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APPENDIX 7.1

Supplemental Material for Climatic Conditions

Long-term Climate Characteristics at Minago

Source: Golder Assoicates, 2009 (Report 08-1428-0024)

TABLE A7.1-1: Derived Monthly and Annual Air Temperature at Minago (1950-2008)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1950	-32.2	-19.8	-13.8	-3.8	7.8	11.6	17.7	13.9	10.8	2.3	-10.6	-20.4	-3.0
1951	-23.0	-18.2	-14.7	0.1	9.2	12.5	16.7	14.6	9.0	0.9	-10.7	-20.7	-2.0
1952	-23.4	-15.9	-11.2	5.3	9.9	13.4	16.5	15.5	10.6	2.6	-5.0	-11.7	0.6
1953	-22.1	-14.8	-10.6	-1.8	6.9	12.8	17.0	17.6	9.8	5.2	-2.2	-15.6	0.2
1954	-28.0	-10.9	-12.8	-6.2	5.4	13.4	17.9	14.8	9.3	3.2	-3.4	-11.0	-0.7
1955	-20.2	-19.8	-16.4	3.3	9.1	16.0	18.7	17.8	9.3	4.2	-13.0	-22.9	-1.2
1956	-22.3	-19.3	-13.6	-4.1	5.9	16.6	17.0	16.2	7.4	3.6	-7.1	-18.4	-1.5
1957	-24.1	-19.6	-10.3	-1.9	7.1	12.7	18.6	14.7	10.1	4.1	-8.0	-18.0	-1.2
1958	-17.4	-18.9	-7.4	1.6	9.2	11.2	16.7	15.4	9.1	4.1	-7.3	-20.2	-0.3
1959	-25.4	-17.8	-7.9	-0.7	6.2	13.5	18.7	14.8	9.3	-0.7	-11.7	-10.4	-1.0
1960	-22.3	-17.3	-14.1	-1.7	9.4	14.0	18.7	17.0	10.8	3.1	-10.0	-17.7	-0.8
1961	-19.8	-14.5	-8.8	-3.4	8.6	15.9	17.2	17.9	6.9	2.2	-8.4	-22.8	-0.8
1962	-24.6	-23.2	-11.0	-2.8	7.6	16.4	17.1	15.7	9.5	5.9	-6.1	-17.5	-1.1
1963	-25.8	-21.1	-12.4	1.3	6.8	14.7	19.2	17.7	11.2	9.1	-6.3	-17.6	-0.3
1964	-18.0	-13.7	-17.5	1.1	9.2	14.0	18.6	13.7	8.1	4.1	-8.3	-22.3	-0.9
1965	-24.1	-23.5	-15.8	1.4	6.6	14.7	16.6	15.3	6.0	5.0	-10.5	-13.2	-1.8
1966	-30.0	-20.2	-9.2	-2.8	5.9	14.6	17.8	16.6	12.5	3.0	-14.0	-19.2	-2.1
1967	-22.4	-23.0	-12.9	-5.5	5.8	13.5	16.9	16.8	13.8	1.9	-6.9	-16.0	-1.5
1968	-22.8	-18.5	-7.0	0.1	7.8	13.2	16.0	13.2	11.5	3.2	-6.7	-19.5	-0.8
1969	-27.3	-16.7	-11.4	3.4	6.6	10.8	16.7	17.9	8.6	-0.9	-6.8	-13.0	-1.0
1970	-21.9	-17.6	-13.4	-2.0	6.8	15.8	18.5	16.8	9.8	3.2	-8.3	-24.0	-1.4
1971	-24.4	-15.3	-11.1	0.7	9.3	15.7	15.2	17.1	10.6	3.4	-8.5	-19.8	-0.6
1972	-27.1	-23.1	-10.5	-0.4	10.4	15.7	14.6	16.5	5.8	0.3	-8.9	-22.7	-2.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1973	-17.0	-19.2	-4.2	-1.9	9.6	13.2	17.1	18.5	10.0	4.0	-10.1	-20.1	0.0
1974	-25.9	-20.3	-15.6	-0.5	5.0	14.2	18.4	14.9	6.8	3.0	-5.0	-11.1	-1.3
1975	-21.7	-18.0	-12.9	-0.4	7.1	14.3	19.2	14.1	8.7	3.4	-5.2	-16.9	-0.7
1976	-20.7	-16.1	-11.3	3.8	10.7	14.9	17.5	16.6	11.1	1.3	-7.5	-19.6	0.1
1977	-22.2	-12.3	-7.4	3.9	13.4	15.3	16.3	11.8	9.8	5.8	-7.0	-21.2	0.5
1978	-22.8	-17.1	-10.4	-1.6	11.3	13.2	16.6	14.2	9.8	4.3	-9.9	-19.1	-1.0
1979	-22.5	-25.2	-12.2	-2.8	5.1	13.9	19.1	14.3	9.6	2.3	-6.6	-12.3	-1.4
1980	-21.3	-16.7	-12.0	6.0	11.4	13.9	17.2	15.2	8.9	3.1	-5.3	-21.3	-0.1
1981	-15.0	-12.5	-4.5	-1.2	8.5	13.5	17.9	18.5	10.6	2.1	-2.0	-17.0	1.6
1982	-30.3	-19.0	-11.9	-1.5	8.5	12.5	17.6	14.5	10.2	3.3	-10.1	-17.0	-1.9
1983	-17.3	-16.2	-10.6	-1.8	4.0	14.7	18.5	19.4	10.3	4.4	-2.6	-22.7	0.0
1984	-19.3	-8.2	-9.5	4.8	7.0	15.4	18.5	19.0	7.7	2.6	-10.6	-22.1	0.4
1985	-19.7	-21.3	-5.9	2.5	10.1	12.0	16.2	14.4	8.2	2.5	-14.6	-18.0	-1.1
1986	-15.4	-16.1	-6.9	-0.2	10.4	13.9	16.5	16.3	8.3	3.7	-13.2	-12.7	0.4
1987	-13.9	-11.7	-7.7	5.2	11.0	16.0	16.9	14.1	11.7	2.3	-4.3	-11.5	2.3
1988	-22.3	-18.5	-8.9	0.8	10.4	18.8	18.4	16.9	10.5	2.7	-6.7	-16.0	0.5
1989	-18.4	-18.3	-14.3	-0.2	9.5	14.6	19.7	16.6	9.8	3.3	-12.1	-22.9	-1.1
1990	-18.9	-20.2	-5.9	-1.0	8.2	15.1	17.4	17.1	11.1	0.9	-9.2	-21.9	-0.6
1991	-22.3	-12.7	-8.5	3.0	9.7	16.3	18.1	18.8	9.3	-1.5	-12.0	-15.8	0.2
1992	-15.5	-14.6	-6.7	-0.4	7.3	11.8	14.9	15.0	8.5	2.6	-4.8	-20.3	-0.2
1993	-18.1	-15.6	-4.8	1.7	8.3	12.5	15.6	15.4	7.4	0.8	-9.2	-15.2	-0.1
1994	-27.2	-23.2	-5.9	0.1	8.5	14.7	16.7	15.4	12.5	5.0	-6.2	-14.7	-0.4
1995	-18.2	-17.1	-9.4	-2.6	8.3	17.4	16.2	16.2	10.8	3.3	-13.0	-17.4	-0.5
1996	-25.2	-16.4	-14.5	-2.0	5.4	15.4	18.3	17.8	10.5	2.5	-12.4	-20.5	-1.8
1997	-22.7	-15.0	-12.2	-1.7	6.1	15.4	18.7	16.3	11.9	1.4	-7.2	-8.2	0.2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1998	-21.2	-7.7	-8.9	5.0	9.4	14.8	18.6	18.5	11.2	4.2	-6.1	-17.1	1.7
1999	-20.6	-13.7	-6.6	4.1	9.0	14.8	17.7	17.0	9.9	2.9	-3.3	-12.6	1.6
2000	-21.0	-12.0	-4.3	0.6	7.8	12.1	18.3	16.3	9.5	4.0	-8.2	-24.3	-0.1
2001	-12.4	-19.7	-6.9	2.8	9.8	13.5	19.0	18.2	12.3	2.8	-3.1	-14.5	1.8
2002	-18.9	-13.0	-15.8	-4.0	4.6	16.0	19.2	16.7	10.6	-2.3	-7.8	-11.3	-0.5
2003	-19.1	-22.7	-11.8	0.7	10.8	16.0	18.1	19.4	11.0	4.2	-9.9	-12.3	0.4
2004	-24.1	-12.9	-9.3	-0.1	4.4	12.1	16.9	13.2	10.8	2.2	-4.6	-21.9	-1.1
2005	-21.6	-15.3	-10.6	3.9	8.5	14.0	18.3	15.6	11.1	4.5	-4.1	-11.3	1.1
2006	-11.4	-17.6	-8.2	5.7	8.7	17.4	19.1	17.3	10.7	1.7	-10.8	-12.3	1.7
2007	-16.6	-20.5	-8.4	0.5	9.0	13.5	20.2	15.0	9.0	4.8	-8.4	-18.0	0.0
2008	-20.0	-20.7	-12.3	-0.6	6.9	15.2	17.3	18.3	-	-	-	-	-
Min	-32.2	-25.2	-17.5	-6.2	4.0	10.8	14.6	11.8	5.8	-2.3	-14.6	-24.3	-32.2
Mean	-21.5	-17.3	-10.4	0.2	8.2	14.3	17.6	16.2	9.8	3.0	-8.0	-17.3	-0.4
Max	-11.4	-7.7	-4.2	6.0	13.4	18.8	20.2	19.4	13.8	9.1	-2.0	-8.2	20.2

TABLE A7.1-2: Derived Monthly and Annual Relative Humidity at Minago (1953-2008)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1953	99.5	92.9	89.9	75.1	71.3	80.6	85.6	88.8	86.0	84.7	91.2	85.8	85.9
1954	78.1	80.8	70.9	73.5	69.1	77.9	76.8	85.2	82.8	82.5	86.8	88.2	79.4
1955	83.8	80.9	73.6	79.1	70.1	75.5	76.1	74.8	79.6	79.0	87.6	86.9	78.9
1956	86.5	84.3	79.6	72.0	73.8	72.7	76.4	80.7	81.4	80.3	88.1	87.0	80.2
1957	86.7	78.8	78.3	72.0	72.4	72.1	77.1	78.8	79.9	80.4	85.5	85.2	79.0
1958	80.7	79.7	81.1	78.8	68.8	74.9	76.3	78.4	87.9	84.0	87.3	84.3	80.2
1959	85.0	84.7	83.1	75.4	70.6	79.2	76.7	82.5	84.0	84.9	89.3	92.0	82.3
1960	89.0	81.0	82.5	78.0	72.7	75.2	69.7	77.0	76.0	82.0	88.8	85.5	79.8
1961	82.3	82.0	83.3	75.7	60.7	62.3	73.0	71.9	75.9	85.6	86.9	79.1	76.5
1962	76.1	76.0	80.4	75.9	71.1	70.6	67.3	74.7	77.2	81.4	89.4	90.9	77.6
1963	81.3	79.3	79.9	71.1	69.5	75.6	78.5	78.8	84.0	79.4	86.6	81.1	78.8
1964	83.4	81.8	74.1	75.1	68.5	55.9	78.1	82.1	81.9	83.0	85.0	82.6	77.6
1965	78.7	76.8	77.9	79.6	72.4	72.8	76.6	77.4	79.9	75.7	88.6	90.3	78.9
1966	-	82.9	82.2	78.6	66.3	75.9	78.5	74.6	74.1	81.8	87.2	86.8	-
1967	81.9	76.9	80.2	78.1	64.3	68.4	71.7	70.1	76.7	88.0	90.1	88.1	77.9
1968	83.8	82.4	76.2	72.7	72.7	72.5	71.6	81.3	84.2	87.9	83.8	89.2	79.9
1969	82.9	88.0	80.6	69.2	68.8	63.1	72.0	76.4	87.6	86.7	83.6	90.9	79.1
1970	89.2	86.2	79.8	79.1	68.2	76.5	74.3	72.1	79.1	82.8	89.3	89.9	80.5
1971	86.6	86.0	83.2	73.5	66.5	69.8	76.7	72.8	76.9	79.2	85.7	74.4	77.6
1972	62.9	63.8	67.3	66.1	68.3	69.5	75.7	77.0	78.3	70.0	80.7	72.2	71.0
1973	78.2	69.6	77.1	68.7	60.5	76.1	74.1	74.1	75.3	85.5	87.0	76.2	75.2
1974	64.2	72.0	70.3	63.9	69.6	69.9	75.2	75.6	75.6	73.3	79.8	79.6	72.4
1975	66.4	64.8	62.3	61.1	74.9	77.2	72.8	79.1	80.8	78.5	76.9	73.2	72.3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1976	63.9	66.3	61.0	61.2	57.4	79.8	74.2	74.4	69.5	75.1	72.0	72.4	68.9
1977	72.0	79.6	71.1	59.6	67.4	67.4	73.7	78.1	84.3	73.9	84.9	75.3	73.9
1978	71.1	73.1	71.4	73.0	64.8	71.2	70.8	78.6	81.8	85.0	76.8	77.9	74.6
1979	72.8	68.3	70.8	72.0	70.3	67.7	68.1	73.5	82.3	83.7	86.1	84.3	75.0
1980	75.0	73.8	71.5	53.3	61.3	64.6	70.7	78.4	78.5	79.8	85.1	73.0	72.1
1981	79.5	76.1	74.0	75.0	56.2	69.9	70.9	77.5	79.3	83.1	85.2	82.1	75.7
1982	67.3	73.0	71.3	63.9	74.2	66.3	69.7	73.3	71.8	86.6	78.5	78.7	72.9
1983	74.8	69.7	65.2	63.8	71.2	68.8	76.7	74.4	79.8	77.9	91.1	71.8	73.8
1984	75.1	82.6	71.8	70.1	64.5	68.7	65.1	62.0	77.6	78.0	81.7	63.7	71.8
1985	74.7	70.5	66.0	62.7	62.5	65.3	62.6	67.9	75.0	73.4	74.8	76.5	69.3
1986	71.0	70.2	72.1	67.5	61.0	68.0	76.2	69.5	79.8	72.2	78.5	84.7	72.5
1987	79.5	83.5	76.1	63.1	62.5	67.0	75.4	73.1	74.8	71.4	71.2	86.5	73.7
1988	70.5	66.0	68.8	62.0	62.3	61.6	68.6	69.2	73.5	71.7	82.0	69.6	68.8
1989	64.0	60.7	68.1	62.0	64.3	65.3	68.3	73.3	76.8	71.8	81.0	71.0	68.9
1990	76.3	69.2	67.2	69.0	61.7	72.0	70.1	67.6	71.3	81.9	85.0	74.0	72.1
1991	70.8	70.8	69.3	71.7	69.3	70.7	71.7	70.8	75.6	81.0	83.5	77.2	73.5
1992	83.0	78.6	74.2	67.7	63.9	65.6	68.1	66.8	75.8	76.9	89.5	77.3	73.9
1993	72.1	68.4	70.9	66.6	62.0	67.2	82.8	82.4	75.2	77.6	83.1	81.4	74.1
1994	66.2	64.0	74.5	60.9	64.5	68.6	77.1	71.1	73.6	83.5	87.0	85.2	73.0
1995	76.7	70.0	76.8	67.8	57.1	66.3	72.3	81.2	74.2	87.5	80.9	79.8	74.2
1996	71.8	74.6	65.9	68.5	69.1	69.5	71.2	70.5	79.0	84.3	80.0	75.7	73.3
1997	64.1	72.5	67.8	65.8	62.8	74.1	73.2	79.4	82.0	86.4	82.4	84.3	74.6
1998	73.7	88.7	69.6	57.9	66.9	72.0	70.5	72.4	75.9	84.0	89.6	77.0	74.9
1999	71.0	74.0	72.5	64.4	74.4	76.2	77.5	77.5	81.3	84.1	88.5	82.6	77.0
2000	75.1	73.4	67.1	65.7	73.4	72.2	74.5	75.6	78.9	74.1	88.4	70.8	74.1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	85.0	68.9	75.2	67.2	68.7	72.5	72.0	72.6	76.6	74.8	87.6	85.1	75.5
2002	74.9	75.5	66.4	72.5	52.8	65.5	63.0	73.0	75.4	77.2	83.3	85.8	72.1
2003	69.2	63.5	65.9	59.1	56.0	67.8	72.7	70.0	80.2	82.4	81.4	80.7	70.7
2004	67.8	78.4	71.7	65.1	58.3	70.5	76.7	81.5	83.2	81.7	82.1	77.6	74.5
2005	77.3	77.5	75.7	71.0	67.2	79.5	77.3	82.6	84.2	86.7	84.0	82.8	78.8
2006	81.8	70.0	65.3	66.2	74.7	67.9	71.1	76.2	78.1	77.2	85.7	84.3	74.9
2007	78.2	71.4	73.1	59.7	68.5	68.5	71.8	78.8	83.7	83.7	83.4	78.7	75.0
2008	74.2	67.1	69.2	60.5	56.1	62.9	75.6	75.2	75.2	-	-	-	-
Min	62.9	60.7	61.0	53.3	52.8	55.9	62.6	62.0	69.5	70.0	71.2	63.7	52.8
Mean	76.5	75.4	73.4	68.7	66.4	70.4	73.4	75.6	78.7	80.5	84.4	80.9	74.9
Max	99.5	92.9	89.9	79.6	74.9	80.6	85.6	88.8	87.9	88.0	91.2	92.0	99.5

TABLE A7.1-3: Derived Monthly and Annual Rainfall at Minago (1950-2008)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1950	0.0	0.0	0.0	23.0	49.5	69.6	43.1	112.1	24.8	22.1	0.9	0.0	345.0
1951	0.0	0.0	0.0	0.9	50.6	135.9	79.8	85.8	84.1	14.6	2.1	0.0	453.8
1952	0.0	0.0	0.0	0.0	101.5	87.7	110.9	20.4	35.5	15.1	13.1	0.0	384.2
1953	0.0	0.0	0.3	0.3	39.3	86.7	120.5	36.4	133.0	0.6	0.9	0.0	418.2
1954	0.0	0.0	0.0	5.3	39.3	76.9	106.0	90.2	44.6	30.3	3.8	0.0	396.2
1955	0.0	0.0	0.0	51.6	71.8	67.5	72.4	37.8	50.6	20.6	1.5	0.0	373.9
1956	0.0	0.0	0.0	0.9	28.0	54.4	49.7	31.4	46.5	23.6	0.0	0.0	234.6
1957	0.0	0.0	0.0	27.0	18.9	27.0	45.7	89.0	45.7	25.9	0.0	0.0	279.4
1958	0.0	0.0	1.7	11.9	14.6	28.2	47.4	55.9	64.6	49.7	6.1	0.0	280.2
1959	0.0	0.0	0.0	2.1	25.3	83.0	91.4	64.1	98.1	11.7	0.0	0.6	376.2
1960	0.0	0.0	0.3	11.9	94.0	34.4	40.4	11.7	41.9	26.5	1.1	0.0	262.3
1961	0.0	0.0	0.0	7.3	29.1	32.0	55.9	10.4	37.0	21.9	0.9	0.0	194.6
1962	0.0	0.0	0.0	14.2	0.9	67.3	11.7	157.2	31.4	21.5	1.7	0.0	305.9
1963	0.0	0.0	0.6	0.6	36.1	88.8	163.9	119.3	55.6	23.3	3.2	1.7	492.9
1964	0.0	0.0	0.0	28.8	65.5	41.0	152.9	72.8	113.6	26.8	0.0	0.0	501.3
1965	0.0	0.0	0.0	1.7	63.5	42.5	79.2	90.2	107.1	5.3	2.1	0.0	391.5
1966	0.0	0.0	2.6	0.9	15.5	94.6	167.1	82.0	30.0	31.7	0.0	0.3	424.9
1967	0.0	0.0	0.3	0.3	8.1	41.0	87.3	29.1	104.2	28.8	14.2	0.0	313.4
1968	3.2	0.0	0.6	10.7	34.3	63.2	78.9	79.8	57.1	23.7	0.0	0.0	351.5
1969	0.0	0.0	0.0	4.7	41.4	17.1	42.4	81.2	67.2	45.0	0.6	0.3	299.9
1970	0.0	0.0	0.0	9.2	40.3	166.8	69.1	37.4	21.5	69.3	0.0	0.0	413.6
1971	0.0	0.6	0.0	14.2	21.8	40.3	69.1	59.7	63.8	58.0	0.0	0.0	327.4
1972	0.0	0.0	0.6	4.9	24.9	126.4	53.1	44.4	80.4	9.2	0.3	0.0	344.2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1973	0.0	0.0	0.0	44.1	22.4	82.7	38.0	81.2	90.4	17.1	0.0	0.0	375.8
1974	0.0	0.0	2.9	11.9	22.0	54.6	52.7	113.9	55.1	5.5	5.3	3.2	327.1
1975	0.0	0.0	0.0	8.7	65.3	133.9	31.9	76.6	71.9	8.7	0.0	0.0	397.0
1976	0.0	0.0	0.0	5.8	16.0	193.4	114.9	14.2	29.3	35.6	0.0	0.0	409.2
1977	0.0	0.0	0.0	27.5	36.5	59.8	130.3	129.1	28.1	60.6	15.4	0.0	487.4
1978	0.0	0.0	0.0	19.6	14.2	46.1	102.6	53.9	41.0	61.8	0.0	0.0	339.2
1979	0.0	0.0	0.0	10.0	38.6	34.0	70.8	60.3	100.0	38.7	0.0	0.0	352.4
1980	0.0	0.0	0.0	7.0	20.7	41.7	75.0	57.5	89.3	13.9	0.0	1.1	306.2
1981	0.0	8.8	13.6	8.7	9.6	79.2	110.4	47.7	92.4	115.2	3.4	0.0	489.0
1982	0.0	0.3	1.4	3.3	29.6	33.1	37.1	66.3	39.2	9.1	0.0	0.5	219.9
1983	0.0	0.0	0.0	7.1	45.3	83.0	153.9	66.0	109.6	10.7	24.7	0.0	500.3
1984	1.1	0.0	6.7	11.2	61.4	85.3	53.9	17.4	73.2	65.9	0.0	0.0	376.1
1985	0.0	0.0	0.0	14.0	57.7	89.6	42.0	164.2	41.3	3.7	2.4	0.2	415.1
1986	0.2	0.0	13.6	17.7	29.8	47.3	132.9	108.9	67.1	26.5	1.1	0.0	445.1
1987	0.0	0.0	10.0	9.7	30.6	59.1	61.3	109.3	28.1	34.3	1.6	3.2	347.2
1988	0.0	0.2	0.2	5.0	38.2	22.5	62.0	85.3	80.1	4.3	3.9	0.5	302.3
1989	0.0	0.0	0.0	5.6	55.1	142.0	39.8	86.5	112.2	16.0	5.4	0.0	462.7
1990	0.0	0.0	2.6	3.0	9.7	43.6	28.1	25.7	22.5	27.1	1.4	0.0	163.6
1991	0.0	0.0	0.0	38.6	42.2	50.7	50.7	30.7	70.0	9.0	0.2	0.0	292.2
1992	0.0	0.0	1.4	14.8	33.5	56.6	63.1	45.8	70.3	20.8	0.0	0.0	306.3
1993	0.0	0.0	12.2	1.9	11.9	131.9	146.7	128.8	32.2	26.7	0.0	0.0	492.3
1994	0.0	0.0	1.4	4.6	35.0	61.1	153.4	21.0	40.4	55.0	6.4	0.5	378.8
1995	0.0	0.0	0.0	0.5	12.3	60.5	58.5	190.5	21.0	21.0	0.0	0.0	364.3
1996	2.5	0.0	1.4	0.2	71.7	84.0	51.0	27.6	56.7	62.2	0.0	0.2	357.7
1997	0.7	0.2	0.2	22.1	30.1	89.7	44.3	64.4	116.2	35.0	3.9	0.2	407.2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1998	0.0	3.9	1.1	0.0	28.1	87.3	56.3	73.2	38.4	44.5	5.9	0.0	338.7
1999	0.0	0.6	0.9	9.1	114.2	110.7	85.6	26.3	33.8	35.4	0.9	0.0	417.5
2000	0.0	0.0	0.0	12.1	74.2	83.6	49.5	62.1	60.5	0.9	0.0	0.0	343.0
2001	0.0	0.0	0.9	4.1	91.3	69.9	70.3	68.0	33.6	13.2	13.9	0.0	365.3
2002	0.5	0.0	0.0	8.2	4.3	64.5	35.4	66.7	91.6	8.7	0.0	0.2	280.1
2003	0.2	0.0	0.2	10.7	24.4	96.6	98.4	34.7	147.3	3.4	0.0	0.0	416.0
2004	0.0	0.0	10.7	12.6	25.8	77.6	167.4	61.9	65.3	7.8	0.2	0.2	429.5
2005	0.0	0.0	2.7	13.6	47.3	96.1	74.0	151.6	126.0	28.3	10.7	0.2	550.6
2006	0.0	0.0	0.2	35.6	56.6	65.8	52.7	92.2	78.3	42.0	0.0	0.0	423.6
2007	2.1	0.0	1.8	3.7	45.0	141.8	35.3	70.2	57.5	18.7	7.1	0.0	383.1
2008	0.0	0.0	0.0	3.4	11.5	46.1	150.0	29.9					
Min	0.0	0.0	0.0	0.0	0.9	17.1	11.7	10.4	21.0	0.6	0.0	0.0	163.6
Mean	0.2	0.2	1.6	11.0	38.6	74.2	78.3	69.6	64.6	27.5	2.9	0.2	368.9
Max	3.2	8.8	13.6	51.6	114.2	193.4	167.4	190.5	147.3	115.2	24.7	3.2	550.6

TABLE A7.1-4: Derived Monthly and Annual Snowfall at Minago (1950-2008)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1950	17.0	22.9	2.1	6.8	0.4	0.9	0.0	0.0	4.3	15.4	30.3	25.3	125.4
1951	6.3	5.2	23.5	14.3	0.7	0.0	0.0	0.0	9.3	26.3	20.1	8.6	114.4
1952	7.0	8.1	7.0	0.0	7.0	0.0	0.0	0.0	0.0	9.7	14.3	8.8	62.0
1953	26.7	5.9	62.5	6.3	3.8	0.0	0.0	0.0	0.0	2.7	26.0	31.3	165.3
1954	28.3	10.4	2.7	41.6	5.4	0.0	0.0	0.0	0.0	4.5	32.2	11.3	136.6
1955	19.3	13.4	5.4	13.1	8.4	0.0	0.0	0.0	0.0	7.7	52.1	30.8	150.0
1956	30.8	28.1	35.3	17.9	8.6	0.0	0.0	0.0	0.0	7.9	36.0	19.0	183.6
1957	8.1	11.3	36.5	2.1	6.6	0.0	0.0	0.0	0.4	3.8	17.2	36.2	122.2
1958	16.8	30.8	13.5	26.3	0.0	0.0	0.0	0.0	0.0	4.1	15.2	38.2	144.8
1959	30.6	5.2	10.6	22.4	11.3	0.0	0.0	0.0	0.0	14.7	33.7	17.0	145.5
1960	7.2	19.3	49.6	11.1	0.0	0.0	0.0	0.0	0.0	7.2	19.3	16.3	129.9
1961	6.2	28.3	25.6	26.0	9.3	0.0	0.0	0.0	12.2	24.0	53.7	29.2	214.5
1962	23.5	6.3	52.9	16.5	7.7	0.0	0.0	0.0	0.0	3.7	21.3	28.3	160.3
1963	36.0	15.4	27.4	10.6	11.8	0.0	0.0	0.0	1.3	0.0	22.4	10.4	135.3
1964	16.3	15.4	15.0	9.3	0.0	0.0	0.0	0.0	0.0	12.0	25.1	19.3	112.4
1965	10.6	73.1	8.4	0.7	16.8	0.0	0.0	0.0	1.3	0.9	45.0	28.5	185.3
1966	24.0	13.5	26.3	26.3	0.9	0.0	0.0	0.0	0.0	7.5	30.6	39.8	168.9
1967	28.3	17.6	47.5	19.0	3.8	0.7	0.0	0.0	0.0	31.3	33.1	33.7	215.1
1968	28.3	8.4	9.3	41.2	3.2	0.0	0.0	0.0	0.0	0.0	35.6	42.6	168.6
1969	30.8	22.6	12.5	8.6	0.0	8.6	0.0	0.0	0.0	5.2	12.7	21.5	122.5
1970	15.9	24.0	18.1	57.5	0.4	0.0	0.0	0.0	0.0	23.4	31.0	46.2	216.4
1971	26.3	19.4	29.0	4.7	0.0	0.0	0.0	0.0	2.5	20.6	27.8	50.7	181.0
1972	15.6	24.4	23.4	20.9	0.0	0.0	0.0	0.0	3.7	4.5	27.2	29.4	149.0

