosion can also introduce large quantities of arsenic into a local water source from rocks and soil. Saskatchewan's *Surface Water Quality Objective for the Protection of Aquatic Life* for arsenic is 5 µg/L. This was exceeded in August and September 2005, with levels of 5.7 µg/L and 6.2 µg/L, respectively.

4.2 Shoreline Stations

Similar to the baseline station, phosphorus at the shoreline stations was equal to or exceeded the objectives on all sample dates. A third shoreline station was added in late summer 2005, so it was only sampled twice in 2005. Shorelines are normally sampled four times in summer. The objective for chlorophyll *a* was generally exceeded in July and August. A shoreline WQI score can not be calculated because not all parameters are measured at the shoreline stations (ex. metal concentrations).

Water quality at shoreline stations is usually compared to the *Surface Water Quality Objectives for Recreation and Aesthetics* for Saskatchewan. In general, Moosomin Reservoir shoreline stations had bacteria populations that were under the objectives for recreational use in the summer months. In 2005, the shoreline stations exceeded

recreational water clarity objectives (Secchi depth in August). In July and August 2006, the shoreline stations at the Moosomin Reservoir exceeded this water clarity objective. This corresponds closely to the same dates that chlorophyll *a* was increased over the WQI objectives. Since Secchi depth is a measure of water clarity and chlorophyll *a* measures algal biomass, it follows that these two parameters behave similarly.

5.0 Recommendations

In order to maintain *fair* to *good* water quality in the reservoir, it is recommended that recreational users and upstream stakeholders minimize nutrient additions to the reservoir. Saskatchewan Watershed Authority encourages the continuing public education and outreach of the *Pipestone Watershed Committee Inc.* to teach users to follow healthy shoreline living practices outlined in *On the Living Edge – Your handbook for waterfront living* (Nature Saskatchewan).

Water quality monitoring should continue in order to identify possible threats to the water quality of Moosomin Reservoir. Lakes with sufficient historical data will be shifted to a three-year monitoring cycle where each lake will have water quality monitored every third year. Water quality monitoring will continue at Moosomin Reservoir for 2007 and be re-evaluated for 2008 For example, if the current plan allowed for lake sampling to occur for three more years, the actual sampling could occur in year three, year six and year nine to better examine changes to water quality over time. This will still allow the assessment of changes to lake water quality over time while conserving resources to permit lake monitoring to continue on these lakes further in the future.

6.0 References Cited

Kipp, S. and C. Gallaway. 2003. On the Living Edge – Your handbook for water front living. Saskatchewan/Manitoba Edition. Federation of British Columbia Naturalist: British Columbia. Available through Nature Saskatchewan.

Saskatchewan Environment and Resource Management. 1998. The Ecoregions of Saskatchewan. Canadian Plains and Research Center pp. 125-131; 140-141.

Saskatchewan Environment, Drinking Water Quality Section. 2006. Surface Water Quality Objectives: Interim Edition EPB 356. p. 7.

7.0 Appendix 1: Moosomin Reservoir Data Tables 2005-2006

Dissolved oxygen, temperature and conductivity profiles for Moosomin Reservoir Baseline # 2*, 2005