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1973	25.1	29.4	22.9	53.4	0.0	0.0	0.0	0.0	0.0	7.7	63.6	21.7	223.9
1974	41.2	36.6	69.7	2.9	13.4	0.0	0.0	0.0	2.9	16.0	31.3	14.0	228.1
1975	44.6	11.8	9.5	21.9	5.9	0.0	0.0	0.0	0.0	0.4	19.0	24.4	137.5
1976	31.9	12.9	7.0	10.6	1.2	0.0	0.0	0.0	0.0	10.6	7.9	24.2	106.4
1977	4.4	17.6	23.4	0.5	0.0	0.0	0.0	0.0	0.0	0.2	29.5	20.0	95.6
1978	13.5	10.1	34.0	11.9	0.7	0.0	0.0	0.0	0.0	3.0	33.5	18.4	125.1
1979	5.3	13.7	18.7	21.0	22.2	0.0	0.0	0.0	0.0	10.6	16.4	11.5	119.5
1980	19.9	13.9	28.9	0.0	1.8	0.0	0.0	0.0	5.8	1.2	25.0	24.0	120.4
1981	8.4	10.3	8.1	22.6	0.0	0.0	0.0	0.0	0.0	15.9	5.6	38.3	109.3
1982	7.8	15.4	19.0	9.7	0.0	0.0	0.0	0.0	1.2	23.1	7.1	48.0	131.3
1983	18.3	12.8	20.6	18.2	26.1	0.0	0.0	0.0	0.0	2.7	32.7	11.0	142.3
1984	29.1	11.6	11.6	23.0	0.9	0.0	0.0	0.0	15.2	21.1	39.5	10.1	162.0
1985	24.8	14.4	10.6	0.4	3.6	0.0	0.0	0.0	0.0	21.3	14.3	32.7	122.0
1986	17.3	3.2	31.8	31.5	0.0	0.0	0.0	0.0	0.0	5.2	22.6	27.2	138.8
1987	14.1	27.2	17.1	0.2	0.0	0.0	0.0	0.0	0.0	20.4	10.3	17.8	107.1
1988	26.7	20.9	24.6	19.2	0.2	0.0	0.0	0.0	0.0	5.1	20.6	16.2	133.4
1989	10.9	18.4	19.6	0.0	0.0	0.0	0.0	0.0	0.0	16.2	41.6	9.6	116.3
1990	34.2	24.0	13.7	36.2	7.7	0.0	0.0	0.0	0.0	13.0	49.0	13.2	191.0
1991	17.1	2.5	9.4	14.4	5.2	0.0	0.0	0.0	0.0	83.6	12.3	8.9	153.5
1992	15.0	23.2	8.6	14.3	1.4	0.9	0.0	0.0	0.0	7.8	18.9	21.2	111.2
1993	7.1	9.8	3.7	36.0	0.0	0.0	0.0	0.0	0.0	8.2	26.2	23.2	114.3
1994	9.5	19.3	26.7	11.9	1.2	0.0	0.0	0.0	0.0	3.0	16.0	27.8	115.6
1995	15.0	16.9	37.4	18.5	0.0	0.0	0.0	0.0	2.3	3.0	39.0	28.3	160.6
1996	13.7	23.0	27.3	35.8	12.5	0.0	0.0	0.0	0.0	14.6	34.0	21.0	182.0
1997	37.1	11.1	25.5	17.6	1.1	0.0	0.0	0.0	0.0	19.9	5.7	13.2	131.1

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1998	41.1	9.5	6.4	7.8	6.9	0.0	0.0	0.0	0.0	29.2	18.2	25.9	145.1
1999	21.3	25.8	12.5	16.7	0.0	0.0	0.0	0.0	0.0	2.1	7.0	31.6	116.9
2000	17.6	6.6	5.0	0.5	3.6	0.0	0.0	0.0	2.5	0.5	15.5	20.9	72.6
2001	7.7	9.1	6.1	8.2	0.0	0.0	0.0	0.0	0.0	2.1	3.7	15.7	52.6
2002	5.7	12.8	11.6	35.3	7.5	0.0	0.0	0.0	0.0	11.6	8.7	48.7	141.9
2003	7.8	17.6	16.6	7.0	0.0	0.0	0.0	0.0	0.0	29.4	7.0	1.1	86.5
2004	29.1	29.6	27.3	9.1	14.4	0.0	0.0	0.0	0.4	15.7	13.2	44.0	182.8
2005	29.3	18.5	12.1	7.3	0.9	0.0	0.0	0.0	0.0	0.2	17.8	39.9	126.1
2006	30.3	26.0	19.8	0.9	0.4	0.0	0.0	0.0	0.0	1.1	61.1	34.5	174.0
2007	18.5	22.1	18.9	0.4	1.4	0.0	0.0	0.0	0.0	4.6	32.1	25.5	123.5
2008	23.5	16.8	20.5	2.9	0.0	0.0	0.0	0.0	-	-	-	-	-
Min	4.4	2.5	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	1.1	52.6
Mean	20.1	17.5	20.9	15.8	4.2	0.2	0.0	0.0	1.1	11.5	25.3	24.8	141.3
Max	44.6	73.1	69.7	57.5	26.1	8.6	0.0	0.0	15.2	83.6	63.6	50.7	228.1

TABLE A7.1-5: Derived Monthly and Annual Total Precipitation at Minago (1950-2008)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1950	17.0	22.9	2.1	29.8	49.9	70.4	43.1	112.1	29.0	37.5	31.2	25.3	470.4
1951	6.3	5.2	23.5	15.2	51.4	135.9	79.8	85.8	93.4	40.8	22.2	8.6	568.1
1952	7.0	8.1	7.0	0.0	108.6	87.7	110.9	20.4	35.5	24.8	27.3	8.8	446.2
1953	26.7	5.9	62.8	6.7	43.1	86.7	120.5	36.4	133.0	3.2	26.9	31.3	583.5
1954	28.3	10.4	2.7	46.9	44.7	76.9	106.0	90.2	44.6	34.8	36.0	11.3	532.8
1955	19.3	13.4	5.4	64.7	80.2	67.5	72.4	37.8	50.6	28.3	53.5	30.8	523.9
1956	30.8	28.1	35.3	18.8	36.6	54.4	49.7	31.4	46.5	31.5	36.0	19.0	418.2
1957	8.1	11.3	36.5	29.1	25.5	27.0	45.7	89.0	46.2	29.7	17.2	36.2	401.6
1958	16.8	30.8	15.3	38.2	14.6	28.2	47.4	55.9	64.6	53.8	21.2	38.2	425.0
1959	30.6	5.2	10.6	24.4	36.6	83.0	91.4	64.1	98.1	26.4	33.7	17.6	521.6
1960	7.2	19.3	49.9	23.0	94.0	34.4	40.4	11.7	41.9	33.7	20.4	16.3	392.1
1961	6.2	28.3	25.6	33.4	38.4	32.0	55.9	10.4	49.2	45.9	54.6	29.2	409.0
1962	23.5	6.3	52.9	30.7	8.6	67.3	11.7	157.2	31.4	25.2	23.0	28.3	466.2
1963	36.0	15.4	27.9	11.2	47.9	88.8	163.9	119.3	56.9	23.3	25.6	12.1	628.2
1964	16.3	15.4	15.0	38.0	65.5	41.0	152.9	72.8	113.6	38.8	25.1	19.3	613.7
1965	10.6	73.1	8.4	2.4	80.2	42.5	79.2	90.2	108.5	6.2	47.1	28.5	576.8
1966	24.0	13.5	28.9	27.2	16.4	94.6	167.1	82.0	30.0	39.2	30.6	40.2	593.8
1967	28.3	17.6	47.9	19.3	12.0	41.7	87.3	29.1	104.2	60.0	47.3	33.7	528.5
1968	31.5	8.4	9.8	51.9	37.5	63.2	78.9	79.8	57.1	23.7	35.6	42.6	520.1
1969	30.8	22.6	12.5	13.3	41.4	25.8	42.4	81.2	67.2	50.2	13.2	21.8	422.4
1970	15.9	24.0	18.1	66.7	40.7	166.8	69.1	37.4	21.5	92.7	31.0	46.2	630.0
1971	26.3	20.0	29.0	18.9	21.8	40.3	69.1	59.7	66.3	78.6	27.8	50.7	508.5
1972	15.6	24.4	23.9	25.8	24.9	126.4	53.1	44.4	84.0	13.8	27.5	29.4	493.2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1973	25.1	29.4	22.9	97.5	22.4	82.7	38.0	81.2	90.4	24.8	63.6	21.7	599.7
1974	41.2	36.6	72.6	14.8	35.4	54.6	52.7	113.9	58.1	21.5	36.5	17.2	555.2
1975	44.6	11.8	9.5	30.6	71.2	133.9	31.9	76.6	71.9	9.1	19.0	24.4	534.5
1976	31.9	12.9	7.0	16.4	17.1	193.4	114.9	14.2	29.3	46.2	7.9	24.2	515.6
1977	4.4	17.6	23.4	28.0	36.5	59.8	130.3	129.1	28.1	60.8	44.9	20.0	583.0
1978	13.5	10.1	34.0	31.6	14.9	46.1	102.6	53.9	41.0	64.8	33.5	18.4	464.3
1979	5.3	13.7	18.7	31.1	60.8	34.0	70.8	60.3	100.0	49.3	16.4	11.5	472.0
1980	19.9	13.9	28.9	7.0	22.4	41.7	75.0	57.5	95.1	15.2	25.0	25.1	426.6
1981	8.4	19.1	21.7	31.3	9.6	79.2	110.4	47.7	92.4	131.1	9.0	38.3	598.3
1982	7.8	15.8	20.4	13.0	29.6	33.1	37.1	66.3	40.4	32.2	7.1	48.4	351.2
1983	18.3	12.8	20.6	25.3	71.4	83.0	153.9	66.0	109.6	13.4	57.4	11.0	642.6
1984	30.3	11.6	18.3	34.2	62.3	85.3	53.9	17.4	88.3	87.0	39.5	10.1	538.1
1985	24.8	14.4	10.6	14.4	61.2	89.6	42.0	164.2	41.3	25.0	16.7	32.9	537.1
1986	17.5	3.2	45.4	49.2	29.8	47.3	132.9	108.9	67.1	31.7	23.8	27.2	583.9
1987	14.1	27.2	27.2	9.9	30.6	59.1	61.3	109.3	28.1	54.7	11.9	21.0	454.3
1988	26.7	21.1	24.8	24.2	38.4	22.5	62.0	85.3	80.1	9.4	24.5	16.7	435.7
1989	10.9	18.4	19.6	5.6	55.1	142.0	39.8	86.5	112.2	32.2	47.0	9.6	579.0
1990	34.2	24.0	16.4	39.2	17.4	43.6	28.1	25.7	22.5	40.1	50.4	13.2	354.6
1991	17.1	2.5	9.4	53.0	47.4	50.7	50.7	30.7	70.0	92.6	12.5	8.9	445.6
1992	15.0	23.2	9.9	29.1	34.9	57.5	63.1	45.8	70.3	28.6	18.9	21.2	417.5
1993	7.1	9.8	16.0	38.0	11.9	131.9	146.7	128.8	32.2	34.9	26.2	23.2	606.6
1994	9.5	19.3	28.1	16.5	36.3	61.1	153.4	21.0	40.4	58.1	22.4	28.3	494.4
1995	15.0	16.9	37.4	19.0	12.3	60.5	58.5	190.5	23.3	24.0	39.0	28.3	524.9
1996	16.2	23.0	28.6	36.1	84.2	84.0	51.0	27.6	56.7	76.8	34.0	21.3	539.7
1997	37.8	11.3	25.7	39.8	31.2	89.7	44.3	64.4	116.2	54.9	9.6	13.4	538.3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1998	41.1	13.4	7.6	7.8	34.9	87.3	56.3	73.2	38.4	73.8	24.1	25.9	483.8
1999	21.3	26.4	13.4	25.8	114.2	110.7	85.6	26.3	33.8	37.5	7.9	31.6	534.5
2000	17.6	6.6	5.0	12.6	77.8	83.6	49.5	62.1	63.0	1.4	15.5	20.9	415.6
2001	7.7	9.1	7.0	12.3	91.3	69.9	70.3	68.0	33.6	15.4	17.7	15.7	417.9
2002	6.2	12.8	11.6	43.5	11.8	64.5	35.4	66.7	91.6	20.3	8.7	48.9	422.0
2003	8.1	17.6	16.8	17.7	24.4	96.6	98.4	34.7	147.3	32.8	7.0	1.1	502.5
2004	29.1	29.6	38.0	21.6	40.2	77.6	167.4	61.9	65.7	23.5	13.4	44.3	612.3
2005	29.3	18.5	14.9	20.9	48.2	96.1	74.0	151.6	126.0	28.5	28.6	40.2	676.7
2006	30.3	26.0	20.0	36.5	57.0	65.8	52.7	92.2	78.3	43.1	61.1	34.5	597.5
2007	20.6	22.1	20.7	4.0	46.4	141.8	35.3	70.2	57.5	23.4	39.2	25.5	506.7
2008	23.5	16.8	20.5	6.3	11.5	46.1	150.0	29.9	-	-	-	-	-
Min	4.4	2.5	2.1	0.0	8.6	22.5	11.7	10.4	21.5	1.4	7.0	1.1	351.2
Mean	20.2	17.8	22.4	26.8	42.8	74.4	78.3	69.6	65.8	39.0	28.2	25.0	510.2
Max	44.6	73.1	72.6	97.5	114.2	193.4	167.4	190.5	147.3	131.1	63.6	50.7	676.7

APPENDIX 7.2

Supplemental Material for Air Quality and Noise Assessment

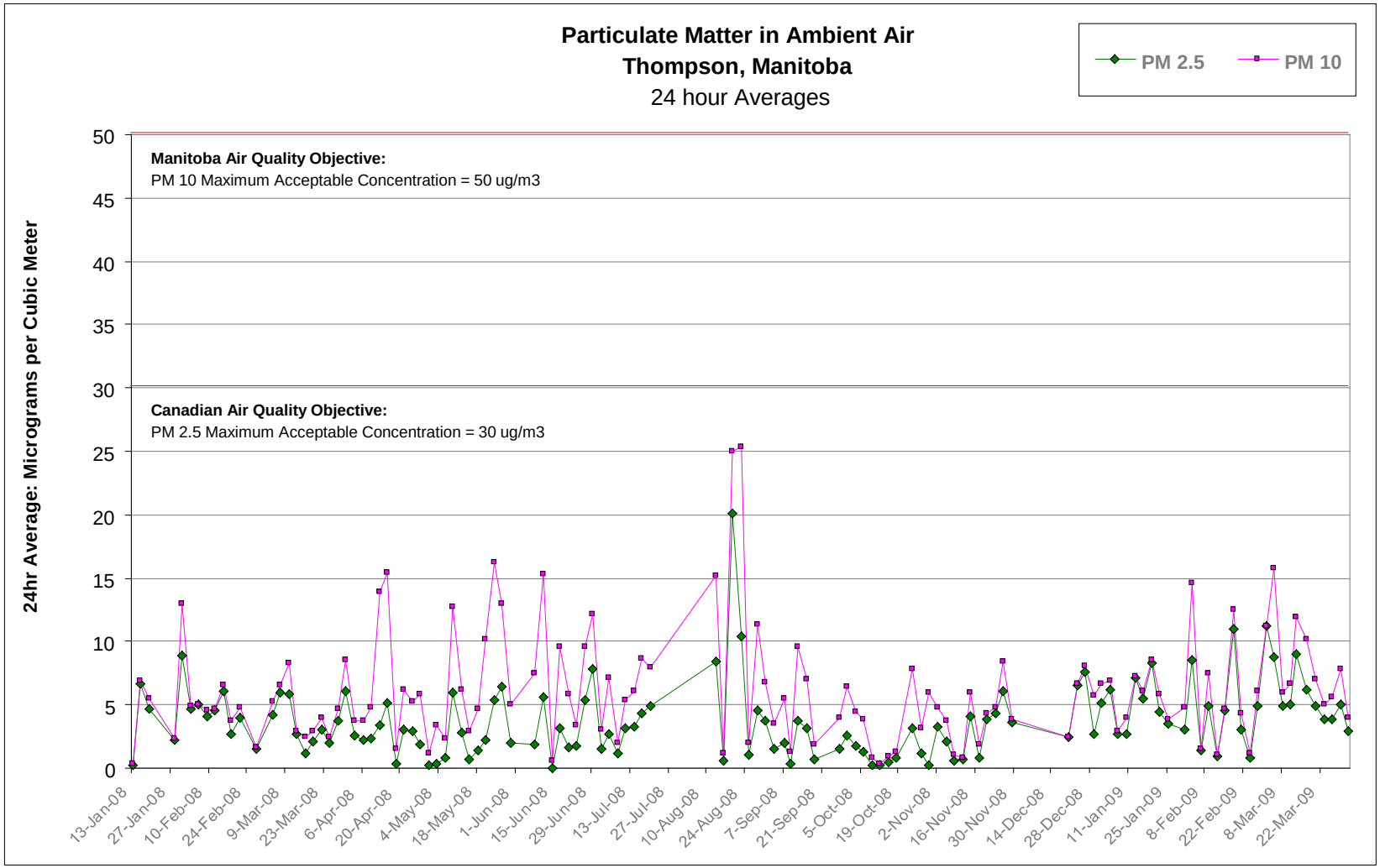
APPENDIX 7.2-A

Particulate Matter (PM) in Ambient Air for Thompson, MB

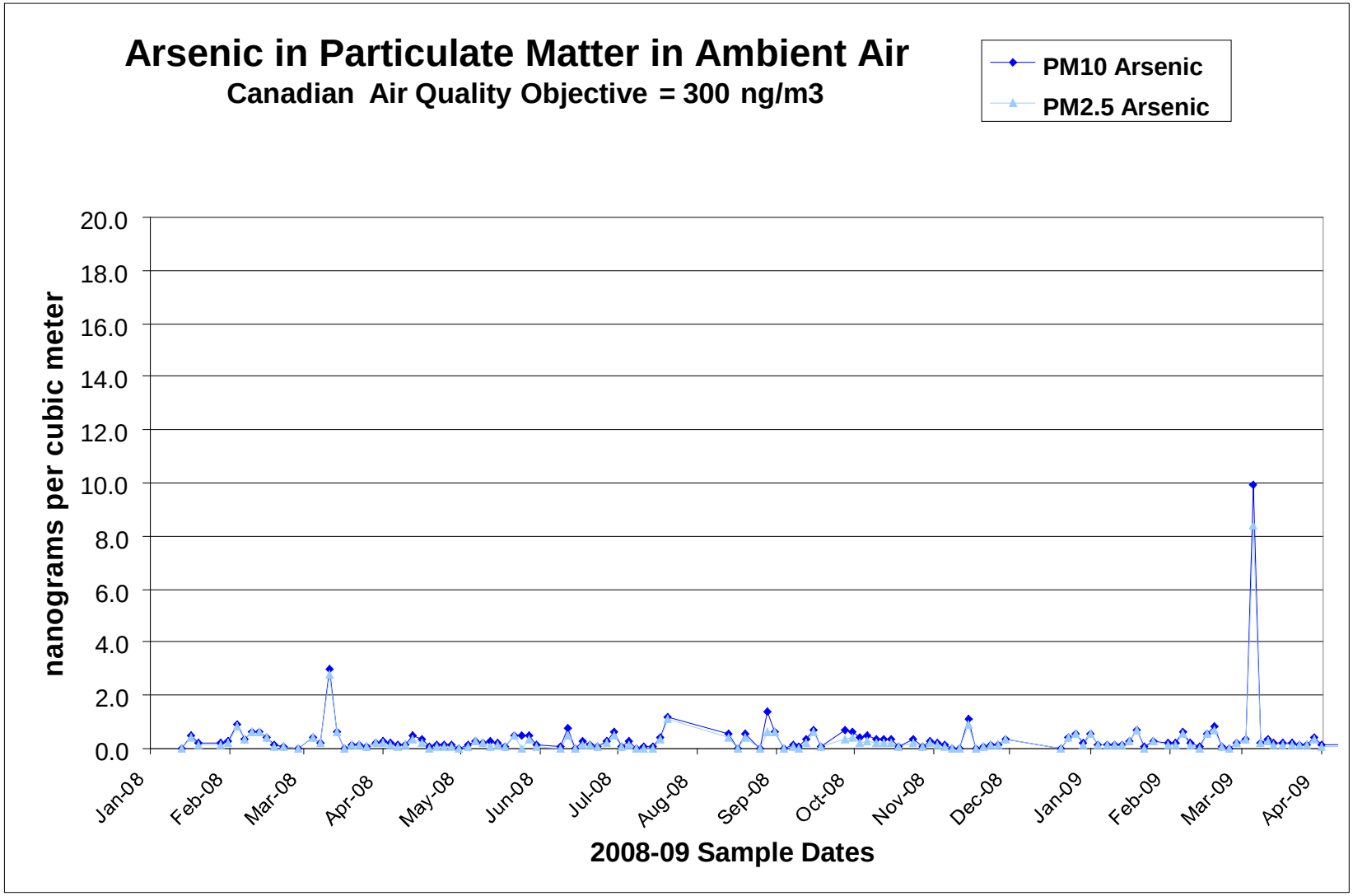
Particulate Matter in Ambient Air in Thompson, Manitoba

Particulate Matter samples are collected for a 24 hour period, once every 72 hours at Ecole Riverside School in the Riverside area. The Samples are analyzed by an external laboratory specializing in air quality sampling and analysis. The results are illustrated graphically below. The Air Quality (AQ) objective for each element is identified at the top of the graph, in nanograms per cubic meter.

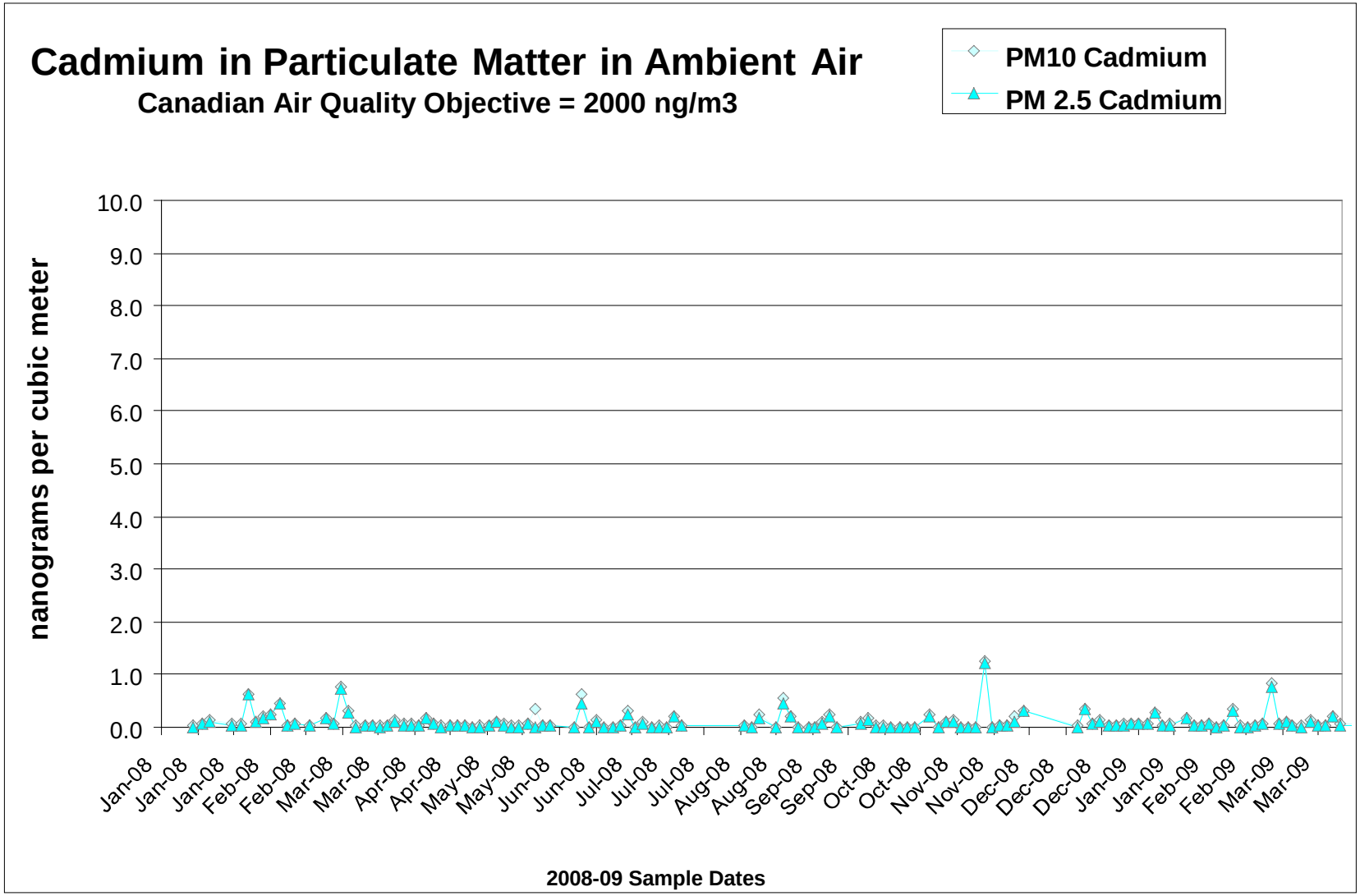
Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009



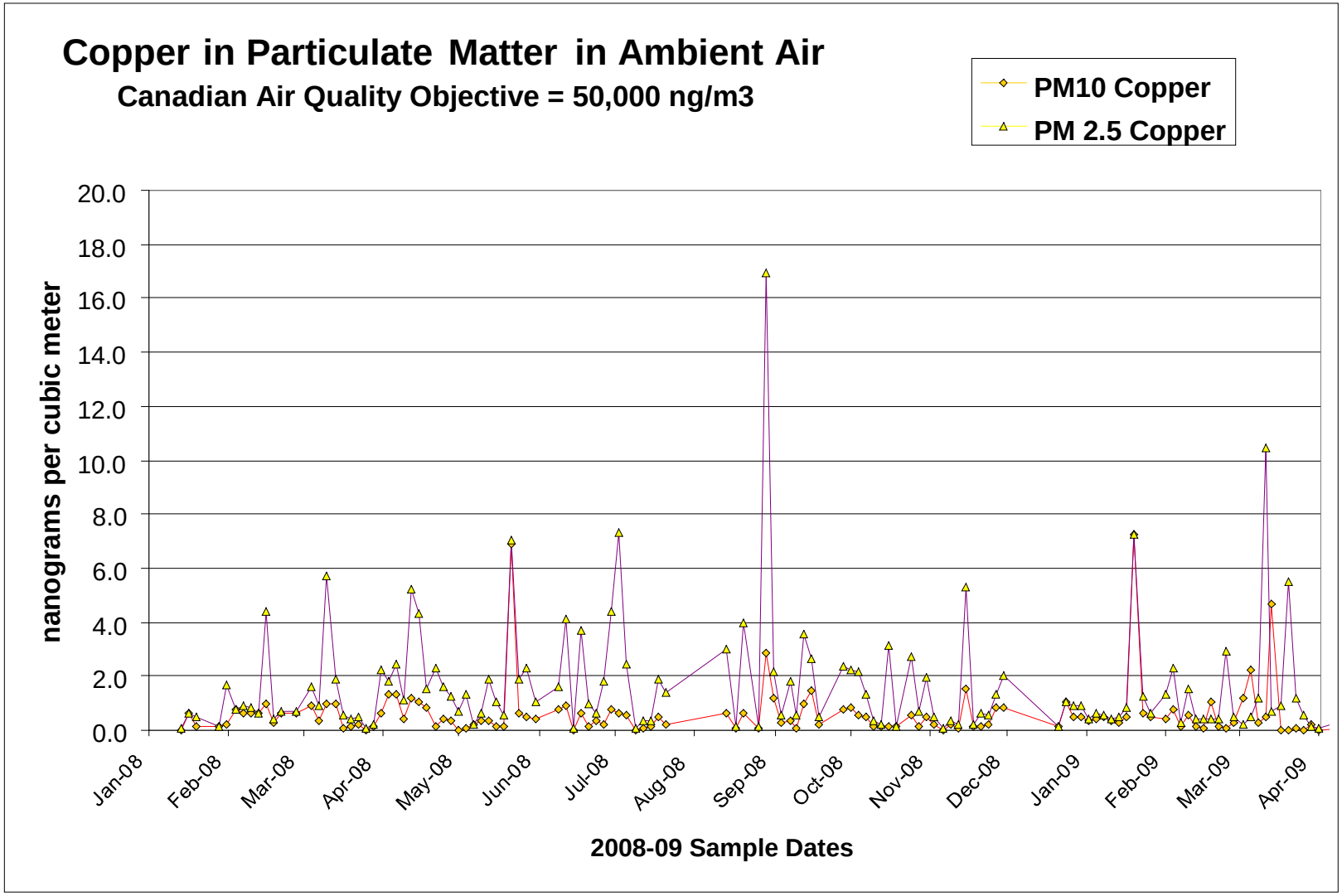
Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009



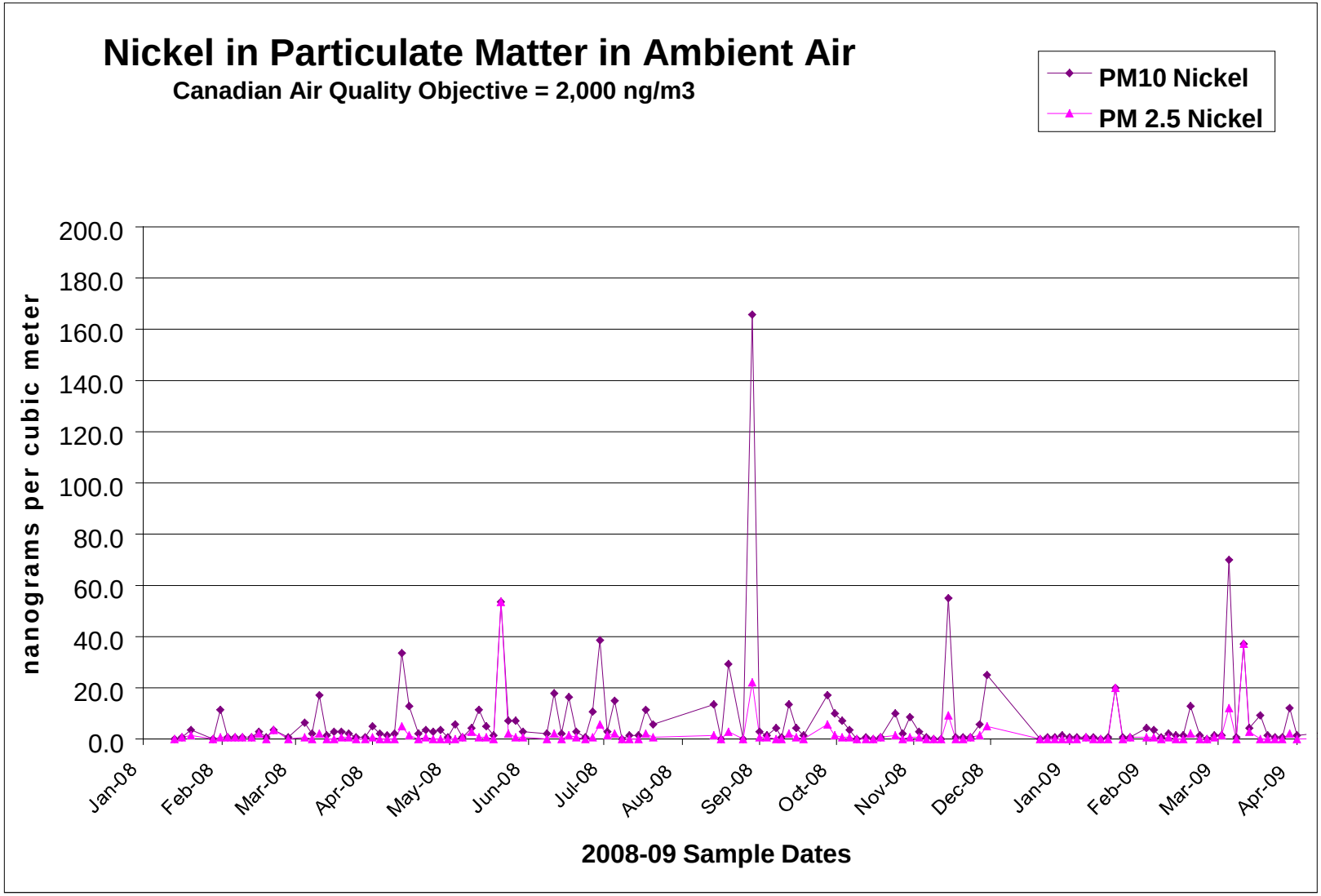
Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009



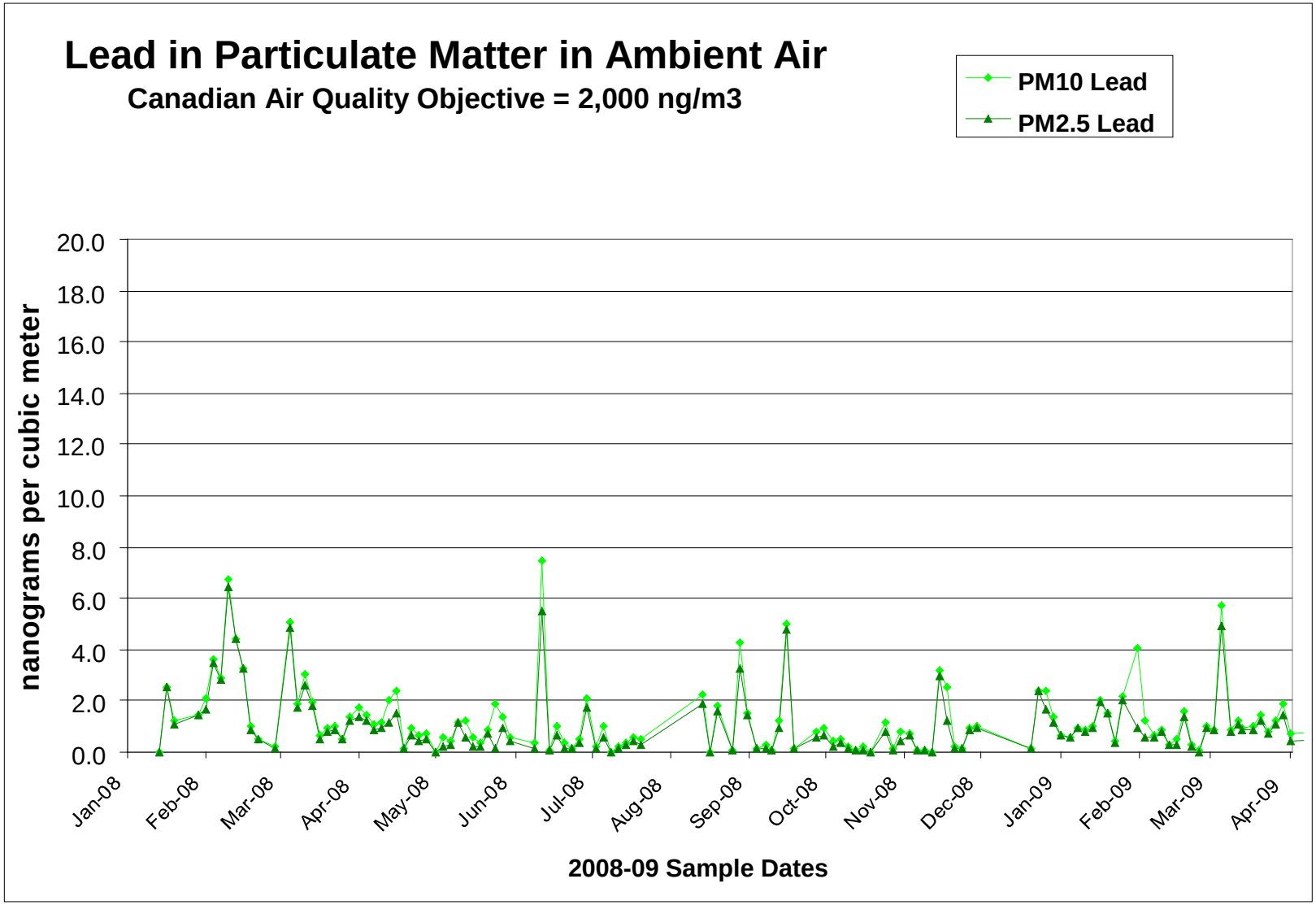
Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009



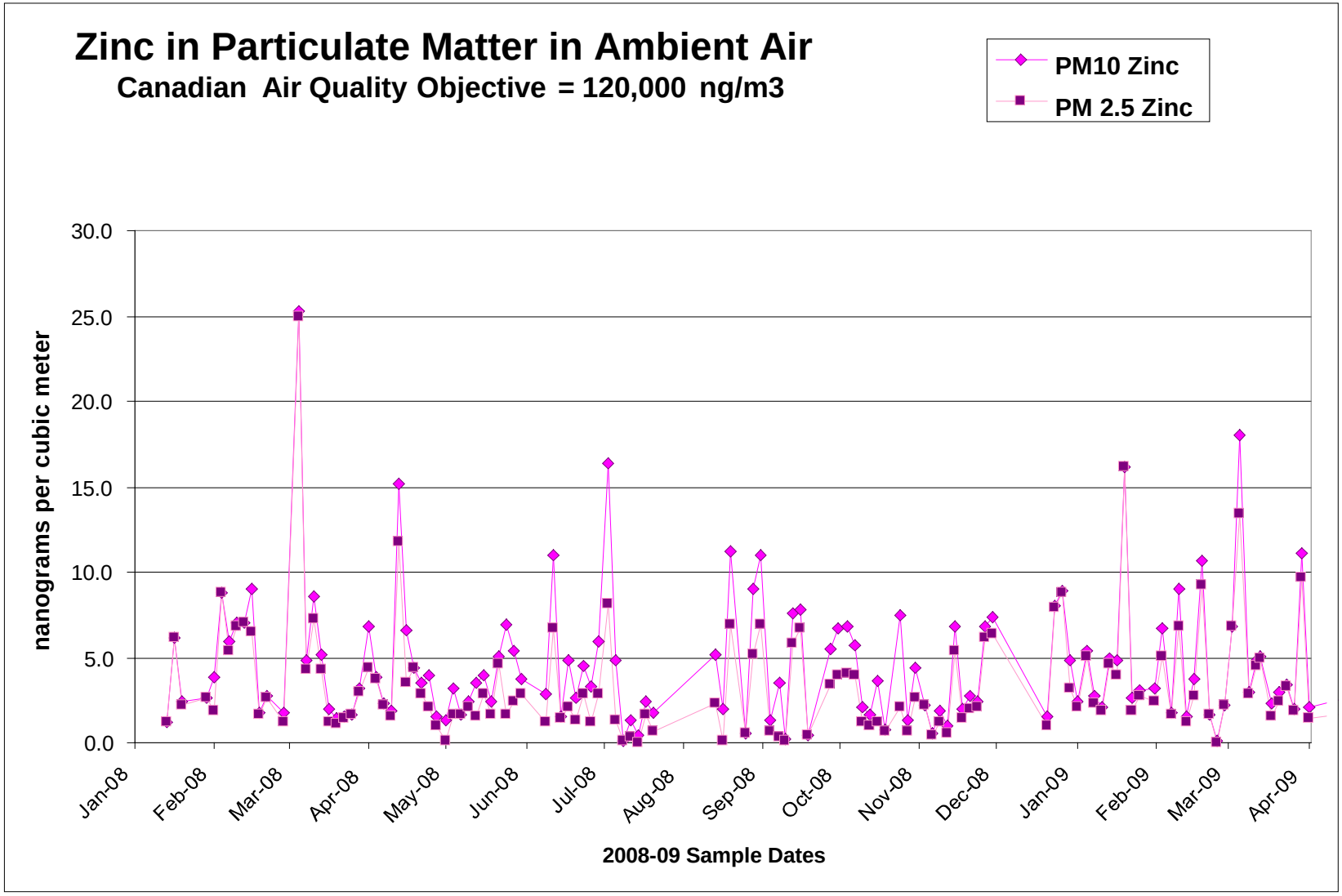
Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009



Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009



Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009



Source: http://www.inco-thompson-airquality.com accessed: June 16, 2009

APPENDIX 7.2-B

Manitoba Ambient Air Quality Criteria (July 2005)

Manitoba Ambient Air Quality Criteria

Name of Contaminant	*Criteria Classification*	*Units of Concentration Measurement*	*Period of Time Contaminant is Measured*	*Maximum Tolerable Level Concentration*	*Maximum Acceptable Level Concentration*	*Maximum Desirable Level Concentration*	*Reference*
Ammonia	Guideline	Milligrams per cubic metre (parts per million) of air	1 - hour average		1.4 (2.0)		7
Arsenic	Guideline (***new***)	Micrograms per cubic metre of air	24 - hour average		0.3		20
Cadmium	Guideline (***new***)	Micrograms per cubic metre of air	24 - hour average		2		20
Carbon Monoxide	Objective	Milligrams per cubic metre (parts per million) of air	1 - hour average 8 - hour average	20 (17)	35 (30) 15 (13)	15 (13) 6 (5)	5,9
Chromic Acid (as Cr^{+6})	Guideline	Micrograms per cubic metre of air	1 - hour average		4.5		11
Copper	Guideline (***new***)	Micrograms per cubic metre of air	24 - hour average		50		20
Fluorides (as HF)	Guideline	Micrograms per cubic metre (parts per billion) of air	24 - hour average 7 - day average 30 - day average 70 - day average		0.85 (1.06) 0.55 (0.69) 0.35 (0.44) 0.20 (0.25)	0.40 (0.50) 0.22 (0.28)	3
Formaldehyde	Guideline	Micrograms per cubic metre (parts per billion) of air	1 - hour average		60 (49)		16
Hydrogen Chloride	Guideline	Micrograms per cubic metre (parts per billion) of air	1 - hour average		100 (70)		8

Source: Manitoba Conservation. Objectives and Guidelines for various Air Pollutants: Ambient Air Quality Criteria (updated July 2005)

Manitoba Ambient Air Quality Criteria

Name of Contaminant	*Criteria Classification*	*Units of Concentration Measurement*	*Period of Time Contaminant is Measured*	*Maximum Tolerable Level Concentration*	*Maximum Acceptable Level Concentration*	*Maximum Desirable Level Concentration*	*Reference*
Hydrogen Sulfide	Guideline	Micrograms per cubic metre (parts per billion) of air	1 - hour average 24 - hour average	1400 (1000)	15 (11.0) 5 (4.0)	1 (0.7)	4,12
Hydrogen Cyanide	Guideline	Micrograms per cubic metre (parts per billion) of air	1 - hour average annual average		40 (36) 3 (2.7)		13
Lead	Guideline **(*revised*)**	Micrograms per cubic metre of air	24 - hour average 30 - day average		2.0 0.7		2
Methylene Diphenyl Diisocyanate (MDI)	Guideline	Micrograms per cubic metre (parts per billion) of air	1 - hour average annual average		3 (0.3) 0.5 (0.05)		14
Nickel	Guideline **(*new*)**	Micrograms per cubic metre of air	24 - hour average		2		20
Nitrogen Dioxide	Objective	Micrograms per cubic metre (parts per million) of air	1 - hour average 24 - hour average Annual arithmetic mean	1000 (0.53)	400 (0.213) 200 (0.106) 100 (0.053)	60 (0.032)	5,9
Odours (see note 1)	Guideline	Odour units	two tests not less than 15 minutes apart nor more than 60 minutes apart		Residential Zone 2.0 (see note 2) ~~Industrial Zone~~ 7.0 (see note 3)	<1.0 (less than the odour threshold)	6
Ground-level Ozone	Objective	Micrograms per cubic metre (parts per billion) of air	1 - hour average Annual arithmetic mean	400 (200)	160 (82) 30 (15)	100 (50)	5,9

Source: Manitoba Conservation. Objectives and Guidelines for various Air Pollutants: Ambient Air Quality Criteria (updated July 2005)

Manitoba Ambient Air Quality Criteria

Name of Contaminant	***Criteria Classification***	***Units of Concentration Measurement***	***Period of Time Contaminant is Measured***	***Maximum Tolerable Level Concentration***	***Maximum Acceptable Level Concentration***	***Maximum Desirable Level Concentration***	***Reference***
Ground-level Ozone	Canada-wide Standard **(*new*)**	Micrograms per cubic metre (parts per billion) of air	8 - hour average (see note 4)		128 (65)		18
Particulate Matter less than 2.5 µm in diameter ($PM_{2.5}$)	Canada-Wide Standard **(*new*)**	Micrograms per cubic metre of air	24 - hour average (see note 5)		30		18
Particulate Matter less than 10 µm in diameter (PM_{10})	Guideline **(*new*)**	Micrograms per cubic metre of air	24 - hour average		50		19
Phenol	Guideline	Micrograms per cubic metre (parts per billion) of air	1 - hour average		63 (16)		15
Styrene	Guideline	Micrograms per cubic metre (parts per billion) of air	24 - hour average		400 (94)		17
Sulphur Dioxide	Objective	Micrograms per cubic metre (parts per million) of air	1 - hour average 24 - hour average Annual arithmetic mean	800 (0.31)	900 (0.34) 300 (0.11) 60 (0.02)	450 (0.17) 150 (0.06) 30 (0.01)	5,9
Sulphuric Acid Mist	Guideline	Micrograms per cubic metre (parts per million) of air	1 - hour average		100 (0.025)		10
Suspended Particulate Matter	Objective	Micrograms per cubic metre of air	24 - hour average Annual geometric mean	400	120 70	60	5
Zinc	Guideline **(*new*)**	Micrograms per cubic metre of air	24 - hour average		120		20

Source: Manitoba Conservation. Objectives and Guidelines for various Air Pollutants: Ambient Air Quality Criteria (updated July 2005)

All measurements of air quality are corrected to a reference temperature of 25 ^{o}C and to a reference pressure of 101.3 kilopascals.

note 1: Nuisance odours from environmentally-regulated developments are managed using a strategy based on the prevention/minimization of odour releases and the use of a community based standard to determine the acceptability of the ambient odour in the community. It is intended that the odour unit limits be used only for evaluating potential impacts on a community during the environmental impact assessment of new or modified developments.

note 2: One volume of odorous air diluted with one volume of odour free air.

note 3: One volume of odorous air diluted with six volumes of odour free air.

note 4: The 8-hour average objective for ozone is the national Canada-wide Standard (CWS) for ozone. (See www.ccme.ca/initiatives/standards.html for more details.)

note 5: The 24-hour average objective for $PM_{2.5}$ is the national CWS for $PM_{2.5}$. (See www.ccme.ca/initiatives/standards.html for more details.)

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APPENDIX 7.2-C

Existing Control Levels for Particulate Matter and Ozone

Existing Control Levels for Particulate Matter (PM)

Country	Jurisdiction	$PM_{2.5}$ – 1 hr avg	$PM_{2.5}$ – 24 hr avg	$PM_{2.5}$ – annual avg	PM_{10} – 24 hour avg	Total Suspended Particulate
Canada	Canada-wide Standard (2000)		30 µg/m³ (2)			
	British Columbia				50 µg/m³ (24 hour)	120/400 µg/m³ (1)
	British Columbia/ GVRD		25 µg/m³	12 µg/m³		
	Alberta	80 µg/m³	30 µg/m³			
	Manitoba		30 µg/m³			
	Ontario					
	Quebec		30 µg/m³ (11)			150/70 µg/m³ (10)
	City of Montreal	35 µg/m³ (9)	25 µg/m³ (9)			150/70 µg/m³ (10)
	Nova Scotia					
	Saskatchewan		30 µg/m³			
	New Brunswick		30 µg/m³			
	Newfoundland and Labrador		25 µg/m³			
	Northwest Territories					
United States	Federal		35 µg/m³ (2)	15 µg/m³ (3)		
Europe	EU			25 µg/m³ (4)	50 µg/m³	
Global	World Health Organization		25 µg/m³ (5)	10 µg/m³ (6)	50 µg/m³ (24 hr) (7) 20 µg/m³ (annual) (8)	

Source: Canadian National Round Table on the Environment and Economy, 2008

Notes:

1 – Acceptable Level / Tolerable Level

2 – 3-year average of the 98th percentile of the 24-hour average achieved by 2010

3 – Averaged over 3 consecutive years

4 – Target of 20% reduction in ambient $PM_{2.5}$ levels over the period 2010-2020

5 – Interim targets of 75, 50, and 37.5 µg/m^3 for areas of poorer air quality

6 – Interim targets of 35, 25, and 15 µg/m^3 for areas of poorer air quality

7 – Interim targets of 150, 100, and 75µg/m^3 for areas of poorer air quality

8 – Interim targets of 70, 50, and 30µg/m^3 for areas of poorer air quality

9 – Valuer IQA

10 – 24-hour average / annual average

11 – By 2010

Existing Control Levels for Ozone (O_3)

Country	Jurisdiction	Ozone – 1 hr	Ozone – 8 hr	Ozone – 24 hr	Ozone – annual
Canada	Canada-wide Standard		65 ppb (by 2010)		
	Health Canada	20 ppb non-accident mortality, 25 ppb respiratory hospitalization (6)			
	British Columbia	100/160/300 µg/m³ (1)	65 µg/m³	30/50 µg/m³ (2)	30 µg/m³
	British Columbia — Fraser Valley	51/82 ppb (2)			65 ppb
	Alberta	160 µg/m³ or 82 ppb			
	Manitoba	100/160/400 µg/m³ (1)	65 ppb		
	Ontario	165 µg/m³			
	Quebec	82 ppb			
	City of Montreal	82 ppb	38 ppb	25 ppb	15 ppb
	Nova Scotia	160 µg/m³ or 82 ppb			
	Newfoundland and Labrador	160 µg/m³	87 µg/m³		
	Saskatchewan		65 ppb		
	New Brunswick		65 ppb		
	Northwest Territories		65 ppb		
United States	Federal	0.12 ppm(5)	0.08 ppm		
Europe	EU — ozone directive	180 µg/m³ (3) 240 µg/m³ (4)	120 µg/m³		
Global	World Health Organization		100 µg/m³		

Source: Canadian National Round Table on the Environment and Economy, 2008

Notes:

1 – Desirable / Acceptable / Tolerable

2 – Desirable / Acceptable

3 – Information threshold

4 – Alert threshold

5 – Applies only in limited areas

6 – Reference levels

APPENDIX 7.4

Supplemental Material for Surface Water Hydrology

APPENDIX 7.4-A

Summary of Hydrological Processes

Source: Golder Associates, 2009

HYDROLOGICAL PROCESSES

Studies of hydrologic processes in cold climate regions typically use the following assumptions explicitly or implicitly:

- Frozen ground has a very low or negligible permeability and therefore acts as an aquiclude;
- Many hydrological processes become dormant during the winter; and
- Energy and water fluxes are strongly linked.

This section summarizes processes that would be expected to impact the water balance in the area of the Minago Project. These processes include snow storage, snowmelt, lake evaporation and evapotranspiration, watershed runoff and ice regime.

Snow Storage

Factors affecting basin snow storage include the following (Woo, 1983):

- Accumulation of snow from individual snowfall events;
- Redistribution and compaction of snow through drifting;
- Compaction of snow by internal pressure of the snow pack;
- Depth hoar formation through vapor diffusion;
- Addition of rain water (including freezing rain) in early winter and through refreezing, formation of an ice layer within the snow pack;
- Occasional, early winter melt, sometimes followed by refreezing to form an ice layer within the snow pack; and
- Condensation and sublimation events.

Among these factors, snow sublimation and redistribution would have a notable impact on the amount of water in the snowpack and would therefore affect the water balance of a watershed. Sublimation can occur directly from snowpack surfaces or during blowing snow events with overall rates dependent on humidity and wind speed (Essery et al., 1999; Déry and Yau, 2002). Snow sublimation is highly dependent on thermal balance of the snowpack.

Wind erosion and deposition are major factors of snow redistribution in regions with sparse or low vegetation. Topographical features govern snow redistribution by wind. Therefore, the snow depth can be correlated to terrain type (Woo et al., 1983), and snow surveys, when completed, should include various terrain types including hilltops, flats, slopes of varying aspects, gullies and valleys (Woo and Marsh, 1978).

Snowmelt

Snowmelt runoff is affected by surface melt, snow metamorphism (physical modification of individual snowflakes), water movement through the wet snow, interaction of the melt water with the underlying soil, and lateral flow at the snow cover base (Marsh and Woo, 1985).

Snowmelt is dependent on the energy balance of the snowpack, and is notably affected by snow albedo (i.e., ratio of reflected energy over the incoming energy). Strong winds and warm, humid air can also cause significant snowmelt of a patchy snow because of sensible heat exchange (Woo, 1986). Contribution of the ground heat flux to melt is negligible in permafrost areas.

The factors affecting melt water percolation into snow include spatial heterogeneities, capillary effects, and changes in the hydraulic and thermal properties of the snow during melt. The interaction of the melt water with the flow during the percolation process could cause delays in runoff as a result of melt water held in storage by the snow cover (Roulet and Woo, 1986). For refrozen snow, the lag time to the onset of drainage from the snow cover is more than that for ripe (i.e., old) snow. However, once the drainage of refrozen snow begins, the remainder of the drainage is similar to ripe snow (Colbeck, 1972).

Lake Evaporation and Evapotranspiration

Evaporation is the process by which water is transferred from land and water to the atmosphere. Transpiration is the evaporation of water from the vascular system of plants to the atmosphere. The combination of both processes is termed evapotranspiration and is a function of the type of surface (open water, leaf, or leaf canopy, bare soil, etc.), the availability of water, and the net energy input into the system. Lake evaporation in the vicinity of the proposed project site is expected to be 500 mm or more (EMRC, 1995), while evapotranspiration is estimated to range between 350 and 400 mm (EMRC, 1995).

There are various methods of estimating evaporation, including direct measurements (pan and lysimeters), mass transfer and energy balance, and their combination (Penman). For evapotranspiration, the Penman-Monteith and the simplified version of the Penman-Monteith model (Priestley-Taylor) can be used. The choice between these methods depends on the time scale required, the type of data available and the type of surface being investigated (Dingman, 2002).

The seasonal distribution of evaporation is affected primarily by radiation. During the snowmelt period, evaporation is relatively small compared with the large supply of melt water within a thinly thawed active layer (Woo and Steer, 1983). Evaporation is greatest following snowmelt and decreases through the summer period. Evaporation decreases as the latitude increases. Evaporation losses from lakes are greater than evapotranspiration losses from an equivalent terrestrial area.

Watershed Runoff

Watershed runoff is the sum of all precipitation (rainfall and snowfall water equivalent) minus all losses (groundwater movements, evapotranspiration, sublimation and snow redistribution). The surface of the watersheds at the proposed project site are composed in large part of wetland vegetation such as fens, bogs and peat (Wiken, 1986). These surfaces are typically highly

absorbent, usually poorly drained and have a high groundwater table that is at or near the ground surface following the spring snowmelt or major storm events. The runoff from these watersheds is therefore anticipated to have the following characteristics:

- Surface water runoff will not be the only dominant contribution to watershed runoff - interflow (i.e., subsurface flow) and groundwater contributions could be significant due to water retention in the watershed;
- Routing of storm events in the watershed will be over a longer period than if only surface runoff was the dominant contributor to watershed runoff; and
- Dominant loss of water in a watershed will be evapotranspiration due to the long water retention time and the expected high groundwater table.

Ice Regime

Ice cover on small watercourses or waterbodies usually begins in shallow calm areas along the shore, where a thin layer of ice or sheet ice develops. In watercourses or waterbodies, turbulence and wind-induced waves may continually disturb the surface before freeze-up and delay or prevent the formation of sheet ice or border ice. In these areas, frazil ice particles tend to form and these adhere to one another to form frazil slush and frazil pans. With further cooling, the concentration of the frazil pans, frazil slush and broken sheet ice becomes high enough to dampen the effects of turbulence and waves to permit the initial formation of a solid ice cover.

After the initial formation of the ice cover, it starts to grow from the underside as a result of freezing air temperatures to form a clear transparent sheet of ice or black ice. Ice growth is sometimes terminated by a snowfall of sufficient weight to submerge the ice. The lower layers of the snow become wet and limit further heat loss from the ice cover to the atmosphere until the wet snow is frozen. The ice formed in this way is called white ice or snow ice. Ice may ultimately reach the bottom of shallow watercourses and waterbodies.

The decay of ice begins with the melting of the snow cover on the ice and the ice near the shore. The ice cover is also melted from the bottom by the contact of warm lake water vertically mixed by waves and lake currents. The processes of ice melt and mechanical disintegration continue until the ice melts entirely.

Mean ice thickness is expected to be between 0.75 and 1 m in lakes and rivers in the area of the project site (Allen, 1977). The freeze-over date is expected to be early to mid November, while the ice-free date would occur by mid April (Allen, 1977).

APPENDIX 7.4-B

Watershed and Sampling Site Descriptions

WILLIAM RIVER WATERSHED DESCRIPTION

The Minago Project is located in the northeast portion of the William River watershed. The portion of the watershed contributing runoff to the downstream monitoring site on the William River (WRW1X) is approximately 1,139 square kilometres (Golder Associates, 2009). Lakes are common in the William River watershed. There are several relatively small lakes and two large lakes, William Lake and Little Limestone Lake, in the western portion of the watershed. The total area of lakes is approximately 151 square kilometres or approximately 13 percent of the watershed area (Golder Assoicates, 2009). The watershed contains boreal forest vegetation, such as black spruce and tamarack, wetlands, and non-forested areas with shrubs and grasses.

Soil survey data is not available for the Minago watershed. Soil survey reconnaissance data from The Pas (located approximately 100 kilometres west of the Project Area) as well as soils data from soil borings advanced within the Project Area, suggests that organic rich soil, such as peat, is a common soil type. Typically, these peat soils are developed over poorly draining material such as glacial till. Saturated soil conditions are common, with varying degrees of standing water and hydrophytic vegetation.

William River headwaters are predominately from two lakes, William Lake and Little Limestone Lake. William River has a relatively low gradient and is a highly sinuous channel, with an average water surface slope of approximately 0.001 metre/metre between WRW2X and WRW1X (URS, 2008a). The channel banks and bed consist of silt and clay sized material, with some undercut banks and banks sloughing on the outside of meander bends. Beaver activity was not observed in the vicinity of the William River/Oakley Creek confluence; however, beaver activity was observed during aerial reconnaissance several kilometres upstream from WRW2X on William River.

WRW1X

Monitoring site WRW1X is located approximately 100 m downstream from the William River/Oakley Creek confluence (Photo A7.4.1). WRW1X staff gage and pressure transducer installation, and cross section site selection, were completed in July 2007. The stream reach is straight, and the cross section is relatively uniform. The stream banks are vegetated with a mixture of spruce trees mixed with willow and alder brush. The streambed material at the cross section consisted of silt and clay material. The staff gage and pressure transducer stilling well were installed on the left side of the river, facing downstream (URS, 2008a).

WRW2X

Monitoring site WRW2X is located several kilometres upstream from the confluence with Oakley Creek. WRW2X staff gage and pressure transducer installation, and cross section site selection were completed in July 2007. The streambed at the cross section consisted of silt and clay, and the streambank vegetation was a mixture of spruce trees mixed with willow and alder brush.

Source: URS, 2008a

Photo A7.4.1 Monitoring Location WRW1x

WRAOC

Monitoring site WRAOC was established on William River approximately 50 m upstream from the Oakley Creek confluence in October 2007. WRAOC staff gage and pressure transducer stilling well were installed on the left side of the river, facing downstream. The streambed at the cross section consisted of silt and clay, and the streambank vegetation was a mixture of spruce trees mixed with willow and alder brush.

William River at Road

Monitoring site WRAR (William River at Road) was established on William River approximately 100 m upstream from Highway 6 in May 2008. WRAR staff gage and pressure transducer stilling well were installed in August 2008 on the left side of the river, facing downstream. The streambed at the cross section consisted of silt, clay, and gravel, and the streambank vegetation was a mixture of spruce trees mixed with willow and alder brush.

OAKLEY CREEK WATERSHED DESCRIPTION

A total of four monitoring sites were established on Oakley Creek. The sites were selected to develop baseline hydrologic conditions upstream and downstream of the Minago Project so that potential impacts from the proposed mine can be evaluated.

The Minago Project is partially located within the Oakley Creek sub-basin of the William River watershed. The portion of the sub-basin contributing runoff to OCW1 is approximately 123 square kilometres, and there are no lakes within the sub-basin (Golder Associates, 2009). The watershed contains boreal forest vegetation, such as black spruce and tamarack, wetlands, and non-forested areas with shrubs and grasses.

OCW-1 / OCW1

OCW-1 is located on the westside of Highway 6 and receives drainage from Oakley Creek and the ditches along Highway 6 (Wardrop, 2007).

Monitoring site OCW1 is located approximately 100 metres downstream from the Highway 6 culverts (Photo A7.4.2). OCW1 staff gage and pressure transducer installation, and cross section site selection, were completed in July 2007. The stream reach is straight and the cross section is uniform. The stream banks are vegetated with a mixture of spruce trees mixed with willow and alder brush. The streambed material at the cross section consisted of gravel and rocks. The staff gage and pressure transducer stilling well were installed on the left side of creek, facing downstream (URS, 2008a).

OCW2 and OCW3

Monitoring site OCW2 is located several kilometres upstream from the Highway 6 crossing (Photo A7.4.3). OCW2 staff gage and pressure transducer installation, and cross section site selection, were completed in July 2007. Oakley Creek is highly sinuous and incised channel in the vicinity of OCW2. The streambed at the cross section consisted of silt material with a high organic content and some grass growing on the channel bottom. The streambanks were somewhat undercut and covered with grass vegetation. Saturated soil conditions and standing water were encountered outside the channel banks in July 2007, possibly due to recent rain events. The floodplain contained a mixture of wetland vegetation with alder and willow brush. The staff gage and pressure transducer stilling well were installed on the right side of the creek.