Date (d/m/y)	Depth (m)	Dissolved Oxygen		Water Temperature (ºC)	Conductivity (µS/cm)
		(mg/L)	% sat		
01/02/05	0	na	na	na	na
	1	7.79	55.6	1.4	683
	2	8.45	61.0	2.7	718
	3	6.94	47.8	2.8	734
	4	3.27	23.5	3.1	778
14/03/05	0	4.65	34.3	2.2	753
	1	5.14	37.0	1.5	746
	2	4.21	30.4	2.6	773
	3	3.09	22.6	2.5	784
	4	2.88	21.1	2.3	787
31/05/05	0	9.80	96.1	14.6	680
	1	9.80	97.0	14.5	680
	2	9.90	96.1	14.2	676
	3	9.90	93.4	12.6	664
	4	9.50	89.3	12.3	657
07/18/05	0	6.98	79.6	21.7	1,033
	1	6.98	79.8	21.8	1,033
	2	6.92	79.2	21.7	1,033
	3	6.60	75.0	21.5	1,036
	4	6.26	71.4	21.0	1,044
08/18/05	0	8.56	96.3	18.7	1,003
	1	8.70	na	18.7	1,005
	2	8.50	92.2	18.7	1,008
	3	8.44	90.4	18.7	1,010
	4	8.20	88.0	18.6	1,011
09/28/05	0	8.09	77.0	12.6	885
	1	7.99	75.5	12.5	896
	2	8.01	75.2	12.5	895
	3	7.97	74.7	12.3	895
	4	7.92	74.2	12.3	895

* Baseline #1 is no longer sampled.

Baseline #2 Surface Metal Parameters, 2005				
Parameters	**May 31**	**July 18**	**Aug 18**	**Sept 28**
Metals (mg/L)				
Mercury (µg/L)	<0.05	<0.05	<0.05	<0.05
Aluminum	<0.005	0.025	<0.005	<0.005
Arsenic (µg/L)	2.8	4.8	5.7	6.2
Barium	0.045	0.054	0.061	0.068
Beryllium	<0.001	<0.001	<0.001	<0.001
Boron	0.10	0.14	0.15	0.16
Cadmium	<0.001	<0.001	<0.001	<0.001
Chromium	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.001	<0.001	<0.001	<0.001
Copper	<0.001	0.002	0.001	<0.001
Iron	0.035	0.072	0.058	0.048
Lead	<0.002	<0.002	<0.002	0.002
Manganese	0.067	0.19	0.21	0.17
Molybdenum	<0.001	0.003	<0.001	0.002
Nickel	0.002	0.003	0.002	0.002
Phoshorous	0.10	0.18	0.20	0.14
Silicon, Soluble	5.4	7.8	10.1	11.4
Silver	<0.001	<0.001	<0.001	<0.001
Strontium	0.28	0.38	0.40	0.41
Titanium	<0.001	0.003	<0.001	<0.001
Vanadium	<0.001	0.001	<0.001	<0.001
Zinc	<0.005	0.009	<0.005	<0.005
Zirconium	<0.001	0.004	<0.001	<0.001
Herbicides (µg/L)				
2,4,5-T	<0.5	<0.5	<0.5	<0.5
2,4,5-TP (silvex)	<0.5	<0.5	<0.5	<0.5
2,4-D	<0.5	<0.5	<0.5	<0.5
Bromoxynil (Buctril)	<0.5	<0.5	<0.5	<0.5
Dicamba (Banvel)	<0.5	<0.5	<0.5	<0.5
Diclofop-methyl (HoeGrass)	<1	<1	<1	<1
MCPA	<0.5	<0.5	<0.5	<0.5
Picloram (Tordon)	<1	<1	<1	<1