Monitoring site OCW3, established in May 2007, is located on a small tributary channel approximately 250 metres upstream from OCW2. The channel conditions at OCW3 were similar to those described above for OCW2; however, the channel at OCW3 was much shallower (~0.2 m) than at OCW2 (> 1.5 m).

OCAWR

Monitoring site OCAWR was established in October 2007 and is located approximately 50 metres upstream from the Oakley Creek/William River. Oakley Creek is highly sinuous upstream from OCAWR, and the surrounding vegetation consisted of spruce forest with some alder and willow brush on the streambanks. The streambed consisted of silt and clay sized material. The pressure transducer and staff gage were installed on the right bank, facing downstream.

Source: URS, 2008a

Photo A7.4.2 Oakley Creek monitoring site OCW1

Source: URS, 2008a

Photo A7.4.3 Oakley Creek monitoring site OCW2

MINAGO RIVER WATERSHED DESCRIPTION

The Minago River watershed lies to the north of the Minago Project. The portion of the watershed contributing runoff to the downstream monitoring site on the Minago River (MRW1) is approximately 716 square kilometres (Golder Associates, 2009). Within this portion of the watershed, there are five relatively small lakes that total approximately 4.5 square kilometres, less than one percent of the watershed area. The watershed contains boreal forest vegetation, such as black spruce and tamarack, wetlands, and non-forested areas with shrubs and grasses (URS, 2008a).

The Minago River has a relatively low gradient and highly sinuous channel, with an average water surface slope of approximately 0.00047 metre/metre between MRW2 and MRW1 (URS, 2008a). Between MRW2 and MRW1, the river flows through Habiluk, Gladish and Wigle Lakes. The channel banks and bed consist of silt and clay sized material, with some undercut banks and bank sloughing on the outside of meander bends. In the vicinity of MRW2, beaver dams are common within the channel.

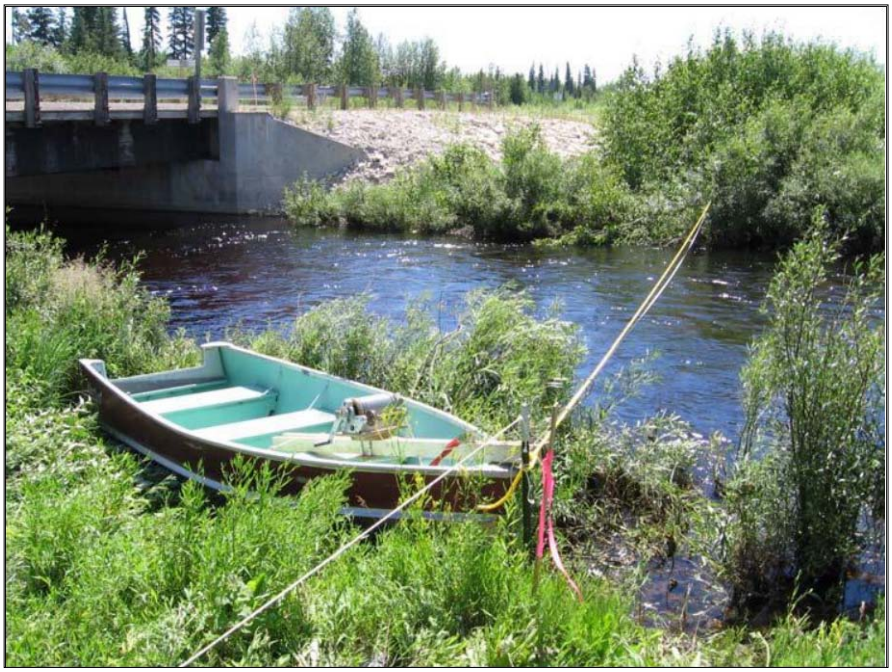
MRW1

Monitoring site MRW1 is located on the upstream side of the Highway 6 Bridge crossing (Photo A7.4.4). MRW1 staff gage and pressure transducer installation, and cross section site selection, were completed in July 2007. The stream reach is straight, transitioning into a large pool approximately 75 metres downstream. The cross section is uniform, with dense willow and alder brush on each stream bank. The staff gage and pressure transducer stilling well were installed on the west (upstream) side of the north bridge abutment.

MRW2 / MRW2x

The transducer initially, deployed at MRW2 in July 2007, had recorded limited data by August 2007. Therefore, that transducer was replaced in August 2007 and then downloaded in September 2007.

During the September 2007 site visit, it was noticed that a new beaver dam had been built across the channel just downstream of the MRW2 monitoring site (Photos A7.4.5 and A7.4.6). Due to the beaver activity, it was decided that changing the location of the monitoring site was necessary. Therefore a new site, MRW2X, was established approximately 100 metres downstream of MRW2.



Source: URS, 2008a

Photo A7.4.4 Minago River monitoring site MRW1 on the upstream side of the Highway 6 Bridge crossing

Photo A7.4.5 Minago River monitoring site MRW2 on May 8, 2008

Photo A7.4.6 Minago River monitoring site MRW2x on May 8, 2008

HARGRAVE RIVER MONITORING SITE DESCRIPTION

Monitoring site HRW1 is located on the upstream side of the Highway 6 Bridge several kilometres north of the Minago Project. The bridge consists of 3 relatively large rectangular concrete culverts (Photo A7.4.7). HRW1 staff gage and pressure transducer installation were completed in July 2007, and were attached to the west side of the northern concrete abutment.

The pressure transducer at HRW1 was mounted near the bottom of a concrete abutment because the stream bed at the discharge monitoring site was either concrete or rip rap, which prevented installation of a post for mounting the transducer stilling well. This limited the range of the installation height for the transducer. The transducer was above the water level at the time of the August 2007 site visit, and was lowered so that it was submerged. The stream stage continued to drop, and the transducer was above the water level again at the time of the September 2007 site visit. The stage had risen by the time of the October 2007 site visit, and the transducer was moved and lowered by URS (URS, 2008a). Upon review of the transducer data, it appears that the transducer was out of the water for the complete 2007 monitoring period. Thus, only monthly water surface water elevations and discharge measurements were recorded from July to October 2007.

In May 2008, the transducer was moved again as the stilling well for the transducer at its October 2007 location had been broken and washed away during the 2008 spring freshet. The HRW1 transducer and its stilling well were reinstalled at its July 2007 coordinates but at the lowest elevation possible on May 9, 2008 by KR Design Inc. and Tom Bercier.

Photo A7.4.7 Hargrave River at monitoring site HRW1

APPENDIX 7.4-C

Streamflow Estimates based on Transducer Measurements

Source: adapted from Golder Associates, 2009

General Characteristics of Hydrometric Stations with Pressure Transducers

Drainage Network	Station	Description	Watershed Surface Area (km^2)	Northing	Easting	Period of Record of the Transducer	Comments
Hargrave River	HRW1	Hargrave at Highway 6	1511.7	6028072	495606	23-Jul-07 to 1-Nov-07, 9-May-08 to 6-Aug-08	Pressure transducer at the bridge abutment at Highway 6.
Minago River	MRW1	Minago at Highway 6 (Alloway Lake outlet)	715.7	6005277	488671	15-Aug-07 to 4-Nov-07, 8-May-08 to 3-Aug-08	Pressure transducer at the bridge abutment at Highway 6. A second channel might be active during period of high flow.
	MRW2/2x	Minago upstream of Habiluk Lake	213.7	6001166	472571	15-Aug-07 to 4-Nov-07, 9-May-08 to 6-Aug-08	A beaver dam was observed after the installation of the station. The station was eventually moved.
	MRW3	Minago downstream of Highway 6, near power line	784.6	6007895	494274	None	No water level/streamflow data available
Oakley Creek [1]	OCW1	Oakley downstream of Highway 6	123.4	5990510	489322	27-Jul-07 to 4-Nov-07, 10-May-08 to 17-Aug-08	The station is installed 100 m downstream of a culvert.
	OCW2	Oakley near mine site	92.6	5990961	487463	23-Jul-07 to 30-Nov-07, 11-May-08 to 16-Aug-08	Shallow stream with a very wide floodplain.
	OCAWR	Oakley upstream of confluence with William River	302.9	5986744	498457	17-Oct-07 to 5-Nov-07, 8-May-08 to 3-Aug-08	Within a well defined channel.
William River	WRW1x	William downstream of confluence with Oakley Creek	1138.7	5986554	498523	23-Jul-07 to 4-Nov-07, 8-May-08 to 18-May-08, 3-Aug-08 to 14-Aug-08	Within a well defined channel.
	WRW2x	William upstream of station WRAOC	815.2	5987162	495416	23-Jul-07 to 15-Sep-07	Not enough data available to derive streamflow yet.
	WRAOC	William upstream of confluence with Oakley Creek	835.8	5986647	498452	Broken transducer; new one installed in Aug 08	Within a well defined channel. No water level/streamflow data available yet.
	WRAR	William at Highway 6	654.1	5973791	485078	Installed in Aug 08	No water level/streamflow data available yet.

1. The Oakley Creek drainage network is within that of William River.

Formulations between Pressure Transducers, Staff Gauge and Streamflow Observations

Station [1]	Staff Gauge (y in m) Versus Pressure Transducer (x in m) [2]	Streamflow Observation (z in m^3/s) Versus Staff Gauge (y in m)
HRW1	Formulation from 1 point: $y = x + 0.033$ Maximum observed water level on staff gauge: 0.36 m	Formulation from 2 points: $z = 8.23y^{0.39}$ Maximum observed streamflow: 6.6 m^3/s
MWR1	Formulation from 3 points: $y = 0.99x + 0.066$ Maximum observed water level on staff gauge: 0.43 m	Formulation from 4 points: $z = 29.6y^{2.54}$ Maximum observed streamflow: 3.7 m^3/s
MWR2/2x	Formulation from 2 points: $y = 1.10x$ Maximum observed water level on staff gauge: 0.38 m	Formulation from 2 points: $z = 2.62y$ Maximum observed streamflow: 1.3 m^3/s
OCW1	Formulation from 9 points: $y = 0.83x + 0.11$ Maximum observed water level on staff gauge: 0.24 m	Formulation from 9 points: $z = 7.17y^{1.44}$ Maximum observed streamflow: 0.95 m^3/s
OCW2	Formulation from 3 points: $y = 0.73x$ Maximum observed water level on staff gauge: 0.38 m	Formulation from 4 points: $z = 1.68y^{0.81}$ Maximum observed streamflow: 1.5 m^3/s
OCAWR	Formulation from 2 points: $y = 1.12x + 0.15$ Maximum observed water level on staff gauge: 0.98 m	Formulation from 2 points: $z = 2.64y^{1.68}$ Maximum observed streamflow: 2.6 m^3/s
WRW1x	Formulation from 3 points: $y = 0.98x + 0.087$ Maximum observed water level on staff gauge: 0.75 m	Formulation from 4 points: $z = 8.27y^{1.02}$ Maximum observed streamflow: 12.8 m^3/s

1. No water level or streamflow can be derived from stations MRW3 and WRAOC. As well, streamflow cannot be derived at station WRW2x and only relative depth from the transducer can be obtained at that station in terms of water level.
2. Variable x represents the height of water (in m) and is calculated from water density and the difference between the absolute pressure measured from the transducer and atmospheric pressure.

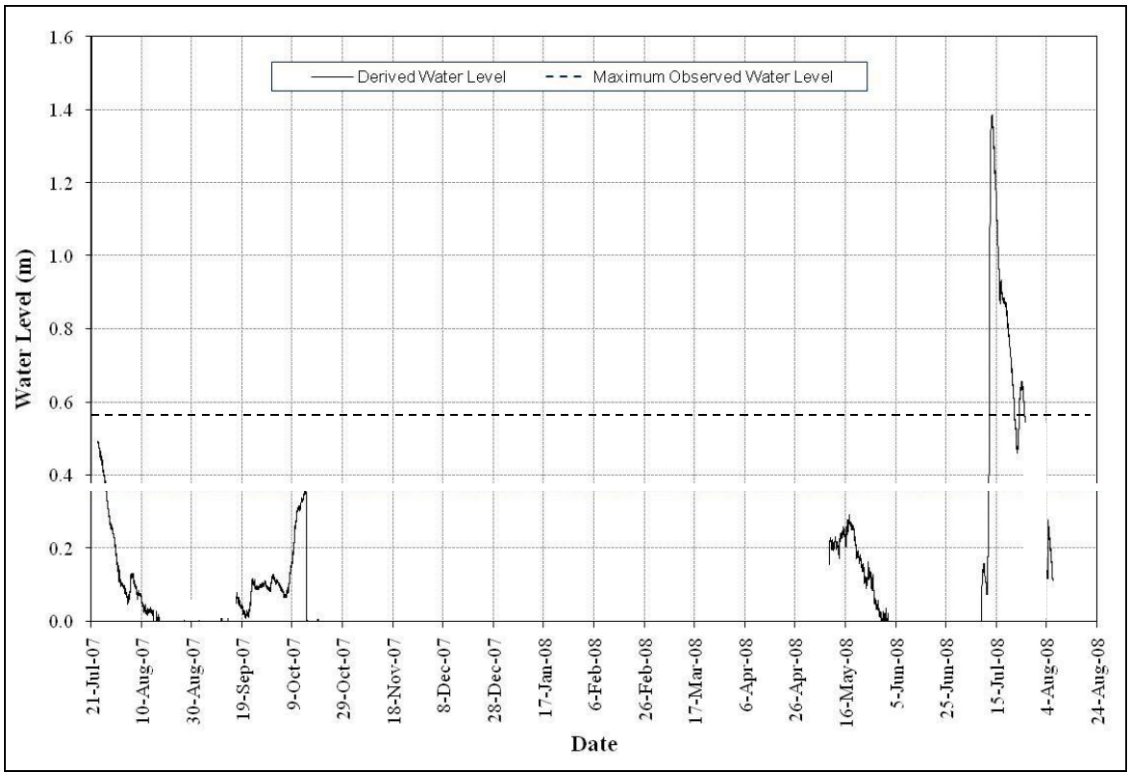


Figure I.1: Water Level Derived at Station HRW1

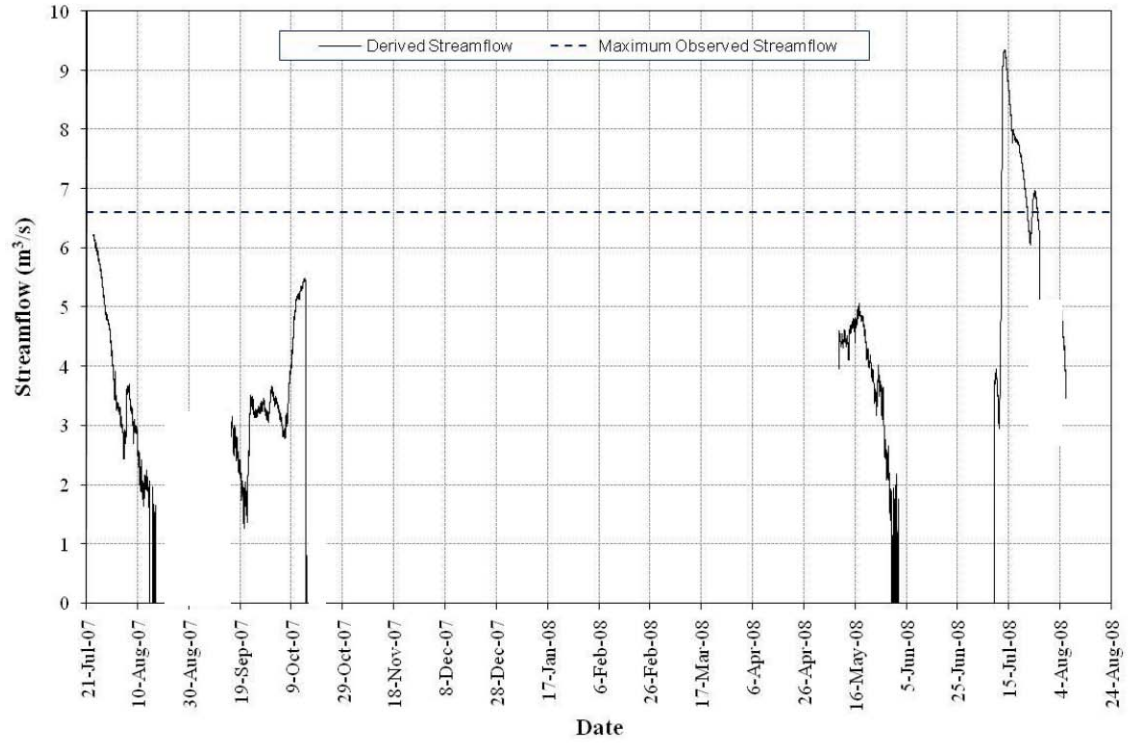


Figure I.2: Streamflow Derived at Station HRW1

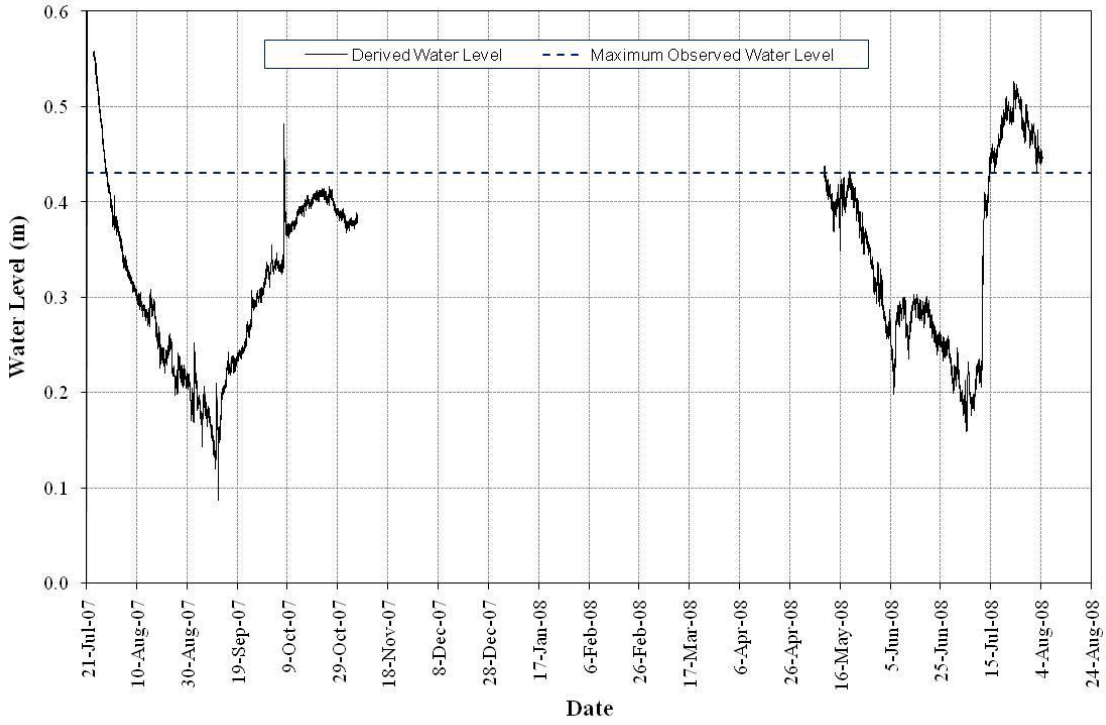


Figure I.3: Water Level Derived at Station MRW1

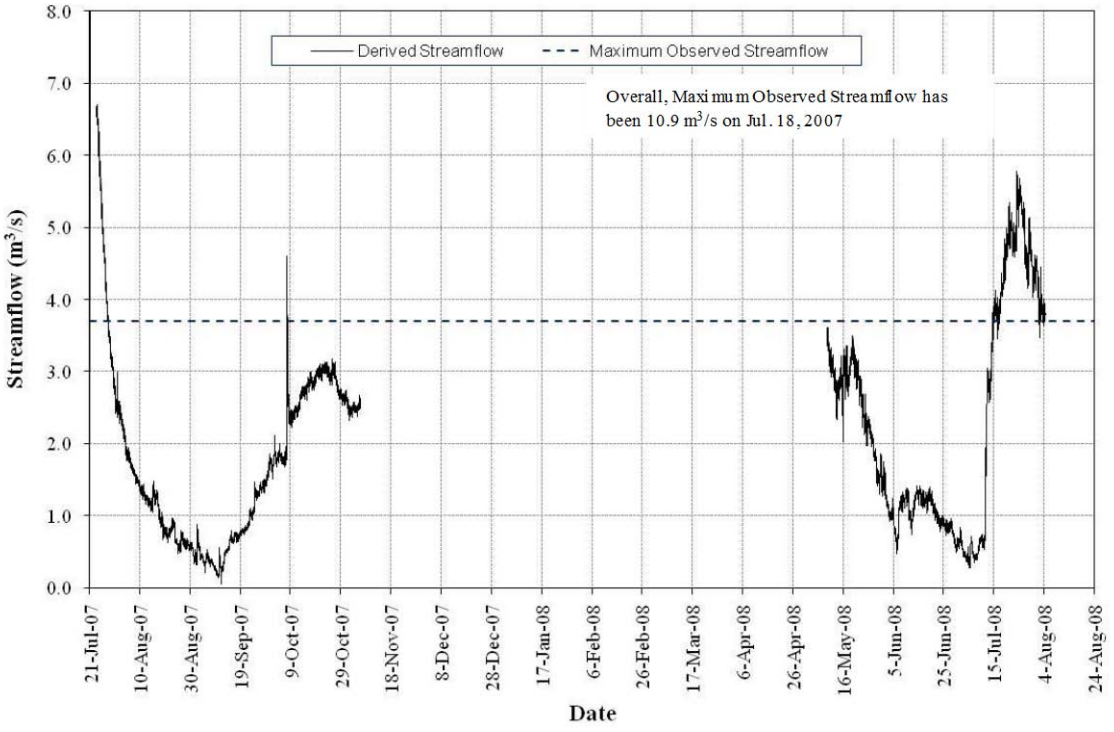


Figure I.4: Streamflow Derived at Station MRW1

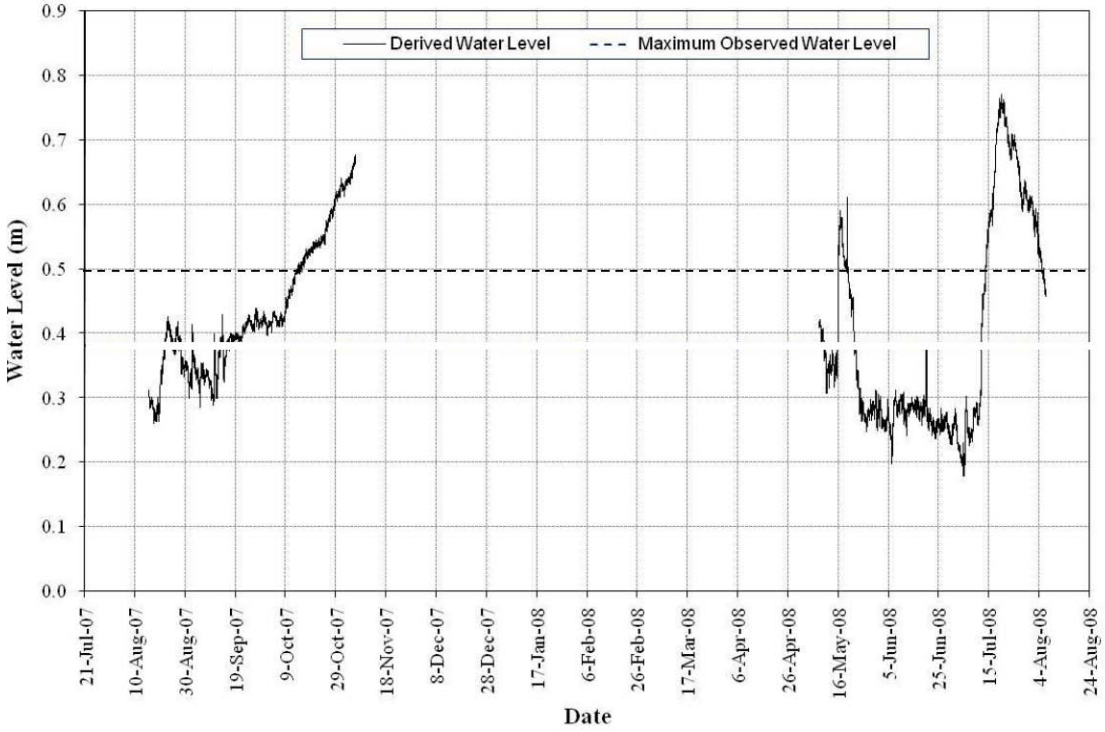


Figure I.5: Water Level Derived at Station MRW2/2x

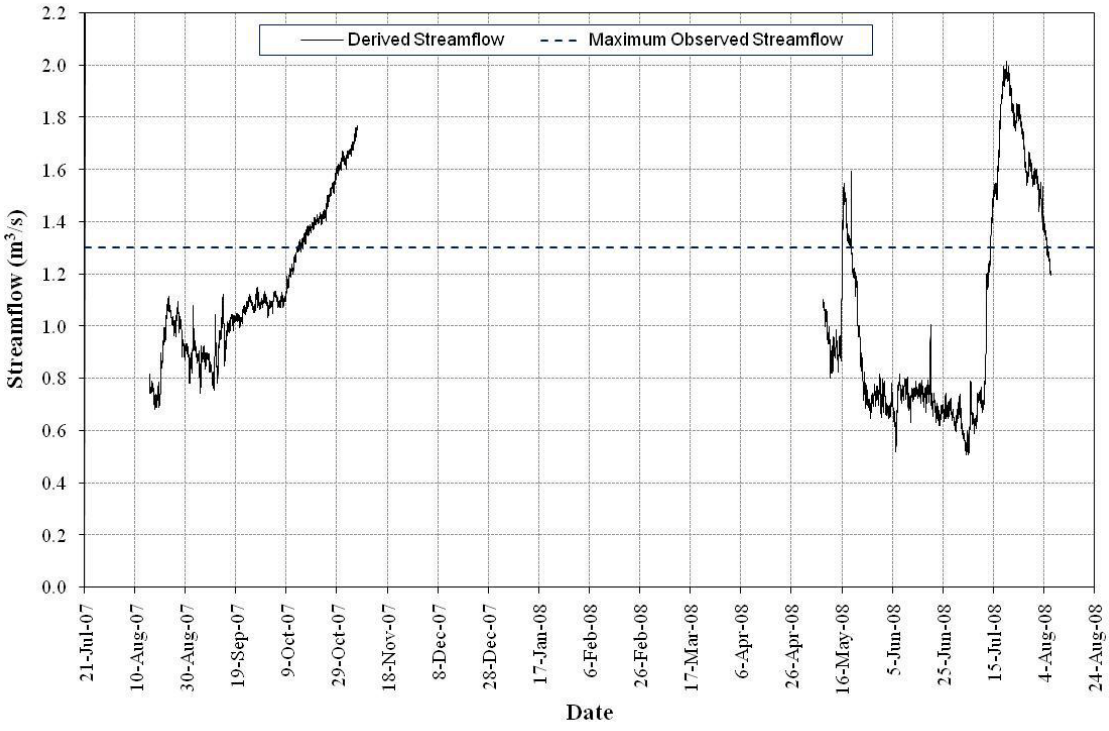


Figure I.6: Streamflow Derived at Station MRW2/2x

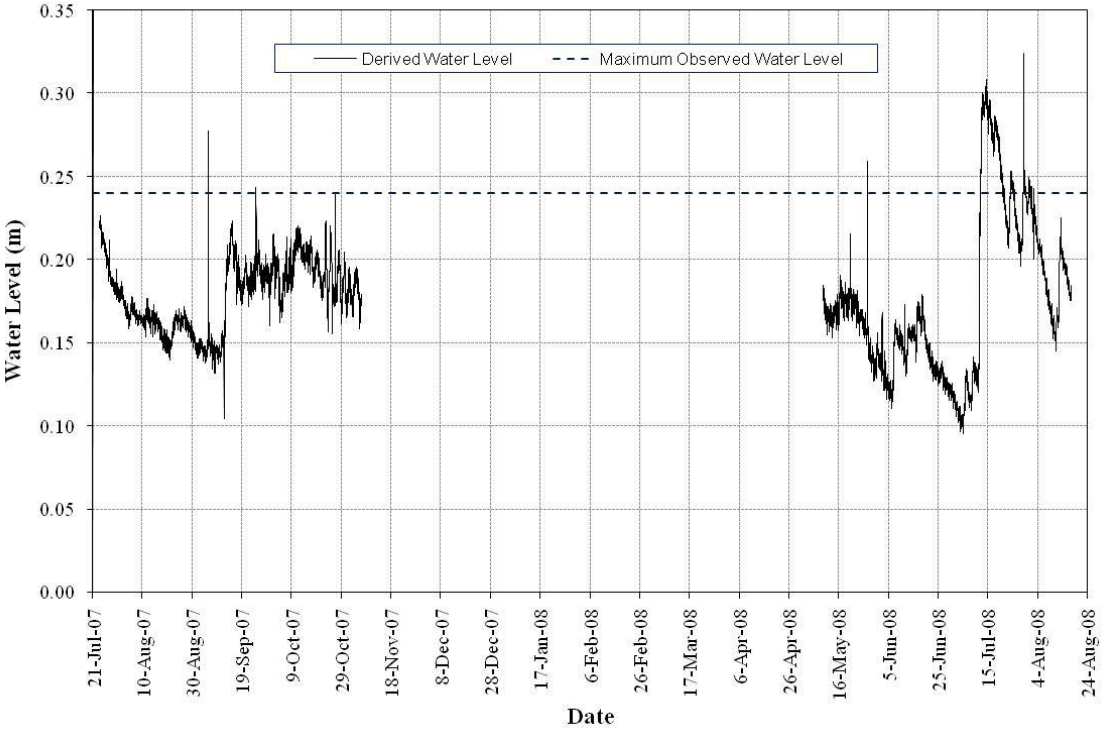


Figure I.7: Water Level Derived at Station OCW1

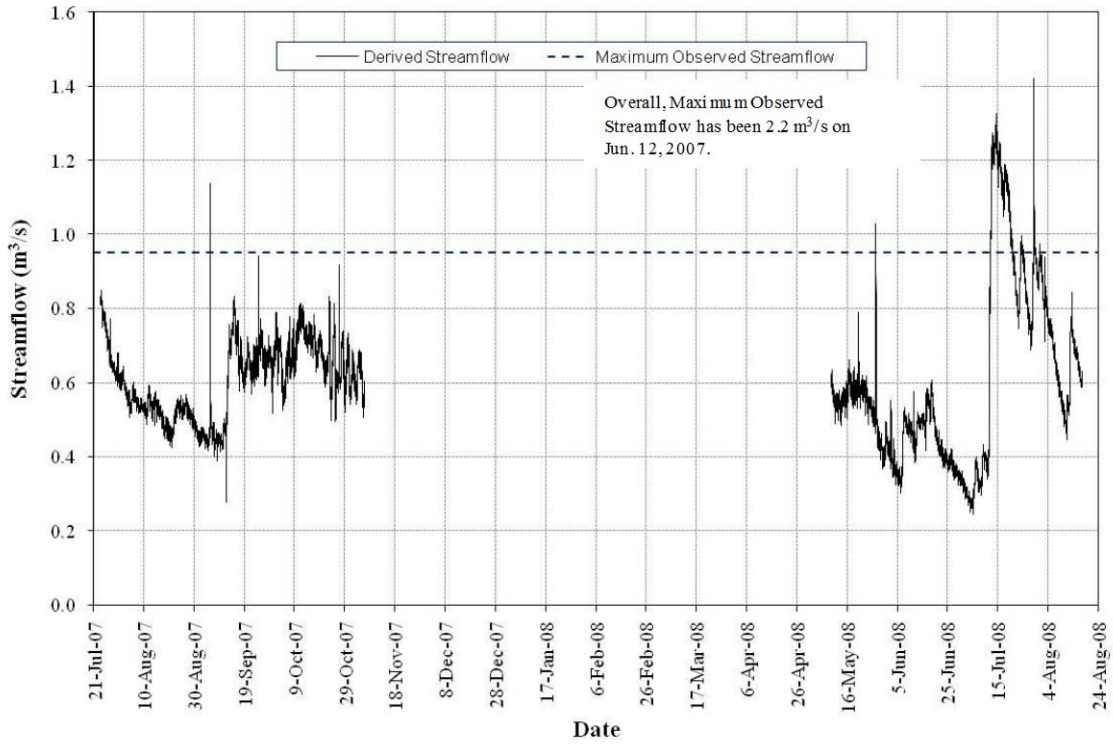


Figure I.8: Streamflow Derived at Station OCW1

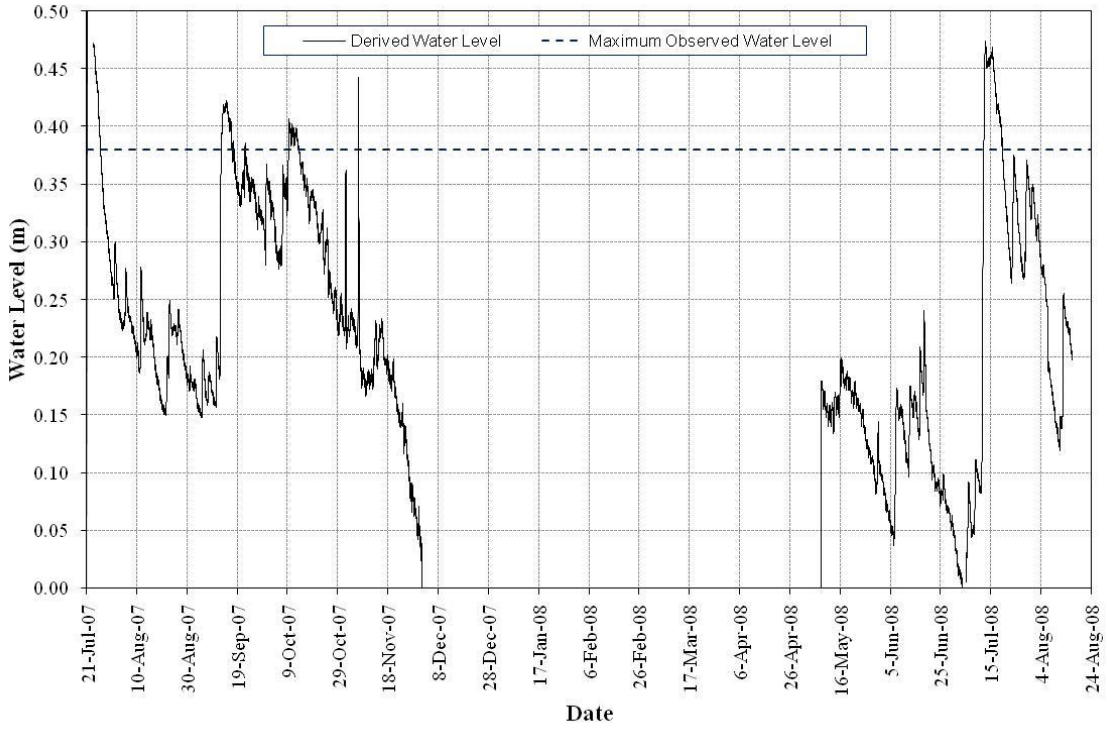


Figure I.9: Water Level Derived at Station OCW2

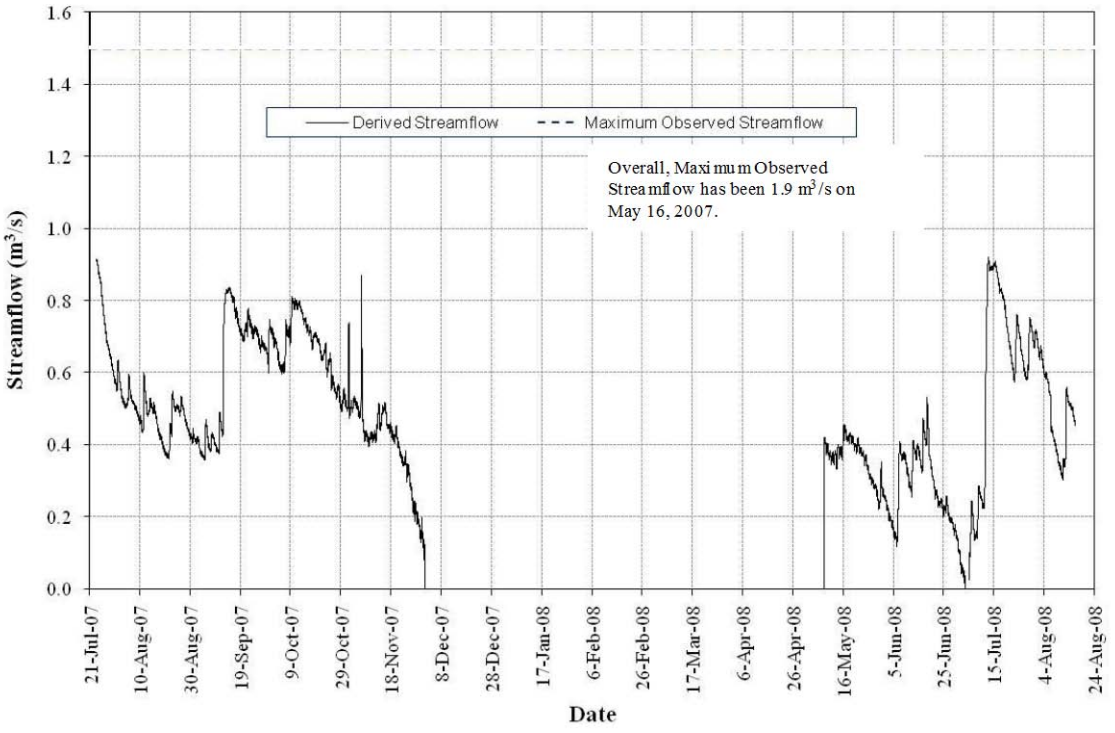


Figure I.10: Streamflow Derived at Station OCW2

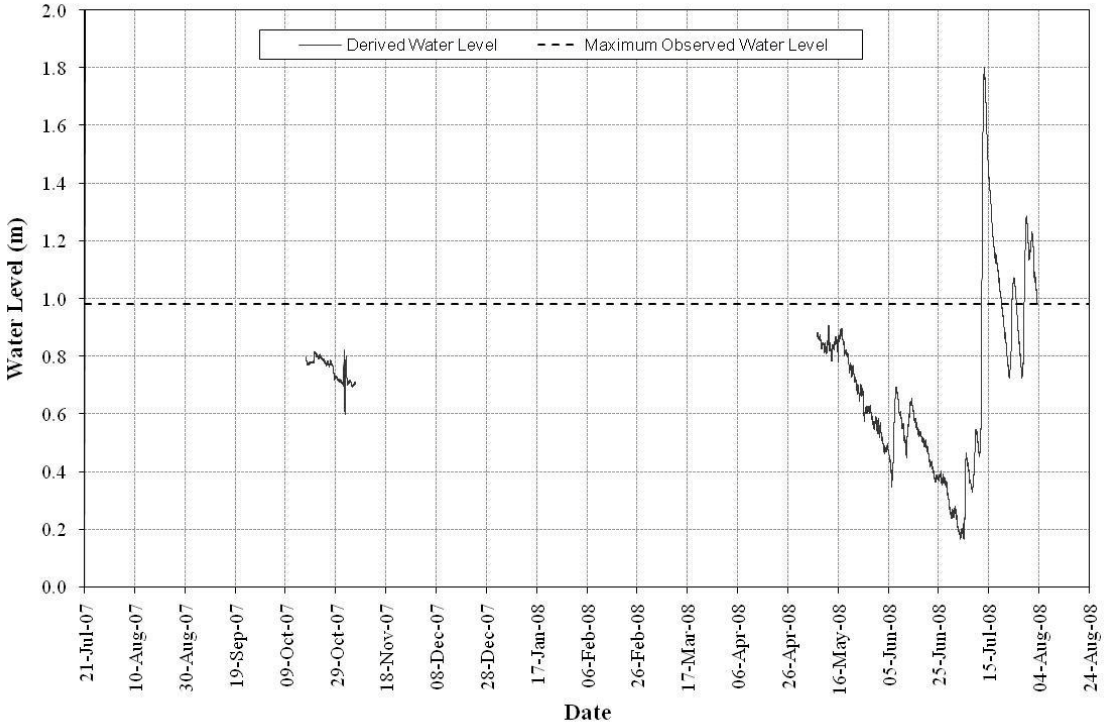


Figure I.11: Water Level Derived at Station OCAWR

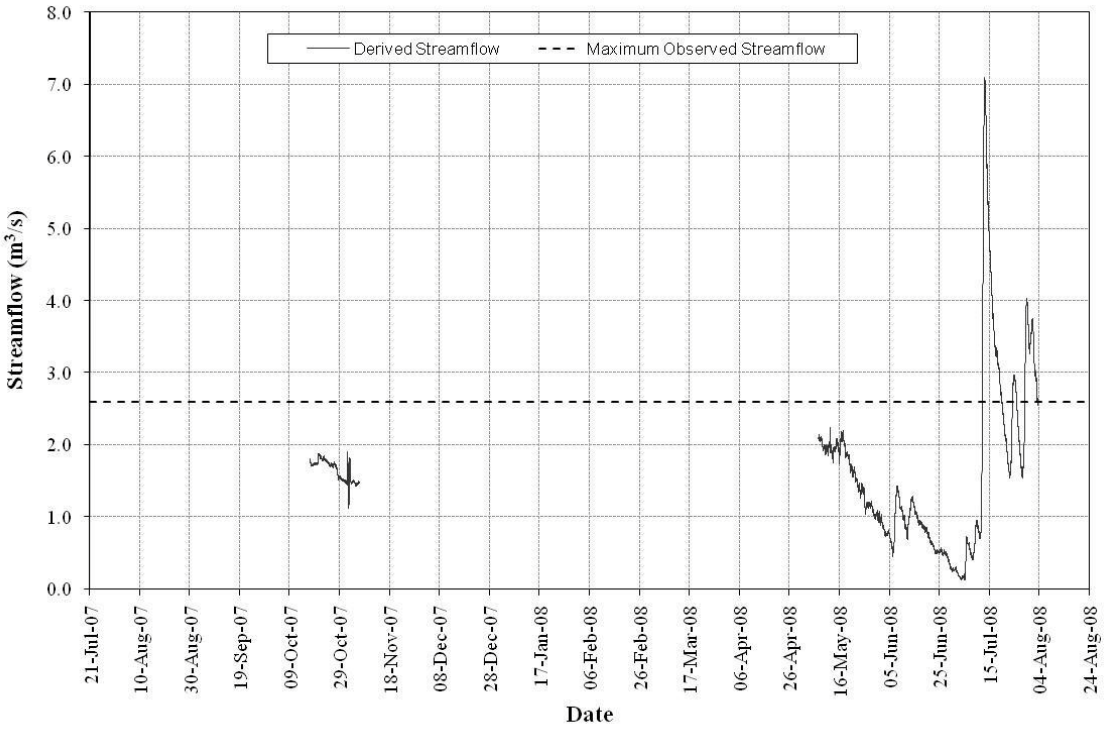


Figure I.12: Streamflow Derived at Station OCAWR

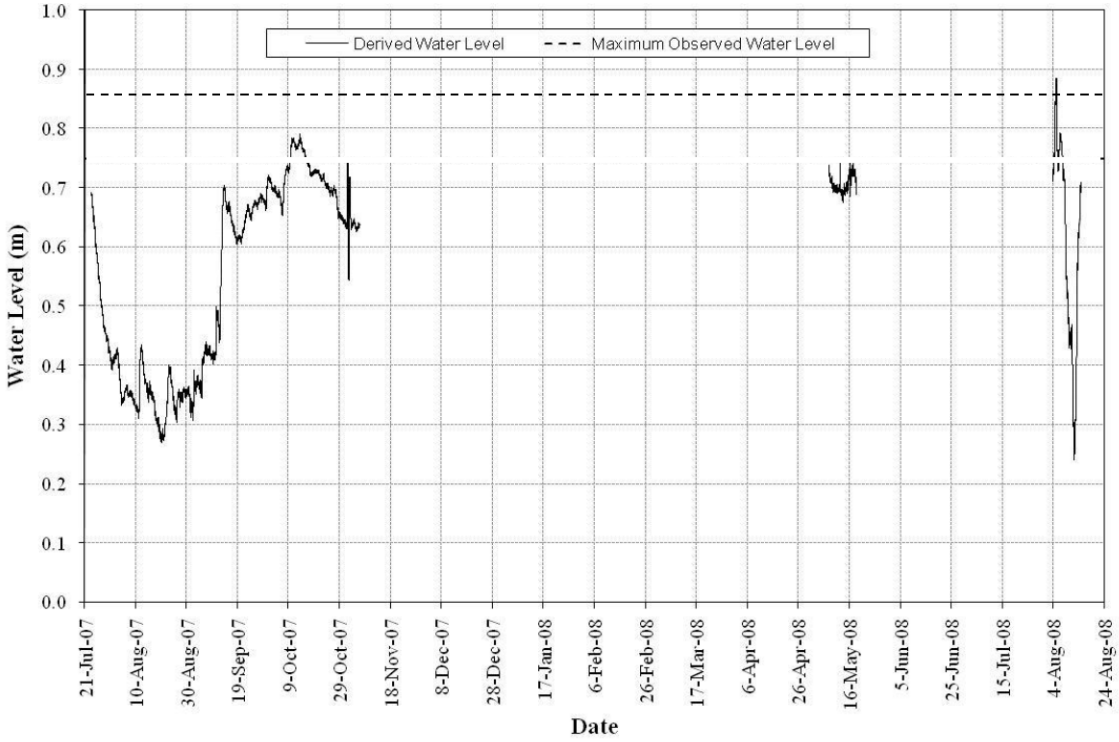


Figure I.13: Water Level Derived at Station WRW1x

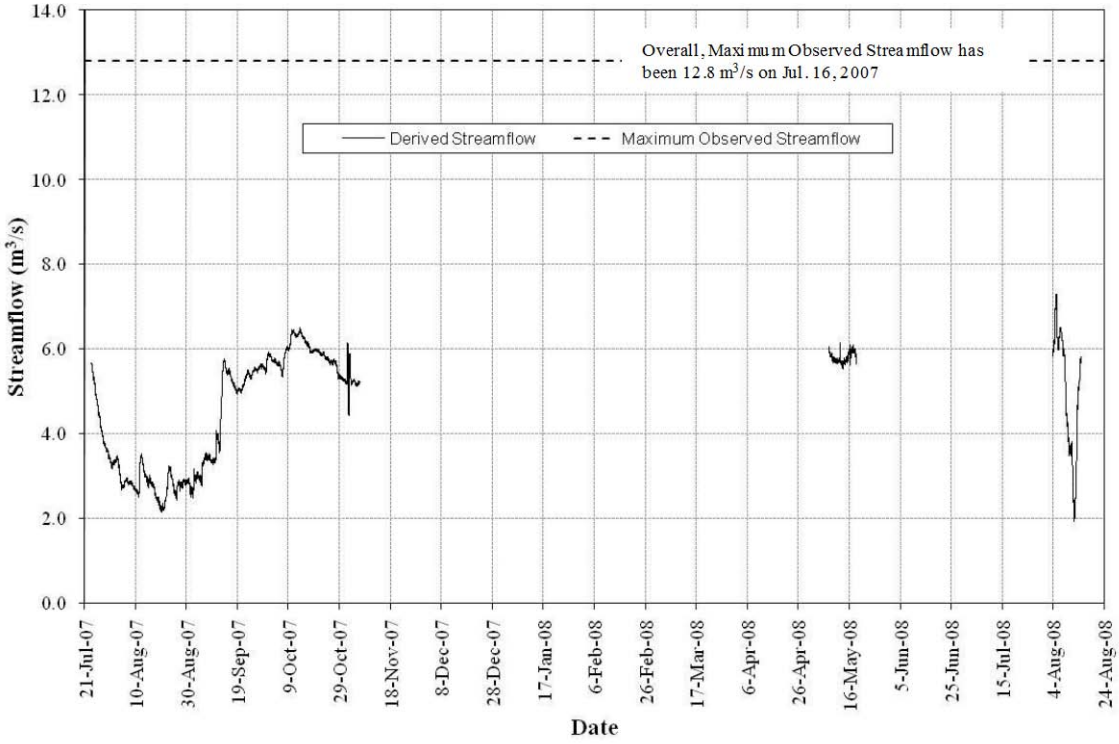


Figure I.14: Streamflow Derived at Station WRW1x

APPENDIX 7.4-D

Summary of Manual Discharge Measurements

Results Discharge Measurements at Minago

Sampling Location & NAD 83 GPS Coordinates (m)	Date and Time		Water Surface Elevation (Source:URS 2008 Report) (m A.S.L.)	Discharge (m^3/s)	Average Velocity (m/s)	Staff Gauge Reading (m)	Transducer S/N or Datalogger Name	Comments
William River at Road								
N 5973791	10-May-08	15:30	NA	3.19	0.25	none installed		
E 485078	5-Aug-08	12:45	NA	2.00	0.13		1146334	A tranducer & staff gauge were installed on Aug. 5, 2008 (18:00).
WRW1x								
(prior to Sept. 15, 2007 called WRW2)	16-Jul-07	16:30	222.00	12.8	0.5		'LowerWilliamRiverBelowOC.WRXS-2'	
N 5986554	14-Aug-07	17:55	221.09	3.2	0.3			
E 498523	15-Sep-07	16:44	221.41	NA	NA	0.675		
	15-Oct-07	17:02	221.48	5.2	0.3		1146327	
	7-May-08	18:20	221.52	NA	NA	0.78	1146331	
	3-Aug-08	14:30	221.60	6.12	0.203	0.86	1146331	
WRW2x								
(prior to Sept. 15, 2007 called WRW1)	16-Jul-07	12:52	NA	5.6	0.4		'WRXS-1'	
N 5987162	15-Aug-07	10:39	NA	2.3	0.3		'WRXS-1'	
E 495416	15-Sep-07	17:20		NA	NA	0.045	'WRXS-1'	
WRAOC								
	16-Oct-07	13:40	NA	3.4	0.3		1146330	
N 5986647	7-May-08	13:40		3.82	0.26	0.68	1146339	
E 498452	3-Aug-08	12:30		3.79	0.20	0.76	1146339	
OCW-1	22-Aug-06	NA		0.08				
	19-Sep-06	NA		0.2				
N 5990528	12-Oct-06	NA		0.62				
E 489238								
OCW1								
	14-May-07	NA	NA	1.2	1.3		'Oakley Below Highway'	
N 5990510	12-Jun-07	NA	NA	2.2	1			
E 489322	17-Jul-07	17:55	239.97	1.7	1.4			
	13-Aug-07	17:21	239.85	0.3	0.7			
	11-Sep-07	15:53	NA	0.3	0.6			
	14-Oct-07	15:00	239.88	0.7	1	0.16		
	10-May-08	13:50		0.67	0.75	NA	1146341	
	2-Aug-08	14:10		0.95	0.88	0.24	1146341	
	4-Aug-08	17:10		NA	NA	0.23	1146341	
OCW2								
	16-May-07	NA	NA	1.9	0.4			
N 5990961	12-Jun-07	NA	NA	0.7	0.3			
E 487463	15-Jul-07	14:52	245.20	1.5	0.3			
	15-Aug-07	13:00	244.60	0.3	0.1			
	16-Oct-07	12:15	244.77	NA	NA	0.38		
	8-May-08	10:45		0.51	0.16	0.16	'OCXS-2'	
	6-Aug-08	16:40		0.54	0.14	0.21	'OCXS-2'	
OCW3							no transducer	
	16-May-07	NA	NA	0.2	0.3	none installed		
N 5990892	12-Jun-07	NA	NA	0.1	0.2	none installed		
E 487230	15-Aug-07	10:10	NA	0.1	0.2	none installed		
	16-Oct-07	11:45	NA	0.1	0.2	none installed		
	8-May-08	12:30	NA	0.03	0.08	none installed		
	6-Aug-08	15:30	NA	0.05	0.14	none installed		
OCAWR								
	16-Oct-07	15:40	NA	1.7	0.2		'Oakley Creek above William R. Confluence'	
N 5986744	7-May-08	16:10		2.09	0.18	0.87	1136966	
E 498457	3-Aug-08	11:30		2.55	0.17	0.98	1136966	
MRW-1	22-Aug-06	NA		0.31				
	19-Sep-06	NA		1.12				
N 6005275								
E 488684								
MRW1								
	15-May-07	NA	NA	8.1	1.1		'Minago at Bridge'	
N 6005277	13-Jun-07	NA	NA	2.9	0.7			
E 488671	18-Jul-07	14:40	226.61	10.9	1.1			
	13-Aug-07	15:20	226.20	1.3	0.3			
	11-Sep-07	13:58	226.06	0.2	0.1	0.14		
	14-Oct-07	13:18	226.30	2.4	0.5	0.38	1146333	
	10-May-08	13:00		3.44	0.55	0.425	1146333	
	4-Aug-08	14:20		3.73	0.60	0.44	1146333	

Results Discharge Measurements at Minago

Sampling Location & NAD 83 GPS Coordinates (m)	Date and Time	Water Surface Elevation (Source:URS 2008 Report) (m A.S.L.)	Discharge (m^3/s)	Average Velocity (m/s)	Staff Gauge Reading (m)	Transducer S/N or Datalogger Name	Comments
MRW2							
	23-Jul-07 12:53	233.24	1.3	0.2		'Upper Minago Above Lake Barometric'	
N 6001212	15-Aug-07 10:39	233.11	0.4	0.1			
E 472476	15-Sep-07 19:00	233.21	NA	NA	0.38		
	16-Oct-07 16:00		NA	NA	0.50	1146323	Staff gauge reading not representative of stream conditions, transducer is located in beaver pond upstream of two beaver dams.
	8-May-08 14:45		NA	NA	0.45	1146323	Staff gauge reading not representative of stream conditions, transducer is located in beaver pond upstream of two beaver dams.
	6-Aug-08 18:00		NA	NA	0.50	1146323	Staff gauge reading not representative of stream conditions, transducer is located in beaver pond upstream of two beaver dams.
MRW2x							
N 6001166	16-Oct-07 15:08	NA	0.8	0.2	none installed		Approximately 100 m downstream of MRW2.
E 472571	8-May-08 15:00		0.40	0.12	none installed		
	6-Aug-08 18:30		1.07	0.19	0.274	1275859	A transducer & staff gauge were installed on Aug. 6, 2008 (19:00).
HRW1							
	22-Jul-07 16:19	230.23	7	0.60		'Hargrave at Bridge'	Transducer was out of water for the following periods::
N 6028072	13-Aug-07 11:05	229.68	2.6	0.40			Aug. 8, 2007 to Sept. 13, 2007
E 495606	11-Sep-07 11:25	229.45	1.6	0.30	-0.165		Oct. 14, 2007 to Oct. 20, 2007
	14-Oct-07 11:19	229.98	5.5	0.40	0.36	1136967	Jul.27, 2008 to Aug. 5, 2008
	9-May-08 13:30		6.55	0.47	0.56	1136967	
	6-Aug-08 14:00		NA	NA	0.48	1136967	
Barometric Pressure Sensor							
OCW1 - Barometric						'MInago Barometric at Okley Below Road'	
N 5990510						1146325	
E 489322							

Note:

NA not available or not recorded

APPENDIX 7.4-E

Field Methods

FIELD METHODS USED FOR HYDROMETRIC ASSESSMENTS

Wardrop recorded streamflow velocity measurements using a Swoffer 2100 Current Velocity Meter once per month from May to October, 2006. At each survey location metre tape was stretched bank to bank, perpendicular to the channel, and eleven equally spaced measurement locations (subdivisions) were established. Mean stream flow velocity was recorded at 60% of the stream depth (0.6D) in each subdivision. Subdivision areas were plotted and areas calculated using AutoCAD 2005 (Wardrop, 2007).

URS used aerial photography and topographic maps to identify potential monitoring sites. During the site visit in July 2007, the final location of each monitoring site was selected based on helicopter access and landing zone potential, the straightness of reach and uniformity of flow, and the proximity to beaver activity (URS, 2008a). Global Positioning System (GPS) coordinates for temporary benchmarks were recorded at each monitoring site. These temporary benchmarks were tied to the mean sea level (MSL) datum by Pollack and Wright Surveyors. Staff gages, which were used to monitor water surface elevations, were installed on either the right or the left edge of the channel (when looking downstream), depending upon channel conditions. Staff gages were tied by level loop survey to the temporary benchmark. One exception, monitoring site MRW1 staff gage was surveyed to a first order benchmark located on the Highway 6 Bridge (identification number 74M059) (URS, 2008a). Pollack and Wright cross referenced the identification number and provided the elevation of the benchmark.

During each 2007 site visit, observations of the water surface elevation at each monitoring site were recorded either from staff gage readings or level loop surveys of the water surface (URS, 2008a). Discharge measurement stations were established at each monitoring site. Anchors were established on the right and left banks at each discharge measurement station, such that a tag line stretched between the anchors was perpendicular to the current. The tag line provided stationing during the discharge measurements.

Discharge was measured according to U.S. Geological Survey (USGS) standard procedures (Buchanan and Somers 1984). Either a Price AA current meter, Swoffer current meter, or a Flow Tracker current meter was used to measure velocity at selected locations within the channel. The current meter was suspended from a wadding rod. The water surface elevation was measured at the beginning and end of each discharge measurement.

The discharge (instantaneous streamflow) was calculated from the velocity, depth, and width measurements. The discharge was estimated by multiplying each subdivision area by the mean velocity measured in the subdivision and summing the resulting volumes into a total instantaneous streamflow as follows:

$$Q = \Sigma_{n=1}^{m} A_n V_n \qquad \text{[Equation 1]}$$

Where: Q is total volume of flow or instantaneous streamflow;
V_n is the velocity in the nth subdivision;
A_n is the area of the nth subdivision; and
m is the number of subdivisions.

Hydraulic roughness was estimated based on measurements of water surface slope and discharge, and normal depth computations.

APPENDIX 7.4-F

2006 Discharge Measurements

Source: Wardrop, 2007

Table 7.4-F Hydrology Data collected in Oakley Creek and the Minago River, August-October 2006

Oakley Creek (OCW-1), transects from left upstream bank to right upstream bank

	22-Aug-06					19-Sep-06					12/10/2006 [a]				
Sub-division	Distance from Streambank (m)	Water Depth, (m)	Flow Velocity (m/s)	Area (m^2)	Volume Flow (m^3/s)	Distance from Streambank (m)	Water Depth, (m)	Flow Velocity (m/s)	Area (m^2)	Volume Flow (m^3/s)	Distance from Streambank (m)	Water Depth, (m)	Flow Velocity (m/s)	Area (m^2)	Volume Flow (m^3/s)
1	0	0.15	0	0.1	0	0	0.12	0	0.1	0	0.05	0.1	0	0.08	0
2	0.7	0.4	0	0.27	0	0.72	0.55	0	0.37	0	0.9	0.25	0	0.25	0
3	1.4	0.52	0	0.35	0	1.44	0.68	0	0.47	0	1.75	0.75	0.1	0.58	0.06
4	2.1	0.45	0	0.32	0	2.16	0.6	0	0.43	0	2.6	0.73	0.13	0.62	0.08
5	2.8	0.41	0.04	0.3	0.01	2.88	0.55	0	0.41	0	3.45	0.73	0.15	0.62	0.09
6	3.5	0.55	0	0.37	0	3.6	0.71	0.05	0.5	0.02	4.3	0.75	0.18	0.65	0.12
7	4.2	0.55	0.02	0.38	0.01	4.32	0.7	0.13	0.5	0.06	5.15	0.88	0.21	0.73	0.15
8	4.9	0.45	0.09	0.32	0.03	5.04	0.62	0.06	0.45	0.03	6	0.88	0.14	0.75	0.11
9	5.6	0.45	0.08	0.32	0.03	5.76	0.58	0.14	0.42	0.06	6.85	0.93	0.01	0.77	0.01
10	6.3	0.45	0.02	0.3	0.01	6.48	0.55	0.08	0.36	0.03	7.7	0.75	0.01	0.61	0.01
11	6.9	0.32	0	0.18	0	7.2	0.12	0	0.1	0	8.55	0.28	0	0.23	0
Total	7.2			3.21	**0.08**	7.56			4.12	**0.2**	8.98			5.89	**0.62**

Minago River (MRW-1), transects from right upstream bank to left upstream bank

1	0	0.06	0	0.08	0	0	0.16	0	0.17	0
2	1.12	0.24	0	0.26	0	1.1	0.4	0.02	0.43	0.01
3	2.24	0.35	0.03	0.39	0.01	2.2	0.55	0.2	0.6	0.12
4	3.36	0.43	0.15	0.49	0.07	3.3	0.67	0.21	0.73	0.15
5	4.48	0.55	0.12	0.6	0.07	4.4	0.72	0.26	0.78	0.2
6	5.6	0.56	0.11	0.6	0.07	5.5	0.71	0.19	0.77	0.15
7	6.72	0.41	0.12	0.48	0.06	6.6	0.65	0.22	0.72	0.16
8	7.84	0.44	0.07	0.48	0.03	7.7	0.63	0.27	0.69	0.19
9	8.96	0.35	0	0.4	0	8.8	0.6	0.2	0.64	0.13
10	10.08	0.3	0	0.31	0	9.9	0.45	0.02	0.48	0.01
11	11.2	0.07	0	0.09	0	11	0.18	0.01	0.19	0
Total	11.76			4.17	**0.31**	11.55			6.2	**1.12**

Note: a - no survey for Minago River was conducted due to unsafe high water level.