Moosomin Reservoir Baseline #2 Surface 2005						
Parameters	**Feb 1**	**Mar 14**	**May 31**	**Jul 18**	**Aug 18**	**Sept 28**
Nutrients (mg/L)						
Dissolved Organic Carbon	13.9	14.1	13.1	17.9	18.2	18.1
Nitrate, as Nitrogen	0.14	0.15	0.04	<0.04	<0.20	0.05
Ammonia, as Nitrogen	0.88	0.56	0.15	0.15	0.13	0.39
Total Kjedahl Nitrogen	2.1	2.0	1.3	1.7	4.0	2.2
Total Phosphorous	0.15	0.15	0.18	0.22	0.42	0.32
Ortho-Phosphate, as P	0.14	0.12	0.16	0.17	0.18	0.23
Solids (mg/L)						
Total Dissolved Solids	1,042	1,104	698	na	967	982
Suspended Solids, Fixed	1	1	1	2	4	3
Suspended Solids, Volatile	1	1	2	5	26	3
Suspended Solids, Total	1	2	2	7	29	6
Bacteria (orgs/100 mL)						
Fecal Coliform	<10	<10	<10	<10	10	<10
Total Coliform	<10	<10	10	10	20	20
Major Ions (mg/L)						
Alkalinity, Total	258	272	232	na	306	312
Alkalinity, Phenol	na	na	8	na	30	20
Bicarbonate	315	332	264	na	300	332
Calcium	75	85	71	na	90	88
Carbonate	na	na	9.6	na	36	24
Chloride	19.7	21.0	11.6	na	15.8	16.4
Hardness, Total	537	595	396	na	554	541
Magnesium	85	93	53	na	80	78
Potassium	13	14	13	na	13	13
Sodium	87	97	42	na	78	77
Sulphate	447.2	462.2	234.0	na	354.1	353.9
Other						
Chlorophyll *a* (µg/L)	0.41	1.36	5.15	44.33	356.36	28.51
Conductivity (µS/cm)	1,291	1,370	854	na	1,151	1,176
pH (pH units)	8.1	7.9	8.4	na	8.8	8.6
Turbidity (N.T.U.)	1.30	0.80	0.66	10.00	23.00	2.80
Biochemical Oxygen Demand (mg/L)	<2	<2	<2	3	27	<2
Chemical Oxygen Demand (mg/L)	39.8	37.2	41.5	37.7	80.9	53.4
Field Data						
Air Temperature (ºC)	1	-6	20	17	17	8
pH (pH units)	na	7.92	8.56	8.81	8.87	8.78
Secchi Disk (meters)	2.3	1.5	2.7	1.2	0.5	1.9
Turbidity (NTU)	0.97	0.39	6.30	2.59	3.75	1.30

Moosomin Reservoir Baseline #2 Bottom 2005				
Parameters	**May 31**	**July 18**	**Aug 18**	**Sept 28**
Nutrients (mg/L)				
Dissolved Organic Carbon	13.1	18.5	17.9	18.0
Nitrate, as Nitrogen	0.05	<0.04	<0.20	0.05
Ammonia, as Nitrogen	0.16	0.14	0.11	0.45
Total Kjedahl Nitrogen	2.0	1.9	2.7	2.7
Total Phosphorous	0.21	0.24	0.32	0.32
Ortho-Phosphate, as P	0.16	0.18	0.19	0.25
Solids (mg/L)				
Total Dissolved Solids	713	na	954	999
Suspended Solids, Fixed	1	3	3	2
Suspended Solids, Volatile	1	5	6	4
Suspended Solids, Total	2	8	9	6
Bacteria (orgs/100 mL)				
Fecal Coliform	<10	10	10	<10
Total Coliform	20	100	10	10
Major Ions (mg/L)				
Alkalinity, Total	240	na	308	312
Alkalinity, Phenol	8	na	28	16
Bicarbonate	273	na	307	342
Calcium	72	na	82	91
Carbonate	9.6	na	33.6	19.2
Chloride	11.9	na	15.8	16.4
Hardness, Total	402	na	514	561
Magnesium	54	na	75	81
Potassium	13	na	12	13
Sodium	42	na	74	79
Sulphate	237.6	na	354.3	357.6
Other				
Chlorophyll *a* (µg/L)	6.00	22.91	61.91	26.81
Conductivity (µS/cm)	872	na	1,154	1,181
pH (pH units)	8.5	na	8.7	8.6
Turbidity (N.T.U.)	0.89	3.3	2.8	3.2
Biochemical Oxygen Demand (mg/L)	<2.0	3.0	2.8	2.0
Chemical Oxygen Demand (mg/L)	35.5	63.8	56.6	52.6