APPENDIX 7.4-G 2007 Manual Discharge Measurements

LIST OF TABLES

LIST OF TABLES (CONTINUED)

Table 7.4-G-1.1: Discharge Measurement on William River at WRW1X on 7/16/2007

DISCHARGE MEASUREMENT NOTES

LOCATION:	William River Below Oakley Creek Confluence						
Date:	16-Jul	**2007**	**Party:**	James Dietzmann, James Phibbs, Chris Brown			
Width (m):	19.5	**Area (sq m):**	27.7	**Vel (m/sec):** 0.5	**G.H. (m):** 222.00	**Disch. (cms):**	12.8
No Secs.	15	**G.H. change:** NA		**in.:**	**hrs.:**	**Susp.:**	NA
					Sus. Coef.:	**Meter No.**	1

Water Surface Elevation Readings (meters, MSL)		
Time	**Description**	**WSE**
16:00	SG-WRW1X	222.00
17:00	SG-WRW1X	222.00

Type of meter:	Price AA
Date rated:	NA
Meter:	
Spin before meas.	2 min 50 sec
Spin after meas.	3 min 11 sec
Method:	Back Pack Rod from boat
Weather:	Clear, light breeze
Air Temp.	30^{o}C
Precip.	None
Cloud Cover	None
Wind	Slight Breeze

Measurement rated:	Fair
Cross section:	Straight stretch between meanders. Silt banks and channel bottom, dense brush on left bank, less dense on right.
Flow:	Uniform.
Other:	Downstream from Oakley Creek confluence
Control:	Upstream and downstream meander bends
Remarks:	River at high stage due to recent precipitation events, appears to be at or above bankfull.

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Table 7.4-G-1.1: Discharge Measurement on William River at WRW1X on 7/16/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	4.50	0.0	0.0								Left edge of water
	9.38	2.9	1.0	0.6	7	43	0.115	0.115	2.9	0.3	
	10.35	1.0	1.2	0.6	16	42	0.262	0.262	1.2	0.3	
	11.33	1.0	1.4	0.6	22	42	0.358	0.358	1.3	0.5	
	12.30	1.0	1.7	0.6	25	41	0.415	0.415	1.6	0.7	
	13.28	1.0	1.8	0.6	29	41	0.481	0.481	1.8	0.9	
	14.25	1.0	2.0	0.6	31	40	0.527	0.527	1.9	1.0	
	15.23	1.0	2.0	0.6	33	41	0.547	0.547	2.0	1.1	
	16.20	1.0	2.1	0.6	32	41	0.530	0.530	2.0	1.1	
	17.18	1.0	2.1	0.6	33	41	0.547	0.547	2.1	1.1	
	18.15	1.0	2.2	0.6	35	41	0.579	0.579	2.1	1.2	
	19.13	1.0	2.2	0.6	37	41	0.612	0.612	2.1	1.3	
	20.10	1.0	2.1	0.6	37	41	0.612	0.612	2.1	1.3	
	21.08	1.0	2.0	0.6	35	41	0.579	0.579	1.9	1.1	
	22.05	0.7	1.6	0.6	29	41	0.481	0.481	1.2	0.6	

Table 7.4-G-1.1: Discharge Measurement on William River at WRW1X on 7/16/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (ft)	Depth (ft)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	22.50	1.0	1.5	0.6	16	42	0.262	0.262	1.5	0.4	
	24.00	0.0	0.0								Right edge of water
	Totals	**19.5**							**27.7**	**12.8**	

Table 7.4-G-1.2: Discharge Measurement on William River at WRW1X on 8/14/2007

DISCHARGE MEASUREMENT NOTES

LOCATION:	William River Below Oakley Creek Confluence								
Date:	14-Aug	**2007**	**Party:**	James Phibbs, Chris Brown					
Width (m):	14.6	**Area (sq m):**	12.4	**Vel (m/sec):**	0.3	**G.H. (m):**	221.09	**Disch. (cms):**	3.2
No Secs.	15	**G.H. change:**	NA	**in.:**		**hrs.:**		**Susp.:**	NA

Sus. Coef.:	**Meter No.**
Type of meter:	Swoffer
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	Swoffer
Weather:	Clear, light breeze
Air Temp.	
Precip.	None
Cloud Cover	None
Wind	Slight Breeze

Water Surface Elevation Readings

Time	Description	WSE
15:30	SG-WRW1X	221.09
16:00	SG-WRW1X	221.09

Measurement rated:	Fair
Cross section:	Straight stretch between meanders. Silt banks and channel bottom, dense brush on left bank, less dense on right.
Flow:	Uniform.
Other:	Downstream from Oakley Creek confluence
Control:	Upstream and downstream meander bends
Remarks:	

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Table 7.4-G-1.2: Discharge Measurement on William River at WRW1X on 8/14/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	9.40	0.0	0.0								Left edge of water
	12.20	1.75	0.60	0.6	NA	NA	0.040	0.040	1.1	0.04	
	12.90	0.70	0.77	0.6	NA	NA	0.120	0.120	0.5	0.1	
	13.60	0.70	0.88	0.6	NA	NA	0.220	0.220	0.6	0.1	
	14.30	0.70	1.05	0.6	NA	NA	0.230	0.230	0.7	0.2	
	15.00	0.70	1.05	0.6	NA	NA	0.270	0.270	0.7	0.2	
	15.70	0.70	1.10	0.6	NA	NA	0.280	0.280	0.8	0.2	
	16.40	0.70	1.17	0.6	NA	NA	0.300	0.300	0.8	0.2	
	17.10	0.53	1.18	0.6	NA	NA	0.310	0.310	0.6	0.2	
	17.45	0.35	1.17	0.6	NA	NA	0.300	0.300	0.4	0.1	
	17.80	0.53	1.15	0.6	NA	NA	0.290	0.290	0.6	0.2	
	18.50	0.70	1.25	0.6	NA	NA	0.280	0.280	0.9	0.2	
	19.20	0.57	1.28	0.6	NA	NA	0.310	0.310	0.7	0.2	
	19.65	0.35	1.25	0.6	NA	NA	0.290	0.290	0.4	0.1	
	19.90	0.35	1.22	0.6	NA	NA	0.340	0.340	0.4	0.1	

Table 7.4-G-1.2: Discharge Measurement on William River at WRW1X on 8/14/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	20.35	0.48	1.17	0.6	NA	NA	0.32	0.32	0.6	0.2	
	20.60	0.48	1.13	0.6	NA	NA	0.33	0.33	0.5	0.2	
	21.30	0.70	1.04	0.6	NA	NA	0.33	0.33	0.7	0.2	
	22.0	0.70	0.77	0.6	NA	NA	0.32	0.32	0.5	0.2	
	22.7	0.70	0.58	0.6	NA	NA	0.27	0.27	0.4	0.1	
	23.4	0.65	0.33	0.6	NA	NA	0.05	0.05	0.21	0.01	
	24.0	0.0	0.0								Right edge of water
	Totals	**14.6**							**12.4**	**3.2**	

Table 7.4-G-1.3: Discharge Measurement on William River at WRW1X on 10/15/2007

DISCHARGE MEASUREMENT NOTES

LOCATION:	William River Below Oakley Creek Confluence								
Date:	15-Oct	**2007**	**Party:**	James Dietzmann, Ken Bud					
Width (m):	17.0	**Area (sq m):**	17.1	**Vel (m/sec):**	0.3	**G.H. (m):**	221.48	**Disch. (cms):**	5.2
No Secs.	15	**G.H. change:**	NA	**in.:**		**hrs.:**		**Susp.:**	NA
						Sus. Coef.:		**Meter No.**	1

Water Surface Elevation Readings (meters, MSL)				
Time	**Description**	**WSE**	**Type of meter:**	Price AA
16:30	SG-WRW1X	221.48	**Date rated:**	NA
17:35	SG-WRW1X	221.48	**Meter:**	
			Spin before meas.	3 min 38 sec
			Spin after meas.	3 min 11 sec
			Method:	Back Pack Rod from boat
			Weather:	Clear, light breeze
			Air Temp.	15°C
			Precip.	None
			Cloud Cover	None
			Wind	Slight Breeze

Measurement rated:	Fair
Cross section:	Straight stretch between meanders. Silt banks and channel bottom, dense brush on left bank, less dense on right.
Flow:	Uniform.
Other:	Downstream from Oakley Creek confluence
Control:	Upstream and downstream meander bends
Remarks:	Trees across channel approximately 30 meters downstream from WRW1X, might impact stage and discharge at higher flows

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Table 7.4-G-1.3: Discharge Measurement on William River at WRW1X on 10/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	6.50	0.0	0.0								Left edge of water
	9.70	2.0	0.5	0.6	6	49	0.088	0.088	0.9	0.1	
	10.55	0.9	0.6	0.6	6	49	0.088	0.088	0.5	0.0	
	11.40	0.9	0.5	0.6	7	45	0.110	0.110	0.4	0.0	
	12.25	0.9	1.0	0.6	7	41	0.120	0.120	0.8	0.1	
	13.10	0.9	1.3	0.6	16	43	0.256	0.256	1.1	0.3	
	13.95	0.9	1.4	0.6	15	43	0.240	0.240	1.2	0.3	
	14.80	0.9	1.4	0.6	17	42	0.278	0.278	1.2	0.3	
	15.65	0.9	1.4	0.6	20	41	0.333	0.333	1.2	0.4	
	16.50	0.9	1.4	0.6	22	42	0.358	0.358	1.2	0.4	
	17.35	0.9	1.6	0.6	22	41	0.366	0.366	1.3	0.5	
	18.20	0.9	1.6	0.6	21	42	0.342	0.342	1.3	0.5	
	19.05	0.9	1.7	0.6	24	43	0.381	0.381	1.4	0.5	
	19.90	0.9	1.7	0.6	25	42	0.406	0.406	1.4	0.6	
	20.75	0.9	1.5	0.6	25	44	0.388	0.388	1.3	0.5	

Table 7.4-G-1.3: Discharge Measurement on William River at WRW1X on 10/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	21.60	1.4	1.2	0.6	20	40	0.342	0.342	1.7	0.6	
	23.50	0.0	0.0								Right edge of water
	Totals	**17.0**							**17.1**	**5.2**	

Table 7.4-G-2.1: Discharge Measurement on William River at WRW2X on 7/16/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: William River several kilometers above the Oakley Creek Confluence

Date: 16-Jul **2007** **Party:** James Dietzmann, James Phibbs, Chris Brown

Width (m): 11.6 **Area (sq m):** 13.1 **Vel (m/sec):** 0.4 **G.H. (m):** NA **Disch. (cms):** 5.6

No Secs. 17 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.** 1

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
12:30	SG-WRW2X	NA
13:15	SG-WRW2X	NA

Type of meter:	Price AA
Date rated:	NA
Meter:	
Spin before meas.	2 min 50 sec
Spin after meas.	2 min 25 sec
Method:	Back Pack Rod from boat
Weather:	Clear, light breeze
Air Temp.	27^{o}C
Precip.	None
Cloud Cover	None
Wind	Slight Breeze

Measurement rated: Good

Cross section: Straight stretch between meanders. Silt banks and channel bottom, dense brush on right bank, less dense on left (alders)

Flow: Uniform, thalweg left of center.

Other:

Control: Upstream and downstream meander bends

Remarks: River at high stage due to recent precipitation events, appears to be at or above bankfull.

Benchmark not surveyed to MSL in 2007.

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Table 7.4-G-2.1: Discharge Measurement on William River at WRW2X on 7/16/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	0.60	0.0	0.0								Left edge of water
	1.76	0.9	1.0	0.6	25	44	0.388	0.388	0.8	0.3	Grass on bottom
	2.34	0.6	1.2	0.6	33	42	0.534	0.534	0.7	0.4	Silt
	2.92	0.6	1.3	0.6	32	44	0.494	0.494	0.8	0.4	silt
	3.50	0.6	1.4	0.6	30	43	0.475	0.475	0.8	0.4	silt and gravel
	4.08	0.6	1.4	0.6	32	42	0.518	0.518	0.8	0.4	silt and gravel
	4.66	0.6	1.6	0.6	30	44	0.464	0.464	0.9	0.4	silt and gravel
	5.24	0.6	1.6	0.6	30	42	0.486	0.486	0.9	0.5	silt and gravel
	5.82	0.6	1.6	0.6	28	43	0.443	0.443	0.9	0.4	silt and gravel
	6.40	0.6	1.6	0.6	26	42	0.422	0.422	0.9	0.4	silt and gravel
	6.98	0.6	1.6	0.6	26	43	0.412	0.412	0.9	0.4	silt
	7.56	0.6	1.6	0.6	27	45	0.409	0.409	0.9	0.4	silt
	8.14	0.6	1.4	0.6	27	45	0.409	0.409	0.8	0.3	silt
	8.72	0.6	1.3	0.6	27	45	0.409	0.409	0.7	0.3	silt
	9.30	0.6	1.1	0.6	23	43	0.365	0.365	0.6	0.2	silt

Table 7.4-G-2.1: Discharge Measurement on William River at WRW2X on 7/16/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	9.88	0.6	0.9	0.6	23	45	0.349	0.349	0.5	0.2	silt streambed
	10.46	0.6	0.7	0.6	22	44	0.342	0.342	0.4	0.1	silt streambed
	11.04	0.9	0.5	0.6	12	42	0.198	0.198	0.5	0.1	silt streambed
	12.2	0.0	0.0								Right edge of water
	Totals	**11.6**							**13.1**	**5.6**	

Table 7.4-G-2.2: Discharge Measurement on William River at WRW2X on 8/15/2007

DISCHARGE MEASUREMENT NOTES

LOCATION:	William River several kilometers above the Oakley Creek Confluence						
Date:	15-Aug	**2007**	**Party:**	James Phibbs, Chris Brown			
Width (m):	9.8	**Area (sq m):**	7.6	**Vel (m/sec):** 0.3	**G.H. (m):**		**Disch. (cms):** 2.3
No Secs.	17	**G.H. change:** NA		**in.:**	**hrs.:**		**Susp.:** NA
					Sus. Coef.:	**Meter No.**	

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
10:24	SG-WRW2X	NA
10:55	SG-WRW2X	NA

Type of meter:	Swoffer Meter
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	Swoffer Meter
Weather:	Clear, light breeze
Air Temp.	27^{o}C
Precip.	None
Cloud Cover	None
Wind	Slight Breeze

Measurement rated:	Fair
Cross section:	Straight stretch between meanders. Silt banks and channel bottom, dense brush on right bank, less dense on left (alders)
Flow:	Uniform, thalweg left of center.
Other:	Measured with a Swoffer meter
Control:	Upstream and downstream meander bends
Remarks:	

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Table 7.4-G-2.2: Discharge Measurement on William River at WRW2X on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	1.80	0.0	0.0								Left edge of water
	2.30	0.5	0.06	0.6	NA	NA	0.100	0.100	0.03	0.003	Grass on bottom
	2.80	0.5	0.80	0.6	NA	NA	0.250	0.250	0.4	0.1	Silt
	3.30	0.5	0.89	0.6	NA	NA	0.370	0.370	0.4	0.2	silt
	3.80	0.5	0.93	0.6	NA	NA	0.400	0.400	0.5	0.2	silt and gravel
	4.30	0.5	1.02	0.6	NA	NA	0.360	0.360	0.5	0.2	silt and gravel
	4.80	0.5	1.08	0.6	NA	NA	0.340	0.340	0.5	0.2	silt and gravel
	5.30	0.4	1.12	0.6	NA	NA	0.380	0.380	0.4	0.2	silt and gravel
	5.55	0.3	1.16	0.6	NA	NA	0.320	0.320	0.3	0.1	silt and gravel
	5.80	0.3	1.18	0.6	NA	NA	0.320	0.320	0.3	0.1	silt and gravel
	6.05	0.3	1.14	0.6	NA	NA	0.290	0.290	0.3	0.1	silt
	6.30	0.3	1.15	0.6	NA	NA	0.300	0.300	0.3	0.1	silt
	6.55	0.3	1.14	0.6	NA	NA	0.300	0.300	0.3	0.1	silt
	6.80	0.4	1.15	0.6	NA	NA	0.280	0.280	0.4	0.1	silt
	7.30	0.5	1.15	0.6	NA	NA	0.300	0.300	0.6	0.2	silt

Table 7.4-G-2.2: Discharge Measurement on William River at WRW2X on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (sm)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	7.80	0.5	1.12	0.6	NA	NA	0.310	0.310	0.6	0.2	silt streambed
	8.30	0.5	0.98	0.6	NA	NA	0.280	0.280	0.5	0.1	silt streambed
	8.80	0.5	0.90	0.6	NA	NA	0.260	0.260	0.5	0.1	silt streambed
	9.30	0.5	0.67	0.6	NA	NA	0.290	0.290	0.3	0.1	silt streambed
	9.80	0.5	0.48	0.6	NA	NA	0.200	0.200	0.2	0.05	silt streambed
	10.30	0.9	0.30	0.6	NA	NA	0.110	0.110	0.3	0.03	silt streambed
	11.60	0.0	0.00								Right edge of water
	Totals	**9.8**							**7.6**	**2.3**	

Table 7.4-G-3.1: Discharge Measurement on William River at WRAOC on 10/16/2007

DISCHARGE MEASUREMENT NOTES

LOCATION:	William River above Oakley Creek Confluence						
Date:	16-Oct	**2007**	**Party:**	James Dietzmann, Ken Bud			
Width (m):	12.0	**Area (sq m):**	12.7	**Vel (m/sec):** 0.3	**G.H. (m):** NA	**Disch. (cms):**	3.4
No Secs.	11	**G.H. change:** NA		**in.:**	**hrs.:**	**Susp.:**	NA
					Sus. Coef.:	**Meter No.**	1

Water Surface Elevation Readings (meters, MSL)			**Type of meter:**	Price AA
Time	**Description**	**WSE**	**Date rated:**	NA
13:20	SG-WRAOC	NA	**Meter:**	
14:00	SG-WRAOC	NA	**Spin before meas.**	3 min 50 sec
			Spin after meas.	3 min 11 sec
			Method:	Back Pack Rod from boat
			Weather:	Clear, light breeze
			Air Temp.	15°C
			Precip.	None
			Cloud Cover	None
			Wind	Slight Breeze

Measurement rated:	Fair
Cross section:	Straight stretch between meanders. Silt banks and channel bottom, dense brush on left bank, less dense on right.
Flow:	Uniform.
Other:	Upstream from Oakley Creek confluence approximately 50 meters.
Control:	Upstream and downstream meander bends
Remarks:	New cross section
	Benchmark not surveyed to MSL in 2007.

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Table 7.4-G-3.1: Discharge Measurement on William River at WRAOC on 10/16/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	5.00	0.0	0.0								Left edge of water
	6.00	1.0	0.5	0.6	5	42	0.085	0.085	0.5	0.04	
	7.00	1.0	1.2	0.6	15	43	0.240	0.240	1.2	0.3	
	8.00	1.0	1.4	0.6	16	42	0.262	0.262	1.4	0.4	
	9.00	1.0	1.4	0.6	20	44	0.311	0.311	1.4	0.4	
	10.00	1.0	1.4	0.6	20	42	0.326	0.326	1.4	0.4	
	11.00	1.0	1.1	0.6	9	44	0.143	0.143	1.1	0.2	Submerged log 5 feet upstream
	12.00	1.0	0.9	0.6	19	43	0.303	0.303	0.9	0.3	Submerged log 5 feet upstream
	13.00	1.0	1.4	0.6	21	42	0.342	0.342	1.4	0.5	
	14.00	1.0	1.4	0.6	21	42	0.342	0.342	1.4	0.5	
	15.00	1.0	1.2	0.6	18	42	0.294	0.294	1.2	0.4	
	16.00	1.0	0.8	0.6	4	49	0.060	0.060	0.8	0.05	
	17.00	0.0									Right edge of water
	Totals	**12.0**							**12.7**	**3.4**	

Table 7.4-G-4.1: Discharge Measurement on Oakley Creek at OCW1 on 7/17/2007

DISCHARGE MEASUREMENT NOTES

LOCATION:	Oakley Creek downstream from Highway 6 road culverts approximately 60 meters.								
Date:	17-Jul	**2007**	**Party:**	James Dietzmann, James Phibbs, Chris Brown					
Width (m):	4.0	**Area (sq m):**	1.2	**Vel (m/sec):**	1.4	**G.H.(m):**	239.97	**Disch. (cms):**	1.7
No Secs.	16	**G.H. change:**	NA	**in.:**		**hrs.:**		**Susp.:**	NA
						Sus. Coef.:		**Meter No.**	1

Water Surface Elevation Readings (meters, MSL)		
Time	**Description**	**WSE**
17:55	Cut to water	239.97

Type of meter:	Price AA
Date rated:	NA
Meter:	
Spin before meas.	3 min 28 sec
Spin after meas.	3 min 6sec
Method:	Back Pack Rod
Weather:	Clear and hot
Air Temp.	27^{o}C
Precip.	None
Cloud Cover	None
Wind	Windy

Measurement rated:	Fair
Cross section:	Straight stretch downstream from road culverts. Sense brush on both banks, loose flat rocks and exposed bedrock on channel bottom.
Flow:	Uniform.
Other:	Reach is atypical of Oakley Creek, likely the inflence of the road culverts.
Control:	Culverts up stream approximately 60 meters and large pool downstream approximately 60 meters.
Remarks:	River at high stage due to recent precipitation events, appears to be at or above bankfull.

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Table 7.4-G-4.1: Discharge Measurement on Oakley Creek at OCW1 on 7/17/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (ft)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	4.50	0.0	0.0								Left edge of water
	5.10	0.4	0.2	0.6	46	41	0.760	0.760	0.1	0.1	Flat loose rocks over exposed
											bedrock
	5.30	0.2	0.2	0.6	48	41	0.793	0.793	0.05	0.04	Flat loose rocks over exposed
											bedrock
	5.50	0.2	0.3	0.6	79	40	1.334	1.334	0.1	0.1	Flat loose rocks over exposed
											bedrock
	5.70	0.2	0.4	0.6	80	41	1.318	1.318	0.1	0.1	Flat loose rocks over exposed
											bedrock
	5.90	0.2	0.4	0.6	84	41	1.383	1.383	0.1	0.1	Flat loose rocks over exposed
											bedrock
	6.10	0.2	0.4	0.6	99	41	1.629	1.629	0.1	0.1	Flat loose rocks over exposed
											bedrock
	6.30	0.2	0.4	0.6	99	41	1.629	1.629	0.1	0.1	Flat loose rocks over exposed
											bedrock
	6.50	0.2	0.4	0.6	95	41	1.564	1.564	0.1	0.1	Flatt loose rocks over exposed
											bedrock
	6.70	0.2	0.4	0.6	95	40	1.603	1.603	0.1	0.1	Flat loose rocks over exposed
											bedrock
	6.90	0.2	0.4	0.6	97	40	1.636	1.636	0.1	0.1	Flat loose rocks over exposed
											bedrock
	7.10	0.2	0.4	0.6	99	40	1.670	1.670	0.1	0.1	Flat loose rocks over exposed
											bedrock
	7.30	0.2	0.4	0.6	96	40	1.619	1.619	0.1	0.1	Flat loose rocks over exposed
											bedrock
	7.50	0.2	0.4	0.6	90	41	1.482	1.482	0.1	0.1	Flat loose rocks over exposed
											bedrock
	7.70	0.2	0.4	0.6	81	40	1.367	1.367	0.1	0.1	Flat loose rocks over exposed
											bedrock

Table 7.4-G-4.1: Discharge Measurement on Oakley Creek at OCW1 on 7/17/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	7.9	0.2	0.3	0.6	78	40	1.317	1.317	0.1	0.1	Bedrock stream bed with flat rocks
	8.1	0.3	0.3	0.6	40	41	0.661	0.661	0.1	0.1	Bedrock stream bed with flat rocks
	8.5	0.0	0.0								Right edge of water
	Totals	**4.0**							**1.2**	**1.7**	

Table 7.4-G-4.2: Discharge Measurement on Oakley Creek at OCW1 on 8/13/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Oakley Creek downstream from Highway 6 road culverts approximately 60 meters.

Date: 13-Aug **2007** **Party:** James Phibbs, Chris Brown

Width (m): 4.0 **Area (sq m):** 0.5 **Vel (m/sec):** 0.7 **G.H.(m):** 239.85 **Disch. (cms):** 0.3

No Secs. 16 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.**

Water Surface Elevation Readings

Time	Description	WSE
17:06	SGOCW1	239.85
17:36	SGOCW1	239.85

Type of meter:	Swoffer
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	
Weather:	
Air Temp.	16°C
Precip.	None
Cloud Cover	None
Wind	Breeze

Measurement rated: Fair

Cross section: Straight stretch downstream from road culverts. Sense brush on both banks, loose flat rocks and exposed bedrock on channel bottom.

Flow: Uniform.

Other: Reach is atypical of Oakley Creek, likely the inflence of the road culverts.

Control: Culverts up stream approximately 60 meters and large pool downstream approximately 60 meters.