Moosomin Reservoir Shoreline #1 - 2005				
Surface Parameters				
	May 31	**July 18**	**Aug 18**	**Sept 28**
Field Measurements				
Air Temperature (ºC)	20	18	na	9
Water Temperature (ºC)	15.40	21.80	18.87	12.6
Dissolved Oxygen (mg/L)	10.96	7.19	7.89	7.66
Dissolved Oxygen (% sat.)	109	92.5	84.5	72.7
pH (pH units)	8.63	8.80	8.84	8.99
Conductivity (µS/cm)	697	1,034	1,005	899
Secchi Disk (meters)	2.00	1.20	0.50	1.65
Turbidity (NTU)	6.50	2.21	5.08	3.50
Laboratory Analyzed Parameters				
Nutrients (mg/L)				
Dissolved Organic Carbon	13.5	18.0	18.3	18.0
Nitrate, as Nitrogen	<0.04	<0.04	<0.04	<0.04
Ammonia, as Nitrogen	0.13	0.15	0.13	0.42
Total Kjedahl Nitrogen	1.3	1.6	3.5	2.2
Total Phosphorous	0.15	0.23	0.42	0.30
Ortho-Phosphate, as P	0.15	0.17	0.19	0.23
Solids (mg/L)				
Total Dissolved Solids	na	899	na	na
Suspended Solids, Fixed	2	2	5	4
Suspended Solids, Volatile	1	5	22	3
Suspended Solids, Total	3	7	28	7
Bacteria (orgs/100 mL)				
Fecal Coliform	<10	<10	<10	<10
Total Coliform	20	10	20	20
Other				
Chlorophyll *a* (µg/L)	4.56	52.77	290.24	25.70
Conductivity (µS/cm)	na	1,095	na	na
pH (pH units)	na	8.7	na	na
Turbidity (N.T.U.)	0.97	5.20	90.00	4.70
Biochemical Oxygen Demand (mg/L)	<2.0	2.7	20.0	<2.0
Chemical Oxygen Demand (mg/L)	37.5	43.6	72.3	55.7

Moosomin Reservoir Shoreline #2 - 2005				
Surface Parameters				
	May 31	**July 18**	**Aug 18**	**Sept 28**
Field Measurements				
Air Temperature (ºC)	20	18	na	9
Water Temperature (ºC)	15.4	21.9	18.9	12.7
Dissolved Oxygen (mg/L)	10.40	7.33	6.30	7.41
Dissolved Oxygen (% sat.)	106.0	82.6	67.4	69.7
pH (pH units)	8.59	8.81	8.80	8.79
Conductivity (µS/cm)	691	1,034	1,008	902
Secchi Disk (meters)	2.0	1.2	0.5	1.3
Turbidity (NTU)	6.3	2.4	6.67	3.60
Laboratory Analyzed Parameters				
Nutrients (mg/L)				
Dissolved Organic Carbon	13.4	18.1	18.7	17.7
Nitrate, as Nitrogen	<0.04	<0.04	<0.04	0.07
Ammonia, as Nitrogen	0.15	0.15	0.36	0.36
Total Kjedahl Nitrogen	1.3	1.7	4.9	3.0
Total Phosphorous	0.22	0.24	0.66	0.30
Ortho-Phosphate, as P	0.15	0.17	0.21	0.23
Solids (mg/L)				
Total Dissolved Solids	na	897	na	na
Suspended Solids, Fixed	1	2	4	5
Suspended Solids, Volatile	2	6	34	5
Suspended Solids, Total	3	8	38	11
Bacteria (orgs/100 mL)				
Fecal Coliform	<10	<10	<10	<10
Total Coliform	10	70	<10	50
Other				
Chlorophyll *a* (µg/L)	3.45	38.95	398.50	19.41
Conductivity (µS/cm)	na	1,095	na	na
pH (pH units)	na	8.7	na	na
Turbidity (N.T.U.)	0.69	5.40	21.00	5.00
Biochemical Oxygen Demand (mg/L)	<2.0	3.2	11.0	2.2
Chemical Oxygen Demand (mg/L)	37.9	50.6	71.3	51.2

Moosomin Reservoir Shoreline #3 - 2005		
Surface Parameters		
	Aug 18	**Sept 28**
Field Measurements		
Air Temperature (ºC)	na	9
Water Temperature (ºC)	18.9	12.9
Dissolved Oxygen (mg/L)	6.40	8.64
Dissolved Oxygen (% sat.)	69.8	82.1
pH (pH units)	8.80	8.79
Conductivity (µS/cm)	1,006	904
Secchi Disk (meters)	0.9	na
Turbidity (NTU)	9.09	2.90
Laboratory Analyzed Parameters		
Nutrients (mg/L)		
Dissolved Organic Carbon	19.1	17.6
Nitrate, as Nitrogen	<0.04	0.05
Ammonia, as Nitrogen	0.41	0.29
Total Kjedahl Nitrogen	5.1	2.2
Total Phosphorous	0.42	0.29
Ortho-Phosphate, as P	0.21	0.22
Solids (mg/L)		
Suspended Solids, Fixed	5	2
Suspended Solids, Volatile	35	3
Suspended Solids, Total	40	6
Bacteria (orgs/100 mL)		
Fecal Coliform	10	<10
Total Coliform	<100	20
Other		
Chlorophyll *a* (µg/L)	326.51	17.63
Turbidity (N.T.U.)	30.0	3.2
Biochemical Oxygen Demand (mg/L)	19	<2
Chemical Oxygen Demand (mg/L)	121.0	59.6

Dissolved oxygen, temperature and conductivity profiles for Moosomin Reservoir Baseline #2*, 2006

Date (d/m/y)	Depth (m)	Dissolved Oxygen		Water Temperature (ºC)	Conductivity (µS/cm)
		(mg/L)	% sat		
31/01/06	1.0	14.05	101.5	1.5	751
	2.0	13.68	100.1	2.3	784
	3.0	12.09	90.8	2.8	801
	3.5	5.63	42.5	3.5	857
08/03/06	1	9.40	65.8	0.6	782
	2	8.74	63.8	2.3	823
	3	8.09	61.5	2.8	835
	4	5.69	43.7	3.0	865
18/05/06	0	8.17	na	14.8	1,140
	1	8.10	na	14.8	1,140
	2	8.05	na	14.8	1,115
	3	8.06	na	14.8	1,114
	4	8.18	na	14.8	1,115
19/06/06	0	10.82	na	19.4	1,029
	1	10.98	na	19.1	1,030
	2	9.78	na	18.8	1,024
	3	9.25	na	18.7	1,024
	4	7.89	na	18.6	1,024
12/07/06	0	12.73	na	23.0	1,030
	1	12.70	na	22.9	1,031
	2	12.01	na	22.8	1,035
	3	11.78	na	22.8	1,035
	4	9.56	na	22.5	1,039
22/08/06	0	9.44	na	20.4	1,002
	1	9.32	na	20.4	1,002
	2	9.34	na	20.4	1,002
	3	9.31	na	20.4	1,002
	4	9.22	na	20.4	1,002

* Baseline #1 is no longer sampled.