Remarks:

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Table 7.4-G-4.2: Discharge Measurement on Oakley Creek at OCW1 on 8/13/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	5.70	0.0	0.0								Left edge of water
	6.50	0.5	0.07	0.6	NA	NA	0.25	0.25	0.04	0.01	Flat loose rocks over exposed bedrock
	6.70	0.2	0.12	0.6	NA	NA	0.35	0.35	0.02	0.01	Flat loose rocks over exposed bedrock
	6.90	0.2	0.15	0.6	NA	NA	0.32	0.32	0.03	0.01	Flat loose rocks over exposed bedrock
	7.10	0.2	0.15	0.6	NA	NA	0.51	0.51	0.03	0.02	Flat loose rocks over exposed bedrock
	7.30	0.2	0.20	0.6	NA	NA	0.64	0.64	0.03	0.02	Flatt loose rocks over exposed bedrock
	7.40	0.1	0.21	0.6	NA	NA	0.60	0.60	0.02	0.01	Flat loose rocks over exposed bedrock
	7.50	0.1	0.20	0.6	NA	NA	0.88	0.88	0.02	0.02	Flat loose rocks over exposed bedrock
	7.60	0.1	0.18	0.6	NA	NA	0.80	0.80	0.02	0.01	Flat loose rocks over exposed bedrock
	7.70	0.1	0.24	0.6	NA	NA	0.74	0.74	0.02	0.02	Flat loose rocks over exposed bedrock
	7.80	0.1	0.24	0.6	NA	NA	0.90	0.90	0.02	0.02	Flat loose rocks over exposed bedrock
	7.90	0.1	0.18	0.6	NA	NA	1.03	1.03	0.02	0.02	Flat loose rocks over exposed bedrock
	8.00	0.1	0.17	0.6	NA	NA	1.11	1.11	0.02	0.02	Flatt loose rocks over exposed bedrock
	8.10	0.1	0.17	0.6	NA	NA	1.19	1.19	0.02	0.02	Flat loose rocks over exposed bedrock
	8.20	0.1	0.17	0.6	NA	NA	1.00	1.00	0.02	0.02	Flat loose rocks over exposed bedrock

Table 7.4-G-4.2: Discharge Measurement on Oakley Creek at OCW1 on 8/13/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	8.30	0.15	0.17	0.6	NA	NA	0.55	0.55	0.03	0.01	Bedrock stream bed with flat rocks
	8.50	0.20	0.22	0.6	NA	NA	0.69	0.69	0.04	0.03	Bedrock stream bed with flat rocks
	8.70	0.20	0.13	0.6	NA	NA	0.72	0.72	0.03	0.02	Bedrock stream bed with flat rocks
	8.90	0.20	0.15	0.6	NA	NA	0.77	0.77	0.03	0.02	Bedrock stream bed with flat rocks
	9.10	0.20	0.10	0.6	NA	NA	0.77	0.77	0.02	0.02	Bedrock stream bed with flat rocks
	9.30	0.30	0.08	0.6	NA	NA	0.17	0.17	0.02	0.004	Bedrock stream bed with flat rocks
	9.70	0.0	0.0								Right edge of water
	Totals	**4.0**							**0.5**	**0.3**	

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Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information	
File Name	OCW1.MIN.WAD
Start Date and Time	2007/09/11 15:52:50

Site Details	
Site Name	OCW1
Operator(s)	KR

System Information	
Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units	(Metric Units)
Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Summary			
Averaging Int.	10	# Stations	14
Start Edge	LEW	Total Width	4.220
Mean SNR	32.9 dB	Total Area	0.438
Mean Temp	9.68 °C	Mean Depth	0.104
Disch. Equation	Mid-Section	Mean Velocity	0.5873
		Total Discharge	0.2570

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.5%	5.4%
Velocity	2.6%	9.2%
Width	0.2%	0.2%
Method	2.6%	-
# Stations	3.6%	-
Overall	5.2%	10.7%

Measurement Results

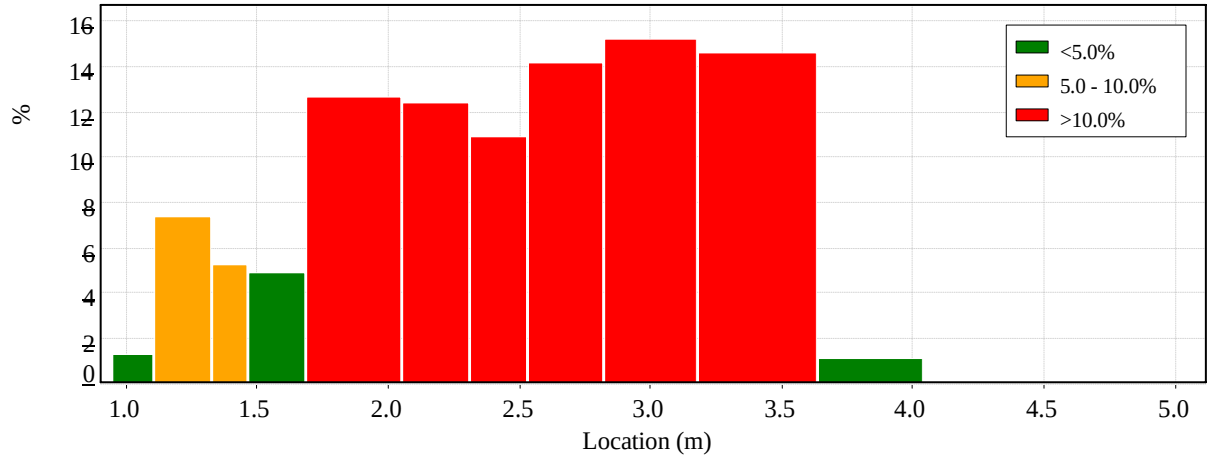
St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area	Flow	%Q
0	15:52	0.90		None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	15:52	1.00		0.6	0.040	0.6	0.016	0.5082	1.00	0.5082	0.006	0.0033	1.3
2	15:54	1.22		0.6	0.120	0.6	0.048	0.7146	1.00	0.7146	0.026	0.0189	7.3
3	15:54	1.44		0.6	0.120	0.6	0.048	0.8081	1.00	0.8081	0.017	0.0136	5.3
4	*15:56*	*1.50*		*0.6*	*0.160*	*0.6*	*0.064*	*0.3609*	*1.00*	*0.3609*	*0.035*	*0.0127*	*4.9*
5	*15:57*	*1.88*		*0.6*	*0.120*	*0.6*	*0.048*	*0.7446*	*1.00*	*0.7446*	*0.044*	*0.0326*	*12.7*
6	15:58	2.23		0.6	0.110	0.6	0.044	1.1167	1.00	1.1167	0.029	0.0319	12.4
7	*15:59*	*2.40*		*0.6*	*0.120*	*0.6*	*0.048*	*1.0662*	*1.00*	*1.0662*	*0.026*	*0.0281*	*11.0*
8	16:00	2.67		0.6	0.170	0.6	0.068	0.7498	1.00	0.7498	0.048	0.0363	14.1
9	16:01	2.97		0.6	0.160	0.6	0.064	0.6714	1.00	0.6714	0.058	0.0392	15.3
10	*16:03*	*3.40*		*0.6*	*0.150*	*0.6*	*0.060*	*0.5500*	*1.00*	*0.5500*	*0.068*	*0.0375*	*14.6*
11	16:05	3.88		0.6	0.120	0.6	0.048	0.0594	1.00	0.0594	0.048	0.0029	1.1
12	*16:06*	*4.20*		*0.6*	*0.050*	*0.6*	*0.020*	*0.0007*	*1.00*	*0.0007*	*0.031*	*0.0000*	*0.0*
13	16:06	5.12		None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

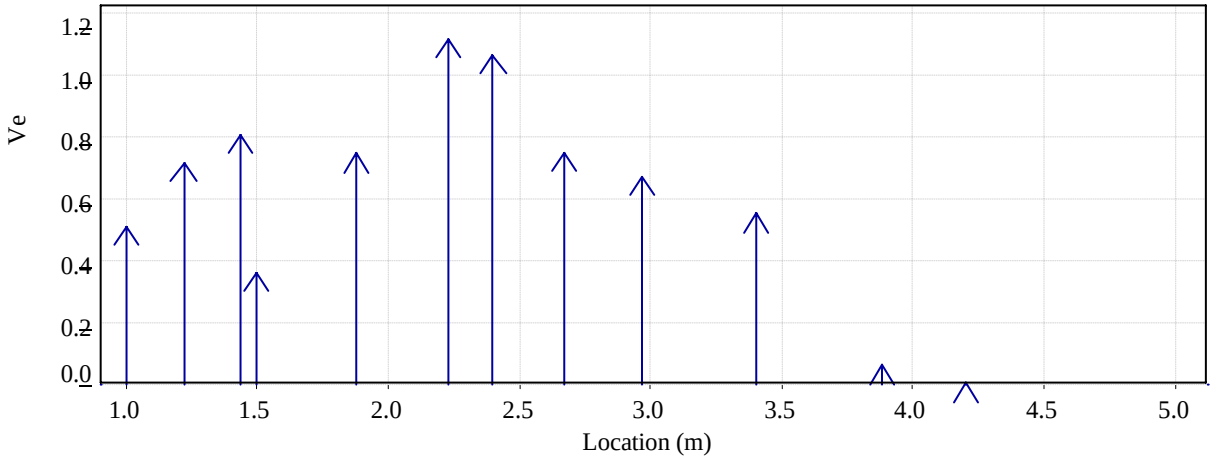
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

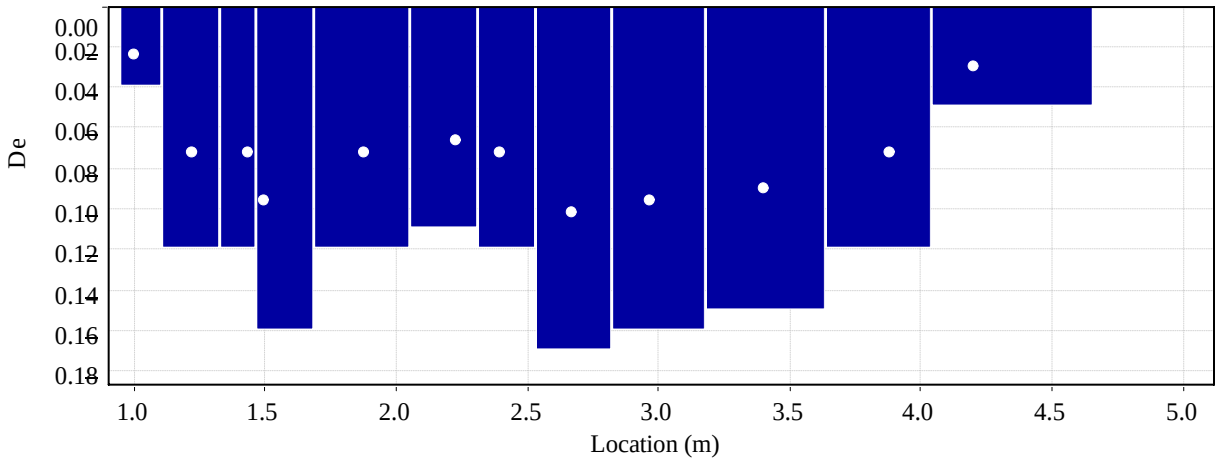
Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	OCW1.MIN.WAD	Site Name	OCW1
Start Date and Time	2007/09/11 15:52:50	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	OCW1.MIN.WAD	Site Name	OCW1
Start Date and Time	2007/09/11 15:52:50	Operator(s)	KR

Quality Control

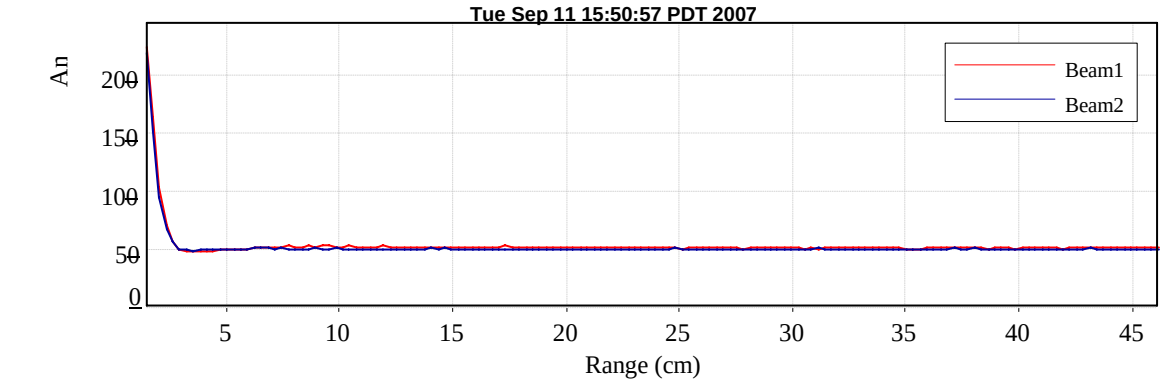
St	Loc	%Dep	Message
4	1.50	0.6	Boundary QC is Poor; possible boundary interference
5	1.88	0.6	High standard error: 0.045
7	2.40	0.6	High standard error: 0.060
10	3.40	0.6	High standard error: 0.077
12	4.20	0.6	SNR (45.5) is different from typical SNR (32.9)

Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	OCW1.MIN.WAD	Site Name	OCW1
Start Date and Time	2007/09/11 15:52:50	Operator(s)	KR

Automatic Quality Control Test (BeamCheck)



Noise level check - Pass
SNR check - Fail
Low SNR: 0.1,0.0
Peak location check - Fail
SNR too low for test
Peak shape check - Fail
SNR too low for test

7.4–60

Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information	
File Name	OCW1O1.WAD
Start Date and Time	2007/10/14 14:46:24

Site Details	
Site Name	
Operator(s)	KR

System Information	
Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units	(Metric Units)
Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.5%	5.2%
Velocity	1.6%	4.9%
Width	0.2%	0.2%
Method	2.7%	-
# Stations	3.1%	-
Overall	4.5%	7.2%

Summary			
Averaging Int.	10	# Stations	16
Start Edge	LEW	Total Width	4.180
Mean SNR	33.4 dB	Total Area	0.751
Mean Temp	5.43 °C	Mean Depth	0.180
Disch. Equation	Mid-Section	Mean Velocity	0.9740
		Total Discharge	0.7310

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area	Flow	%Q
0	14:46	0.00	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	*14:46*	*0.30*	*0.6*	*0.100*	*0.6*	*0.040*	*0.0002*	*1.00*	*0.0002*	*0.035*	*0.0000*	*0.0*
2	14:48	0.70	0.6	0.140	0.6	0.056	0.2449	1.00	0.2449	0.049	0.0120	1.6
3	*14:49*	*1.00*	*0.6*	*0.120*	*0.6*	*0.048*	*0.2844*	*1.00*	*0.2844*	*0.036*	*0.0102*	*1.4*
4	14:50	1.30	0.6	0.200	0.6	0.080	1.1559	1.00	1.1559	0.070	0.0809	11.1
5	14:51	1.70	0.6	0.240	0.6	0.096	1.2311	1.00	1.2311	0.084	0.1034	14.1
6	14:52	2.00	0.6	0.250	0.6	0.100	1.2254	1.00	1.2254	0.113	0.1379	18.9
7	*14:55*	*2.60*	*0.6*	*0.260*	*0.6*	*0.104*	*1.2154*	*1.00*	*1.2154*	*0.117*	*0.1422*	*19.5*
8	14:56	2.90	0.6	0.200	0.6	0.080	1.1116	1.00	1.1116	0.060	0.0667	9.1
9	14:57	3.20	0.6	0.180	0.6	0.072	1.0469	1.00	1.0469	0.041	0.0424	5.8
10	*14:54*	*3.35*	*0.6*	*0.260*	*0.6*	*0.104*	*1.1373*	*1.00*	*1.1373*	*0.033*	*0.0370*	*5.1*
11	14:58	3.45	0.6	0.180	0.6	0.072	1.1894	1.00	1.1894	0.032	0.0375	5.1
12	14:59	3.70	0.6	0.180	0.6	0.072	0.8700	1.00	0.8700	0.041	0.0352	4.8
13	15:00	3.90	0.6	0.140	0.6	0.056	0.6595	1.00	0.6595	0.024	0.0157	2.1
14	15:01	4.04	0.6	0.130	0.6	0.052	0.5455	1.00	0.5455	0.018	0.0099	1.4
15	15:01	4.18	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

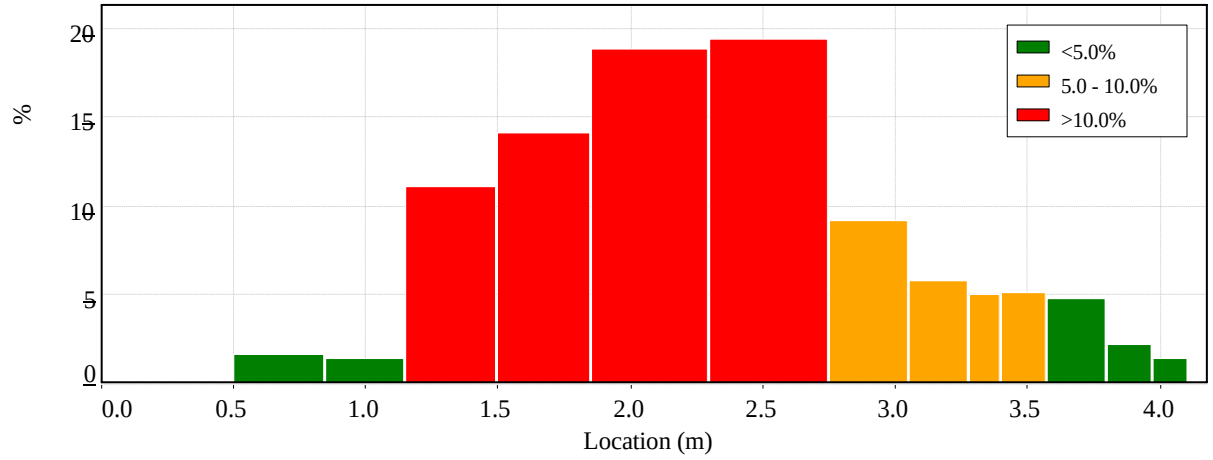
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

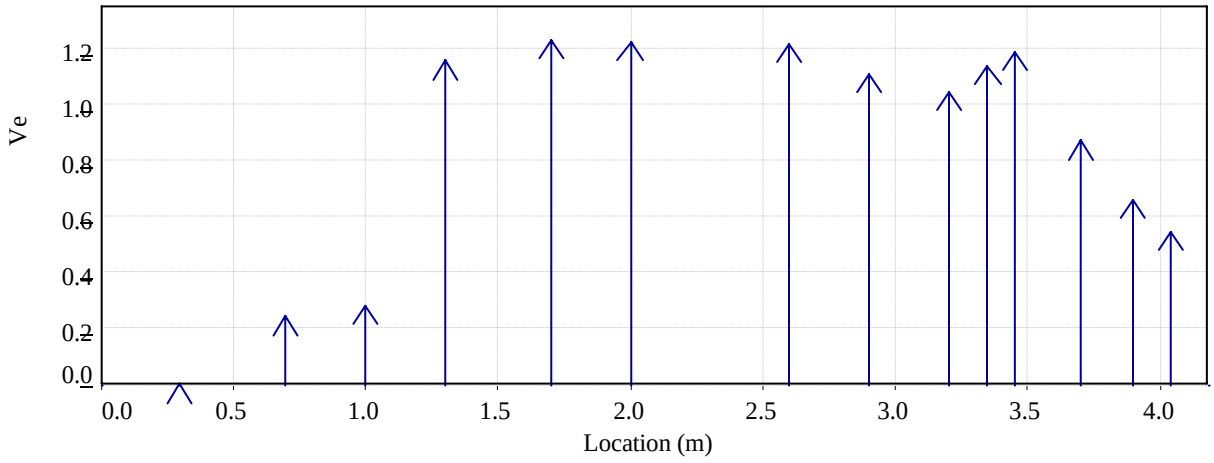
7.4–61

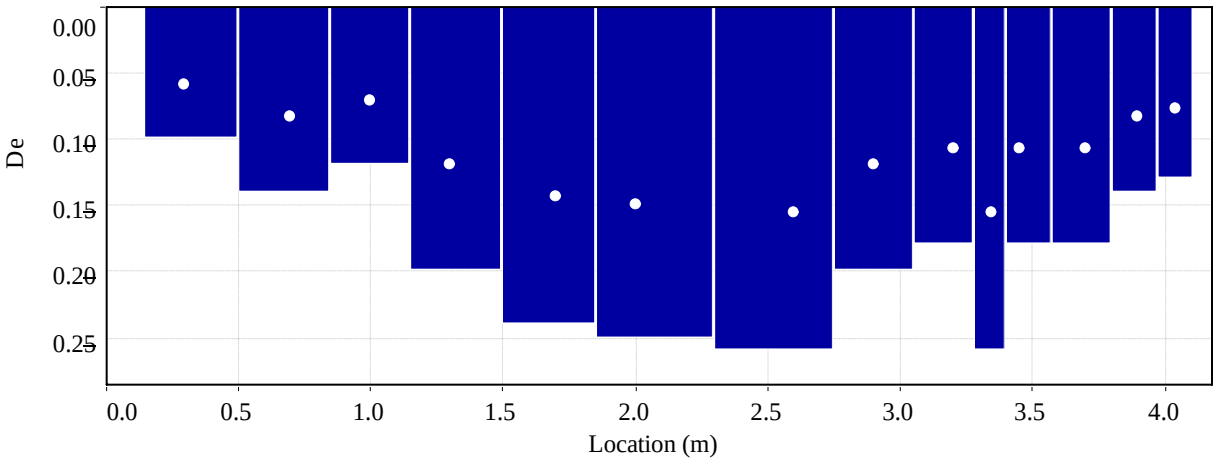
Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	OCW1O1.WAD	Site Name	
Start Date and Time	2007/10/14 14:46:24	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	OCW1O1.WAD	Site Name	
Start Date and Time	2007/10/14 14:46:24	Operator(s)	KR

Quality Control

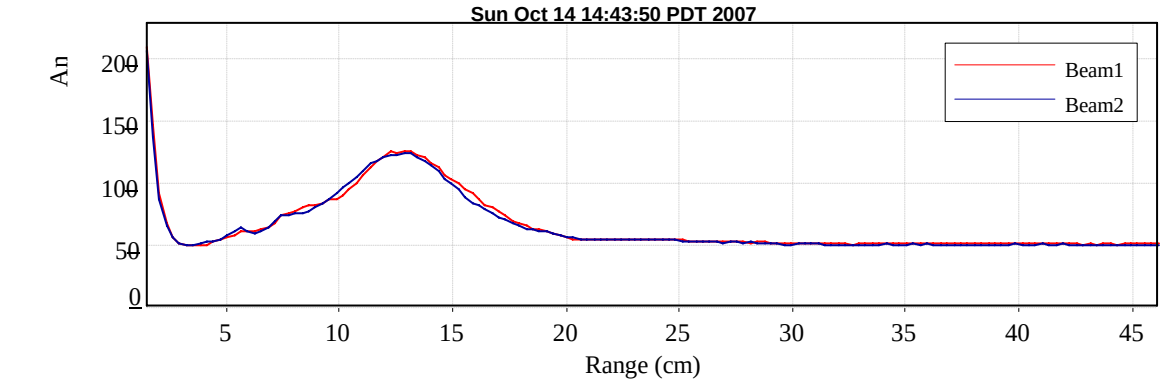
St	Loc	%Dep	Message
1	0.30	0.6	Boundary QC is Fair; possible boundary interference
3	1.00	0.6	High angle: -30
7	2.60	0.6	High standard error: 0.082
10	3.35	0.6	High standard error: 0.076

Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	OCW1O1.WAD	Site Name	
Start Date and Time	2007/10/14 14:46:24	Operator(s)	KR

Automatic Quality Control Test (BeamCheck)



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

Table 7.4-G-5.1: Discharge Measurement on Oakley Creek at OCW2 on 7/15/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Oakley Creek several kilometers upstream from Highway 6.

Date: 15-Jul **2007** **Party:** James Dietzmann, Chris Brown

Width (m): 3.4 **Area (sq m):** 4.6 **Vel (m/sec):** 0.3 **G.H.(m):** 245.20 **Disch. (cms):** 1.5

No Secs. 17 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.** 1

Type of meter: Price AA

Date rated: NA

Meter:

Spin before meas. 2 min 25 sec

Spin after meas. 2 min 50 sec

Method: Back Pack Rod

Weather: Clear and hot

Air Temp. 27^{o}C

Precip. None

Cloud Cover None

Wind Windy

Water Surface Elevation Readings

Time	Description	WSE
14:00	SG-OCW2	245.20
15:04	SG-OCW2	245.20

Measurement rated: Fair

Cross section: Short straight reeach between closely spaced meander bends. Small sized woody debris on top of silty substrate make up streambed.

Flow: Mostly uniform.

Other: Deeply incised channel.

Control: Meander bends approximately 15 meters upstream and downstream from cross section.

Remarks: River at high stage due to recent precipitation events, appears to be at or above bankfull.

Page 1 of 3

Table 7.4-G-5.1: Discharge Measurement on Oakley Creek at OCW2 on 7/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	2.00	0.0	0.0								Left edge of water
	2.34	0.3	0.6	0.6	14	44	0.219	0.219	0.2	0.03	Weeds and woody debris on streambed
	2.51	0.2	1.9	0.6	19	43	0.303	0.303	0.3	0.1	Weeds and woody debris on streambed
	2.68	0.2	2.0	0.6	20	41	0.333	0.333	0.3	0.1	Weeds and woody debris on streambed
	2.85	0.2	2.0	0.6	25	41	0.415	0.415	0.3	0.1	Weeds and woody debris on streambed
	3.02	0.2	2.1	0.6	27	42	0.438	0.438	0.4	0.2	Weeds and woody debris on streambed
	3.19	0.2	1.9	0.6	26	41	0.432	0.432	0.3	0.1	Weeds and woody debris on streambed
	3.36	0.2	1.8	0.6	25	44	0.388	0.388	0.3	0.1	Weeds and woody debris on streambed
	3.53	0.2	1.8	0.6	24	45	0.364	0.364	0.3	0.1	Weeds and woody debris on streambed
	3.70	0.2	1.8	0.6	21	41	0.350	0.350	0.3	0.1	Weeds and woody debris on streambed
	3.87	0.2	1.7	0.6	20	42	0.326	0.326	0.3	0.1	Weeds and woody debris on streambed
	4.04	0.2	1.3	0.6	20	44	0.311	0.311	0.2	0.1	Weeds and woody debris on streambed
	4.21	0.2	1.5	0.6	17	43	0.271	0.271	0.3	0.1	Weeds and woody debris on streambed
	4.38	0.2	1.3	0.6	14	43	0.224	0.224	0.2	0.05	Weeds and woody debris on streambed
	4.55	0.2	0.9	0.6	11	43	0.177	0.177	0.2	0.03	Weeds and woody debris on streambed

Table 7.4-G-5.1: Discharge Measurement on Oakley Creek at OCW2 on 7/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	4.72	0.2	1.2	0.6	11	44	0.174	0.174	0.2	0.04	Weeds and woody debris on streambed
	4.89	0.2	1.1	0.6	12	42	0.198	0.198	0.2	0.04	Weeds and woody debris on streambed
	5.06	0.3	1.0	0.6	13	45	0.200	0.200	0.3	0.1	Weeds and woody debris on streambed
	5.40	0.0	0.0								Right edge of water
	Totals	**3.4**							**4.6**	**1.5**	

Table 7.4-G-5.2: Discharge Measurement on Oakley Creek at OCW2 on 8/15/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Oakley Creek several kilometers upstream from Highway 6.

Date: 15-Aug **2007** **Party:** James Phibbs, Chris Brown

Width (m): 3.0 **Area (sq m):** 2.9 **Vel (m/sec):** 0.1 **G.H. (m):** 244.60 **Disch. (cms):** 0.3

No Secs. 17 **G.H. change:** **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.**

Water Surface Elevation Readings

Time	Description	WSE
12:40	SG-OCW2	244.60
13:20	SG-OCW2	244.60

Type of meter:	Swoffer
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	
Weather:	
Air Temp.	15°C
Precip.	None
Cloud Cover	Partly Cloudy
Wind	None

Measurement rated: Fair

Cross section: Short straight reeach between closely spaced meander bends. Small sized woody debris on top of silty substrate make up streambed.

Flow: Mostly uniform.

Other: Deeply incised channel.

Control: Meander bends approximately 15 meters upstream and downstream from cross section.

Remarks:

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Table 7.4-G-5.2: Discharge Measurement on Oakley Creek at OCW2 on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	2.10	0.0	0.0								Left edge of water
	2.25	0.15	1.18	0.6	NA	NA	0.030	0.030	0.18	0.01	Weeds and woody debris on streambed
	2.40	0.15	1.33	0.6	NA	NA	0.070	0.070	0.20	0.01	Weeds and woody debris on streambed
	2.55	0.15	1.30	0.6	NA	NA	0.080	0.080	0.20	0.02	Weeds and woody debris on streambed
	2.70	0.11	1.33	0.6	NA	NA	0.080	0.080	0.15	0.01	Weeds and woody debris on streambed
	2.78	0.08	1.35	0.6	NA	NA	0.110	0.110	0.10	0.01	Weeds and woody debris on streambed
	2.85	0.08	1.35	0.6	NA	NA	0.120	0.120	0.10	0.01	Weeds and woody debris on streambed
	2.93	0.08	1.35	0.6	NA	NA	0.140	0.140	0.10	0.01	Weeds and woody debris on streambed
	3.00	0.08	1.35	0.6	NA	NA	0.130	0.130	0.10	0.01	Weeds and woody debris on streambed
	3.08	0.08	1.29	0.6	NA	NA	0.110	0.110	0.10	0.01	Weeds and woody debris on streambed
	3.15	0.08	1.31	0.6	NA	NA	0.130	0.130	0.10	0.01	Weeds and woody debris on streambed
	3.23	0.08	1.33	0.6	NA	NA	0.130	0.130	0.10	0.01	Weeds and woody debris on streambed
	3.30	0.11	1.26	0.6	NA	NA	0.130	0.130	0.14	0.02	Weeds and woody debris on streambed
	3.45	0.15	1.20	0.6	NA	NA	0.120	0.120	0.18	0.02	Weeds and woody debris on streambed
	3.60	0.15	1.24	0.6	NA	NA	0.130	0.130	0.19	0.02	Weeds and woody debris on streambed

Table 7.4-G-5.2: Discharge Measurement on Oakley Creek at OCW2 on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	3.75	0.15	1.14	0.6	NA	NA	0.120	0.120	0.17	0.02	Weeds and woody debris on streambed
	3.90	0.15	1.05	0.6	NA	NA	0.100	0.100	0.16	0.02	Weeds and woody debris on streambed
	4.05	0.15	0.93	0.6	NA	NA	0.090	0.090	0.14	0.01	Weeds and woody debris on streambed
	4.20	0.15	0.78	0.6	NA	NA	0.080	0.080	0.12	0.01	Weeds and woody debris on streambed
	4.35	0.15	0.69	0.6	NA	NA	0.080	0.080	0.10	0.01	Weeds and woody debris on streambed
	4.50	0.15	0.65	0.6	NA	NA	0.070	0.070	0.10	0.01	Weeds and woody debris on streambed
	4.65	0.15	0.53	0.6	NA	NA	0.080	0.080	0.08	0.01	Weeds and woody debris on streambed
	4.80	0.15	0.48	0.6	NA	NA	0.080	0.080	0.07	0.01	Weeds and woody debris on streambed
	4.95	0.15	0.52	0.6	NA	NA	0.020	0.020	0.08	0.002	Weeds and woody debris on streambed
	5.10	0.0	0.0								Right edge of water
	Totals	**3.0**							**2.9**	**0.3**	

Table 7.4-G-6.1: Discharge Measurement on Oakley Creek at OCW3 on 8/15/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Oakley Creek upstream from OCW2 on South Fork Oakley Creek.