Moosomin Reservoir Baseline #2 Surface Metal Parameters, 2006						
Parameters	**Jan 31**	**Mar 8**	**May18**	**Jun 19**	**Jul 12**	**Aug 22**
Metals (mg/L)						
Mercury (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aluminum	<0.005	<0.005	<0.005	<0.005	0.090	<0.005
Arsenic (µg/L)	4.6	4.5	2.8	3.7	4.6	6.0
Barium	0.077	0.078	0.056	0.060	0.050	0.053
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.18	0.19	0.11	0.13	0.14	0.15
Cadmium	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Chromium	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Cobalt	<0.001	<0.001	<0.001	0.002	<0.001	0.001
Copper	0.001	0.002	0.001	0.002	0.006	<0.001
Iron	0.014	0.013	0.022	0.048	0.093	0.047
Lead	<0.002	<0.002	<0.002	0.003	<0.002	<0.002
Manganese	0.069	0.120	0.062	0.150	0.140	0.210
Molybdenum	0.002	0.003	0.002	0.003	0.002	0.001
Nickel	0.002	0.002	0.001	0.004	0.001	<0.001
Phoshorous	0.08	0.07	0.07	0.12	0.21	0.12
Silicon, Soluble	9.8	10.5	0.0004	5.9	6.4	7.7
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	0.48	0.51	0.36	0.40	0.41	0.35
Titanium	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Vanadium	<0.001	<0.001	<0.001	0.002	<0.001	0.001
Zinc	<0.005	<0.005	<0.005	0.009	<0.005	<0.005
Zirconium	<0.001	<0.001	<0.001	0.004	<0.001	<0.001
Herbicides (µg/L)						
2,4,5-T	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-TP (silvex)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoxynil (Buctril)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dicamba (Banvel)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diclofop-methyl (HoeGrass)	<1	<1	<1	<1	<1	<1
MCPA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Picloram (Tordon)	<1	<1	<1	<1	<1	<1

Moosomin Reservoir Baseline #2 Surface 2006						
Parameters	**Jan 31**	**Mar 8**	**May 18**	**Jun19**	**Jul 12**	**Aug 22**
Nutrients (mg/L)						
Dissolved Organic Carbon	17.6	18.0	14.8	15.5	15.6	18.1
Nitrate, as Nitrogen	0.24	0.27	<0.04	<0.04	<0.04	<0.04
Ammonia, as Nitrogen	0.21	0.17	0.12	0.04	0.04	0.09
Total Kjedahl Nitrogen	2.1	1.5	1.2	2.1	3.2	2.5
Total Phosphorous	0.15	0.15	0.11	0.14	0.22	0.23
Ortho-Phosphate, as P	0.12	0.14	0.09	0.06	0.05	0.09
Solids (mg/L)						
Total Dissolved Solids	1,163	1,222	928	1,164	842	849
Suspended Solids, Fixed	1	1	<1	2	4	6
Suspended Solids, Volatile	3	1	2	7	17	9
Suspended Solids, Total	4	2	2	9	21	15
Bacteria (orgs/100 mL)						
E. Coli	<1	<1	<10	<10	<10	<10
Total Coliform	<1	<1	20	<10	52	6,488
Major Ions (mg/L)						
Alkalinity, Total	362	386	282	384	246	234
Alkalinity, Phenol	na	na	na	24	18	28
Bicarbonate	442	471	344	410	256	217
Calcium	103	104	94	89	67	60
Carbonate	na	na	na	28.8	21.6	33.6
Chloride	19.0	20.4	17.1	18.5	19.2	20.7
Hardness, Total	615	618	531	502	451	463
Magnesium	87	87	72	68	69	76
Potassium	13	13	12	11	11	13
Sodium	88	86	64	61	63	74
Sulphate	410.6	440.2	325.0	325.0	335.6	354.3
Other						
Chlorophyll *a* (µg/L)	26.18	0.59	1.44	64.08	154.54	81.31
Conductivity (µS/cm)	1,400	1,480	1,129	1,164	1,101	1,101
pH (pH units)	8.3	8.0	8.3	8.7	8.7	9.0
Turbidity (N.T.U.)	2.9	1.0	0.7	8.8	26.9	12.0
Biochemical Oxygen Demand (mg/L)	2.3	1.2	2.0	4.6	15.4	6.1
Chemical Oxygen Demand (mg/L)	47.6	43.4	36.5	48.5	69.9	56.8
Field Measurements						
Air Temperature (ºC)	-4	0	15	22	28	20
pH (pH units)	8.34	7.97	na	na	8.85	9.00
Secchi Disk (meters)	1.7	3.0	3.9	1.6	0.7	0.9
Turbidity (NTU)	na	na	na	na	10.85	6.17

Moosomin Reservoir Baseline #2 Bottom 2006						
Parameters	**Jan 31**	**Mar 8**	**May 18**	**Jun 19**	**Jul 12**	**Aug 22**
Nutrients (mg/L)						
Dissolved Organic Carbon	17.8	17.9	14.9	16.2	15.5	17.7
Nitrate, as Nitrogen	0.24	0.23	<0.04	<0.04	<0.04	<0.04
Ammonia, as Nitrogen	0.28	0.18	0.12	0.05	0.04	0.56
Total Kjedahl Nitrogen	1.7	1.6	1.1	1.5	3.0	2.5
Total Phosphorous	0.14	0.15	0.11	0.13	0.20	0.23
Ortho-Phosphate, as P	0.12	0.13	0.09	0.07	0.05	0.09
Solids (mg/L)						
Total Dissolved Solids	1,181	1,233	920	1,027	862	833
Suspended Solids, Fixed	<1	1	<1	2	4	6
Suspended Solids, Volatile	2	2	9	3	15	9
Suspended Solids, Total	2	2	9	5	19	12
Bacteria (orgs/100 mL)						
E. Coli	<1	<1	<10	<10	<10	<10
Total Coliform	<1	<1	31	20	960	6,488
Major Ions (mg/L)						
Alkalinity, Total	364	390	280	368	248	234
Alkalinity, Phenol	na	na	0.2	na	18	28
Bicarbonate	444	476	341	395	259	217
Calcium	107	108	92	94	68	59
Carbonate	na	na	0.24	na	21.6	33.6
Chloride	19.4	20.3	17.1	19.3	19.8	20.1
Hardness, Total	634	636	522	535	454	452
Magnesium	89	89	71	73	69	74
Potassium	14	13	12	11	11	12
Sodium	90	88	63	65	64	72
Sulphate	417.5	438.1	324.1	343.0	349.8	344.9
Other						
Chlorophyll *a* (µg/L)	2.81	0.85	1.70	14.02	168.35	88.28
Conductivity (µS/cm)	1,400	1,480	1,127	1,166	1,099	1,102
pH (pH units)	8.2	8.0	8.3	8.7	8.7	9.0
Turbidity (N.T.U.)	0.85	1.10	1.20	26.00	27.4	11.0
Biochemical Oxygen Demand (mg/L)	<2.0	1.1	<2	<2.0	13.9	5.9
Chemical Oxygen Demand (mg/L)	47.5	43.8	37.5	70.8	63.0	56.0

Surface Parameters	2006 Shoreline #1			
	May 18	**Jun 19**	**Jul 12**	**Aug 22**
Field Measurements				
Air Temperature (ºC)	15	22	30	20
Water Temperature (ºC)	14.5	18.8	na	20.6
Dissolved Oxygen (mg/L)	8.15	9.14	15.45	9.84
pH (pH units)	na	8.70	8.97	9.02
Conductivity (µS/cm)	1,098	1,021	1,027	1,005
Secchi Disk (meters)	2.15	3.20	0.70	1.05
Turbidity (NTU)	na	1.03	13.3	6.65
Laboratory Analyzed Parameters				
Nutrients (mg/L)				
Dissolved Organic Carbon	14.6	15.7	15.6	17.6
Nitrate, as Nitrogen	<0.04	<0.04	<0.04	<0.04
Ammonia, as Nitrogen	0.11	0.05	0.04	0.08
Total Kjedahl Nitrogen	1.1	1.6	3.4	2.5
Total Phosphorous	0.10	0.11	0.23	0.22
Ortho-Phosphate, as P	0.09	0.07	0.05	0.08
Solids (mg/L)				
Suspended Solids, Fixed	<1	2	3	5
Suspended Solids, Volatile	1	3	19	9
Suspended Solids, Total	1	6	22	14
Bacteria (orgs/100 mL)				
E. Coli	<10	<10	10	<10
Total Coliform	20	<10	480	1,785
Other				
Chlorophyll *a* (µg/L)	2.00	32.84	156.90	75.68
Turbidity (N.T.U.)	1.0	12.0	23.3	13.0
Biochemical Oxygen Demand (mg/L)	<2.0	<2.0	16.5	5.5
Chemical Oxygen Demand (mg/L)	36.0	39.9	92.2	53.6

Surface Parameters	2006 Shoreline #2			
	May 18	**June 19**	**July 12**	**Aug 22**
Field Measurements				
Air Temperature (ºC)	15	22	30	22
Water Temperature (ºC)	14.6	18.7	23.3	20.8
Dissolved Oxygen (mg/L)	8.34	9.02	13.91	10.35
pH (pH units)	na	8.62	8.84	9.04
Conductivity (µS/cm)	1,096	1,027	1,033	1,010
Secchi Disk (meters)	3.00	3.20	0.60	0.95
Turbidity (NTU)	na	0.81	17.90	6.26
Laboratory Analyzed Parameters				
Nutrients (mg/L)				
Dissolved Organic Carbon	14.6	15.9	15.4	17.8
Nitrate, as Nitrogen	<0.04	<0.04	<0.04	<0.04
Ammonia, as Nitrogen	0.12	0.09	0.05	0.10
Total Kjedahl Nitrogen	1.2	1.4	3.2	2.5
Total Phosphorous	0.10	0.10	0.25	0.23
Ortho-Phosphate, as P	0.08	0.08	0.05	0.08
Solids (mg/L)				
Suspended Solids, Fixed	1	3	4	5
Suspended Solids, Volatile	2	1	19	10
Suspended Solids, Total	1	3	23	15
Bacteria (orgs/100 mL)				
E. Coli	<10	<10	<10	<10
Total Coliform	31	20	457	3,873
Other				
Chlorophyll *a* (µg/L)	1.84	6.40	179.71	76.30
Turbidity (N.T.U.)	1.4	1.4	30.8	14.0
Biochemical Oxygen Demand (mg/L)	<2.0	<2.0	16.1	6.0
Chemical Oxygen Demand (mg/L)	38.0	42.7	77.6	56.5

Surface Parameters	2006 Shoreline #3			
	May 18	**June 19**	**July 12**	**Aug 22**
Field Measurements				
Air Temperature (ºC)	16	22	30	22
Water Temperature (ºC)	14.6	18.7	23.7	20.9
Dissolved Oxygen (mg/L)	8.25	9.20	14.40	11.10
pH (pH units)	na	8.70	8.94	9.04
Conductivity (µS/cm)	1,095	na	1,031	1,011
Secchi Disk (meters)	3.00	3.40	0.70	0.65
Turbidity (NTU)	na	0.80	10.35	7.63
Laboratory Analyzed Parameters				
Nutrients (mg/L)				
Dissolved Organic Carbon	14.0	16.0	15.3	17.8
Nitrate, as Nitrogen	<0.04	<0.04	<0.04	<0.04
Ammonia, as Nitrogen	0.11	0.07	0.04	0.08
Total Kjedahl Nitrogen	1.1	1.4	2.4	2.4
Total Phosphorous	0.10	0.11	0.13	0.21
Ortho-Phosphate, as P	0.08	0.08	0.05	0.07
Solids (mg/L)				
Suspended Solids, Fixed	<1	2	6	7
Suspended Solids, Volatile	1	2	17	12
Suspended Solids, Total	2	4	23	19
Bacteria (orgs/100 mL)				
E. Coli	<10	<10	<10	<10
Total Coliform	20	<10	1,722	4,611
Other				
Chlorophyll *a* (µg/L)	1.70	8.85	103.59	96.27
Turbidity (N.T.U.)	1.1	1.4	25.5	13.0
Biochemical Oxygen Demand (mg/L)	<2.0	<2.0	14.2	9.0
Chemical Oxygen Demand (mg/L)	37.0	37.4	71.6	49.8