Date: 15-Aug **2007** **Party:** James Phibbs, Chris Brown

Width (m): 1.5 **Area (sq m):** 0.2 **Vel (m/sec):** 0.2 **G.H. (m):** NA **Disch. (cms):** 0.05

No Secs. 17 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.**

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
10:10	None taken	NA

Type of meter:	Swoffer
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	
Weather:	Clear and hot
Air Temp.	15°C
Precip.	None
Cloud Cover	None
Wind	Windy

Measurement rated: Fair

Cross section:

Flow:

Other:

Control:

Remarks: South tribuutary of upper Oakley Creek, upstream from OCW2

Page 1 of 3

Table 7.4-G-6.1: Discharge Measurement on Oakley Creek at OCW3 on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	0.90	0.0	0.0								Left edge of water
	0.975	0.08	0.10	0.6	NA	NA	0.120	0.120	0.01	0.001	Weeds on streambed
	1.050	0.08	0.18	0.6	NA	NA	0.140	0.140	0.01	0.002	Weeds on streambed
	1.125	0.08	0.20	0.6	NA	NA	0.120	0.120	0.02	0.002	Weeds on streambed
	1.200	0.08	0.25	0.6	NA	NA	0.140	0.140	0.02	0.003	Weeds on streambed
	1.275	0.08	0.25	0.6	NA	NA	0.140	0.140	0.02	0.003	Weeds on streambed
	1.350	0.05	0.23	0.6	NA	NA	0.260	0.260	0.01	0.003	Weeds on streambed
	1.383	0.04	0.22	0.6	NA	NA	0.240	0.240	0.01	0.002	Weeds on streambed
	1.425	0.04	0.23	0.6	NA	NA	0.330	0.330	0.01	0.003	Weeds on streambed
	1.462	0.04	0.25	0.6	NA	NA	0.350	0.350	0.01	0.003	Weeds on streambed
	1.500	0.04	0.27	0.6	NA	NA	0.320	0.320	0.01	0.003	Weeds on streambed
	1.538	0.04	0.26	0.6	NA	NA	0.260	0.260	0.01	0.003	Weeds on streambed
	1.575	0.04	0.26	0.6	NA	NA	0.270	0.270	0.01	0.003	Weeds on streambed
	1.613	0.04	0.26	0.6	NA	NA	0.250	0.250	0.01	0.002	Weeds on streambed
	1.650	0.04	0.24	0.6	NA	NA	0.250	0.250	0.01	0.002	Weeds on streambed

Table 7.4-G-6.1: Discharge Measurement on Oakley Creek at OCW3 on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revolu-tions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	1.69	0.04	0.23	0.6	NA	NA	0.160	0.160	0.01	0.001	Weeds on streambed
	1.73	0.06	0.20	0.6	NA	NA	0.160	0.160	0.01	0.002	Weeds on streambed
	1.80	0.08	0.17	0.6	NA	NA	0.190	0.190	0.01	0.002	Weeds on streambed
	1.88	0.08	0.15	0.6	NA	NA	0.160	0.160	0.01	0.002	Weeds on streambed
	1.95	0.08	0.13	0.6	NA	NA	0.140	0.140	0.01	0.001	Weeds on streambed
	2.03	0.08	0.10	0.6	NA	NA	0.170	0.170	0.01	0.001	Weeds on streambed
	2.10	0.19	0.08	0.6	NA	NA	0.120	0.120	0.02	0.002	Weeds on streambed
	2.40	0.0	0.0								Right edge of water
	Totals	**1.5**							**0.2**	**0.05**	

Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information	
File Name	OCW31.MIN.WAD
Start Date and Time	2007/10/16 11:50:56

Site Details	
Site Name	
Operator(s)	KR

System Information	
Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units	(Metric Units)
Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.6%	6.2%
Velocity	2.8%	22.0%
Width	0.3%	0.3%
Method	4.5%	-
# Stations	5.1%	-
Overall	7.5%	22.9%

Summary

Averaging Int.	10	# Stations	10
Start Edge	LEW	Total Width	1.470
Mean SNR	10.6 dB	Total Area	0.295
Mean Temp	3.93 °C	Mean Depth	0.201
Disch. Equation	Mid-Section	Mean Velocity	0.2021
		Total Discharge	0.0597

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area	Flow	%Q
0	11:50	4.90	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	*11:51*	*5.15*	*0.6*	*0.260*	*0.6*	*0.104*	*0.0005*	*1.00*	*0.0005*	*0.039*	*0.0000*	*0.0*
2	*11:53*	*5.20*	*0.6*	*0.290*	*0.6*	*0.116*	*0.0017*	*1.00*	*0.0017*	*0.036*	*0.0001*	*0.1*
3	*11:55*	*5.40*	*0.6*	*0.250*	*0.6*	*0.100*	*0.2739*	*1.00*	*0.2739*	*0.044*	*0.0120*	*20.1*
4	*11:57*	*5.55*	*0.6*	*0.300*	*0.6*	*0.120*	*0.6028*	*1.00*	*0.6028*	*0.045*	*0.0271*	*45.4*
5	11:58	5.70	0.6	0.260	0.6	0.104	0.4432	1.00	0.4432	0.046	0.0202	33.8
6	*11:59*	*5.90*	*0.6*	*0.250*	*0.6*	*0.100*	*0.0010*	*1.00*	*0.0010*	*0.050*	*0.0001*	*0.1*
7	*12:00*	*6.10*	*0.6*	*0.160*	*0.6*	*0.064*	*0.0104*	*1.00*	*0.0104*	*0.026*	*0.0003*	*0.5*
8	*12:02*	*6.23*	*0.6*	*0.070*	*0.6*	*0.028*	*0.0003*	*1.00*	*0.0003*	*0.009*	*0.0000*	*0.0*
9	12:02	6.37	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

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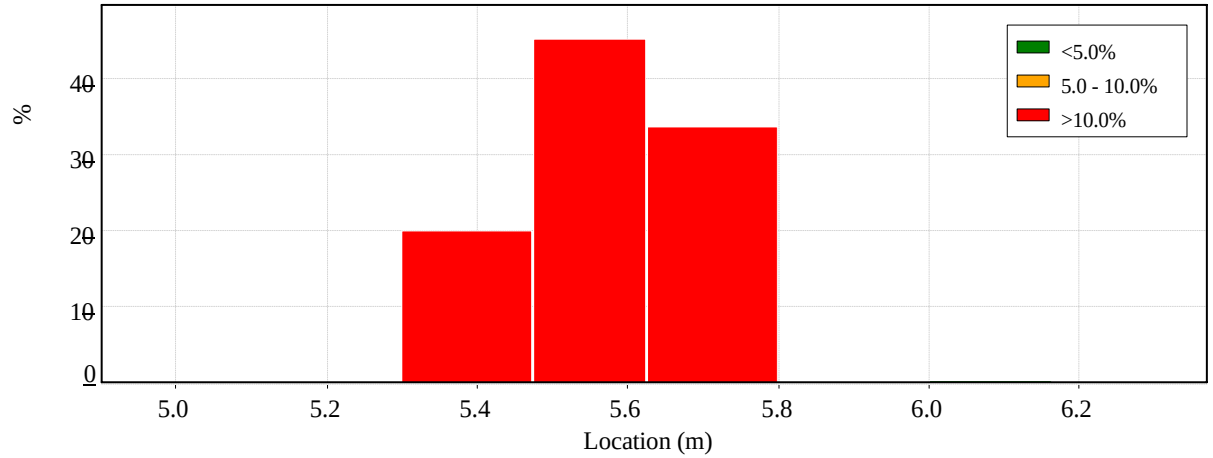
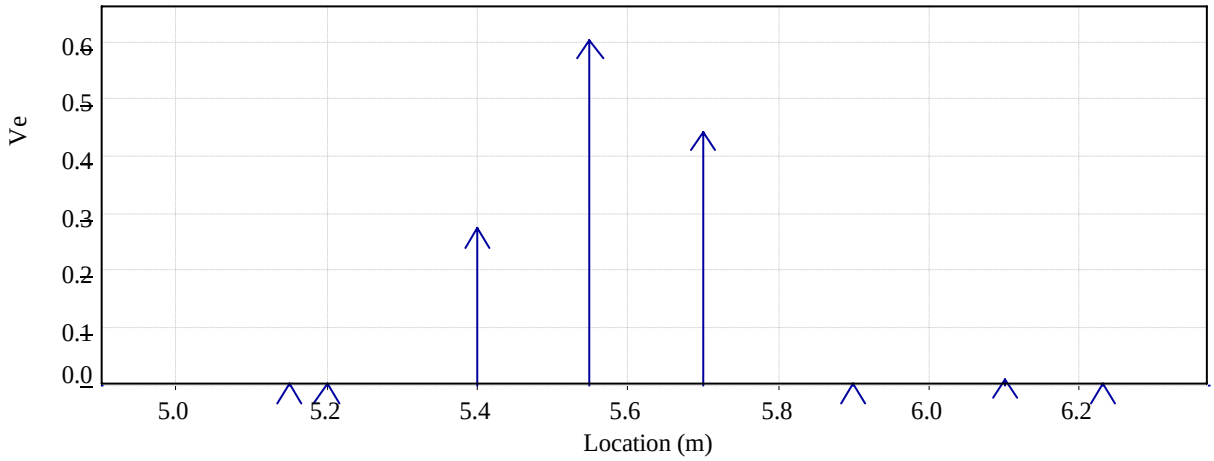
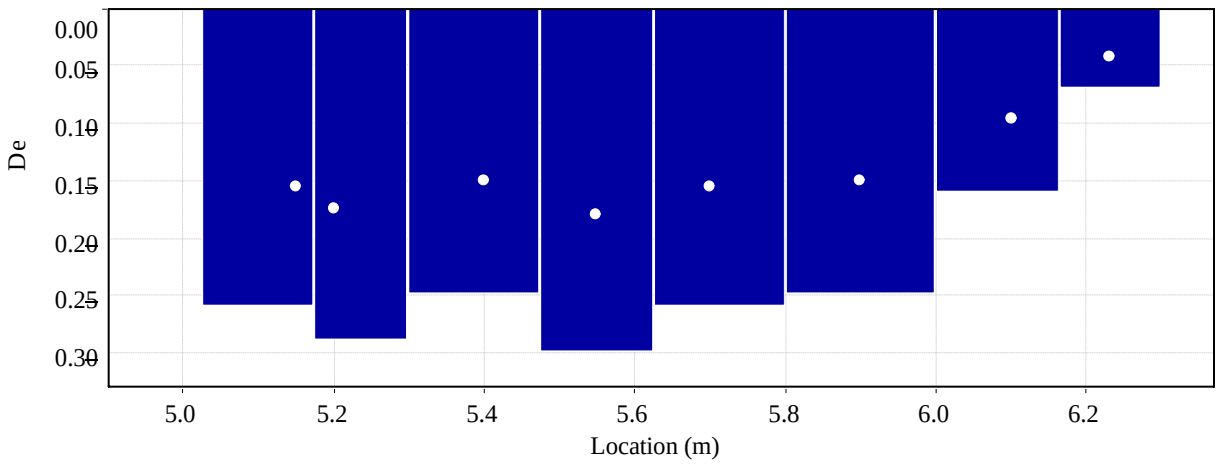
Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	OCW31.MIN.WAD	Site Name	
Start Date and Time	2007/10/16 11:50:56	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	OCW31.MIN.WAD	Site Name	
Start Date and Time	2007/10/16 11:50:56	Operator(s)	KR

Quality Control

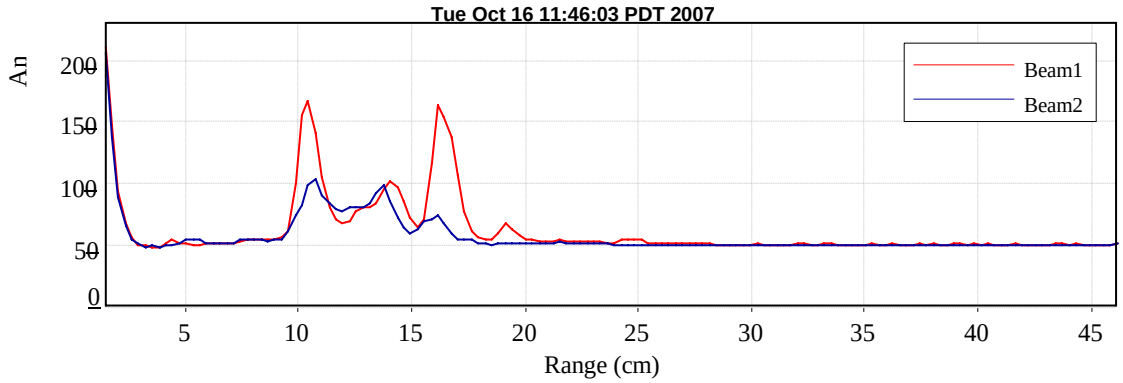
St	Loc	%Dep	Message
1	5.15	0.6	Boundary QC is Poor; possible boundary interference
2	5.20	0.6	High differences in beam SNR: 26.6,4.3
		0.6	Boundary QC is Poor; possible boundary interference
3	5.40	0.6	Boundary QC is Good; possible boundary interference
4	5.55	0.6	High standard error: 0.035
		0.6	Boundary QC is Poor; possible boundary interference
6	5.90	0.6	Boundary QC is Fair; possible boundary interference
7	6.10	0.6	Boundary QC is Good; possible boundary interference
8	6.23	0.6	Boundary QC is Fair; possible boundary interference

Discharge Measurement Summary

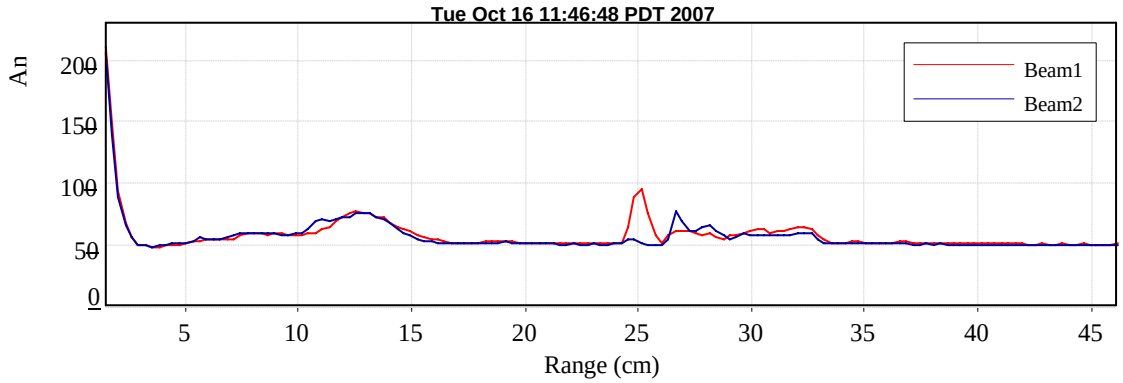
Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	OCW31.MIN.WAD	Site Name	
Start Date and Time	2007/10/16 11:50:56	Operator(s)	KR

Automatic Quality Control Test (BeamCheck)



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Fail
- Peak shape check - Fail



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

Table 7.4-G-7.1: Discharge Measurement on Oakley Creek at OCAWR on 10/16/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Oakley Creek upstream from Oakley Creek and William River confluence approximately 50 meters.

Date: 16-Oct **2007** **Party:** James Dietzmann, Ken Bud

Width (m): 9.1 **Area (sq m):** 10.8 **Vel (m/sec):** 0.2 **G.H. (m):** NA **Disch. (cms):** 1.7

No Secs. 10 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.** 1

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
15:20	SGOCAWR	NA
16:00	SGOCAWR	NA

Type of meter:	Price AA
Date rated:	NA
Meter:	
Spin before meas.	3 min 28 sec
Spin after meas.	3 min 6sec
Method:	Back Pack Rod
Weather:	Clear
Air Temp.	20°C
Precip.	None
Cloud Cover	None
Wind	Windy

Measurement rated: Poor

Cross section: Straight reach upstreak from William River confluence. Dense brush on right bank, silty channel bottom.

Flow: Uniform.

Other: Reach is typical of lower Oakley Creek, high sinuosity and silty banks and channel.

Control: Meander bend upstream and William River confluence approximately 30 meters downstream.

Remarks: Time limitation due to helpicopter schedule prevented obtaining 20 verticles.

Benchmark not surveyed to MSL in 2007 due to poor visibility in October, limiting helicopter access.

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Table 7.4-G-7.1: Discharge Measurement on Oakley Creek at OCAWR on 10/16/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	2.00	0.0	0.0								Left edge of water
	3.00	1.0	1.2	0.6	4	45	0.065	0.065	1.2	0.1	Silty bottom
											some grass
	4.00	1.0	1.3	0.6	12	40	0.207	0.207	1.3	0.3	Silty bottom
	5.00	1.0	1.6	0.6	13	44	0.204	0.204	1.6	0.3	Silty bottom
	6.00	0.8	1.6	0.6	13	44	0.204	0.204	1.2	0.2	Silty bottom
	6.50	0.5	1.6	0.6	13	44	0.204	0.204	0.8	0.2	Silty bottom
	7.00	0.5	1.6	0.6	10	42	0.166	0.166	0.8	0.1	Silty bottom
	7.50	0.5	1.6	0.6	10	42	0.166	0.166	0.8	0.1	Silty bottom
	8.00	0.5	1.4	0.6	10	42	0.166	0.166	0.7	0.1	Silty bottom
	8.50	0.8	1.4	0.6	8	42	0.134	0.134	1.1	0.1	Silty bottom
	9.50	0.8	1.1	0.6	7	43	0.115	0.115	0.8	0.1	Silty bottom
	10.00	0.8	0.9	0.6	4	43	0.068	0.068	0.7	0.0	Silty bottom
											some grass
	11.10	0.0	0.0								Silty bottom
	Totals	**9.1**							**10.8**	**1.7**	

Table 7.4-G-8.1: Discharge Measurement on Minago River at MRW1 on 7/18/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Minago River on upstream side of Highway 6 bridge crossing.

Date: 18-Jul **2007** **Party:** James Dietzmann, James Phibbs, Chris Brown

Width (m): 17.8 **Area (sq m):** 10.2 **Vel (m/sec):** 1.1 **G.H. (m):** 226.61 **Disch. (cms):** 10.9

No Secs. 13 **G.H. change:** NA **Susp.:** NA

Method coef.: NA **Hor. Angle coef.** NA **Sus. Coef.:** NA **Meter No.** 1

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
13:40	Cut to water	226.61
15:40	Cut to water	226.61

Type of meter:	Price AA
Date rated:	NA
Meter:	
Spin before meas.	3 min 118 sec
Spin after meas.	2 min 50 sec
Method:	Back pack rod from boat
Weather:	Clear and hot
Air Temp.	25^{o}C
Precip.	None
Cloud Cover	None
Wind	Light Breeze

Measurement rated: Fair

Cross section: Straight stretch immediately upstream from Highway 6 bridge crossing. Dense brush on both banks, loose flat rocks make up streambed.

Flow: Uniform.

Flow along right and left bank is in dense alder brush due to high stage, velocity not measured due to brush.

Other:

Control: Bridge abutments approximately 10 meters downstream from cross section.

Remarks: River at high stage due to recent precipitation events, appears to be at or above bankfull.

Staff gage and pressure transducer mounted to northwest concrete bridge abutment.

Page 1 of 2

Table 7.4-G-8.1: Discharge Measurement on Minago River at MRW-1 on 7/18/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	0.80	0.0	0.0								Left edge of water
											dense brush
	3.80	2.0	0.5	0.6	47	41	0.776	0.776	1.0	0.8	Flat loose rocks over bedrock
	4.70	0.9	0.7	0.6	73	41	1.203	1.203	0.6	0.7	Flat loose rocks over bedrock
	5.60	0.9	0.7	0.6	76	41	1.252	1.252	0.7	0.8	Flat loose rocks over bedrock
	6.50	0.9	0.7	0.6	71	41	1.170	1.170	0.7	0.8	Flat loose rocks over bedrock
	7.40	0.9	0.8	0.6	69	41	1.137	1.137	0.7	0.8	Flat loose rocks over bedrock
	8.30	0.9	0.8	0.6	65	40	1.098	1.098	0.7	0.8	Flat loose rocks over bedrock
	9.20	0.9	0.9	0.6	71	41	1.170	1.170	0.8	1.0	Flat loose rocks over bedrock
	10.10	0.9	0.9	0.6	75	41	1.236	1.236	0.8	1.0	Flat loose rocks over bedrock
	11.00	0.9	0.9	0.6	76	41	1.252	1.252	0.8	1.0	Flat loose rocks over bedrock
	11.90	0.9	0.9	0.6	65	40	1.098	1.098	0.9	0.9	Flat loose rocks over bedrock
	12.80	0.9	0.9	0.6	67	40	1.132	1.132	0.9	1.0	Flat loose rocks over bedrock
	13.70	0.9	0.7	0.6	66	41	1.088	1.088	0.7	0.7	Flat loose rocks over bedrock
	14.60	2.5	0.4	0.6	37	41	0.612	0.612	1.0	0.6	Flat loose rocks over bedrock
	18.60	0.0	0.0								Dense brush, velocity
											measurements not obtainable
	Total:	**17.8**							**10.2**	**10.9**	Page 2 of 2

Table 7.4-G-8.2: Discharge Measurement on Minago River at MRW1 on 8/13/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Minago River on upstream side of Highway 6 bridge crossing.

Date: 13-Aug **2007** **Party:** James Phibbs, Chris Brown

Width (m): 11.9 **Area (sq m):** 4.0 **Vel (m/sec):** 0.3 **G.H. (m):** 226.20 **Disch. (cms):** 1.3

No Secs. 13 **G.H. change:** **Susp.:**

Method coef.: **Hor. Angle coef.** **Sus. Coef.:** **Meter No.**

Water Surface Elevation Readings

Time	Description	WSE
15:00	SG-MRW1	226.20
15:40	SG-MRW1	226.20

Type of meter:	Swoffer
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	
Weather:	
Air Temp.	15°C
Precip.	None
Cloud Cover	None
Wind	Light Breeze

Measurement rated: Fair

Cross section: Straight stretch immediately upstream from Highway 6 bridge crossing. Dense brush on both banks, loose flat rocks make up streambed.

Flow: Uniform.

Flow along right and left bank is in dense alder brush due to high stage, velocity not measured due to brush.

Other:

Control: Bridge abutments immediately downstream from cross section.

Remarks:

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Table 7.4-G-8.2: Discharge Measurement on Minago River at MRW1 on 8/13/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	3.2	0.0	0.0								Left edge of water
											dense brush
	5.0	1.2	0.27	0.6	NA	NA	0.23	0.23	0.32	0.07	Flat loose rocks over bedrock
	5.6	0.6	0.28	0.6	NA	NA	0.46	0.46	0.17	0.08	Flat loose rocks over bedrock
	6.2	0.6	0.32	0.6	NA	NA	0.58	0.58	0.19	0.11	Flat loose rocks over bedrock
	6.8	0.6	0.39	0.6	NA	NA	0.53	0.53	0.23	0.12	Flat loose rocks over bedrock
	7.4	0.6	0.35	0.6	NA	NA	0.35	0.35	0.21	0.07	Flat loose rocks over bedrock
	8.0	0.6	0.39	0.6	NA	NA	0.33	0.33	0.23	0.08	Flat loose rocks over bedrock
	8.6	0.6	0.45	0.6	NA	NA	0.30	0.30	0.27	0.08	Flat loose rocks over bedrock
	9.2	0.5	0.46	0.6	NA	NA	0.32	0.32	0.21	0.07	Flat loose rocks over bedrock
	9.5	0.3	0.47	0.6	NA	NA	0.30	0.30	0.14	0.04	Flat loose rocks over bedrock
	9.8	0.5	0.44	0.6	NA	NA	0.32	0.32	0.20	0.06	Flat loose rocks over bedrock
	10.4	0.4	0.49	0.6	NA	NA	0.44	0.44	0.22	0.10	Flat loose rocks over bedrock
	10.7	0.3	0.38	0.6	NA	NA	0.51	0.51	0.11	0.06	Flat loose rocks over bedrock
	11.0	0.5	0.45	0.6	NA	NA	0.45	0.45	0.20	0.09	Flat loose rocks over bedrock
	11.6	0.6	0.40	0.6	NA	NA	0.25	0.25	0.24	0.06	Flat loose rocks over bedrock

Table 7.4-G-8.2: Discharge Measurement on Minago River at MRW1 on 8/13/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	12.20	0.60	0.45	0.6	NA	NA	0.29	0.29	0.27	0.08	Gravel streambed
	12.80	0.60	0.44	0.6	NA	NA	0.31	0.31	0.26	0.08	Gravel streambed
	13.40	0.45	0.41	0.6	NA	NA	0.22	0.22	0.18	0.04	Gravel streambed
											some grass
	13.70	0.30	0.35	0.6	NA	NA	0.30	0.30	0.11	0.03	Gravel streambed
	14.00	0.30	0.17	0.6	NA	NA	0.24	0.24	0.05	0.01	Gravel streambed
	14.30	0.55	0.24	0.6	NA	NA	0.02	0.02	0.13	0.003	Gravel streambed
	15.10	0.00	0.00								Right edge of water
	Totals	**11.9**							**4.0**	**1.3**	

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Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information

File Name	MRW1.MIN.WAD
Start Date and Time	2007/09/11 13:57:48

Site Details

Site Name	MRW1
Operator(s)	KR

System Information

Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units (Metric Units)

Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.5%	3.9%
Velocity	1.5%	10.7%
Width	0.2%	0.2%
Method	2.7%	-
# Stations	2.6%	-
Overall	4.2%	11.5%

Summary

Averaging Int.	10	# Stations	19
Start Edge	LEW	Total Width	10.500
Mean SNR	24.2 dB	Total Area	2.208
Mean Temp	11.34 °C	Mean Depth	0.210
Disch. Equation	Mid-Section	Mean Velocity	0.1026
		Total Discharge	0.2265

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area		Flow	%Q
0	13:57	2.50	None	0.050		0.0	0.0	0.0000	1.00	0.0032	0.003	0.0000	0.0	
1	*13:57*	*2.60*	*0.6*	*0.080*	*0.6*	*0.032*		*0.0032*	*1.00*	*0.0032*	*0.028*	*0.0001*	*0.0*	
2	13:59	3.20	0.6	0.100	0.6	0.040		0.0447	1.00	0.0447	0.055	0.0025	1.1	
3	14:00	3.70	0.6	0.240	0.6	0.096		0.0492	1.00	0.0492	0.156	0.0077	3.4	
4	*14:02*	*4.50*	*0.6*	*0.330*	*0.6*	*0.132*		*0.0398*	*1.00*	*0.0398*	*0.248*	*0.0099*	*4.3*	
5	*14:03*	*5.20*	*0.6*	*0.350*	*0.6*	*0.140*		*0.0569*	*1.00*	*0.0569*	*0.210*	*0.0119*	*5.3*	
6	14:04	5.70	0.6	0.280	0.6	0.112		0.2063	1.00	0.2063	0.182	0.0375	16.6	
7	14:05	6.50	0.6	0.280	0.6	0.112		0.1953	1.00	0.1953	0.196	0.0383	16.9	
8	14:05	7.10	0.6	0.260	0.6	0.104		0.1926	1.00	0.1926	0.156	0.0300	13.3	
9	14:06	7.70	0.6	0.300	0.6	0.120		0.1659	1.00	0.1659	0.195	0.0324	14.3	
10	*14:07*	*8.40*	*0.6*	*0.260*	*0.6*	*0.104*		*0.2019*	*1.00*	*0.2019*	*0.156*	*0.0315*	*13.9*	
11	*14:08*	*8.90*	*0.6*	*0.200*	*0.6*	*0.080*		*0.2183*	*1.00*	*0.2183*	*0.110*	*0.0240*	*10.6*	
12	*14:09*	*9.50*	*0.6*	*0.200*	*0.6*	*0.080*		*0.0032*	*1.00*	*0.0032*	*0.110*	*0.0004*	*0.2*	
13	*14:10*	*10.00*	*0.6*	*0.170*	*0.6*	*0.068*		*-0.0003*	*1.00*	*-0.0003*	*0.102*	*0.0000*	*0.0*	
14	*14:11*	*10.70*	*0.6*	*0.180*	*0.6*	*0.072*		*0.0018*	*1.00*	*0.0018*	*0.108*	*0.0002*	*0.1*	
15	*14:13*	*11.20*	*0.6*	*0.130*	*0.6*	*0.052*		*0.0004*	*1.00*	*0.0004*	*0.078*	*0.0000*	*0.0*	
16	*14:15*	*11.90*	*0.6*	*0.110*	*0.6*	*0.044*		*0.0002*	*1.00*	*0.0002*	*0.061*	*0.0000*	*0.0*	
17	*14:17*	*12.30*	*0.6*	*0.100*	*0.6*	*0.040*		*0.0024*	*1.00*	*0.0024*	*0.055*	*0.0001*	*0.1*	
18	14:17	13.00	None	0.000		0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0	

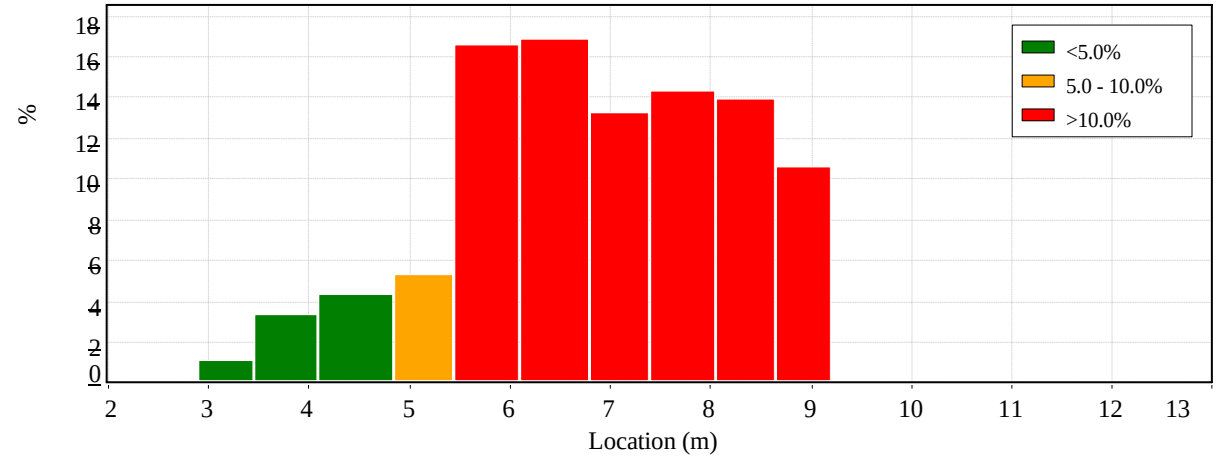
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

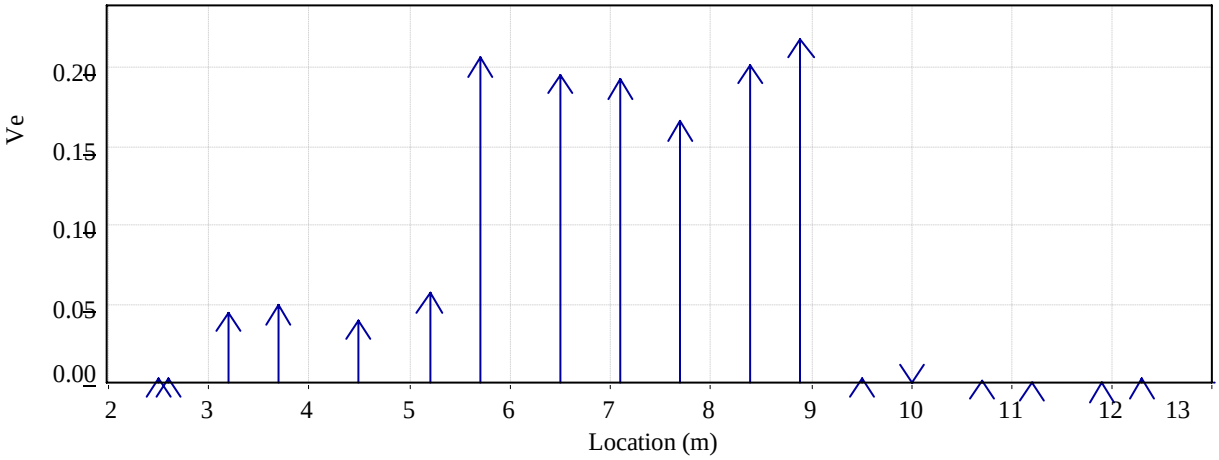
7.4–85

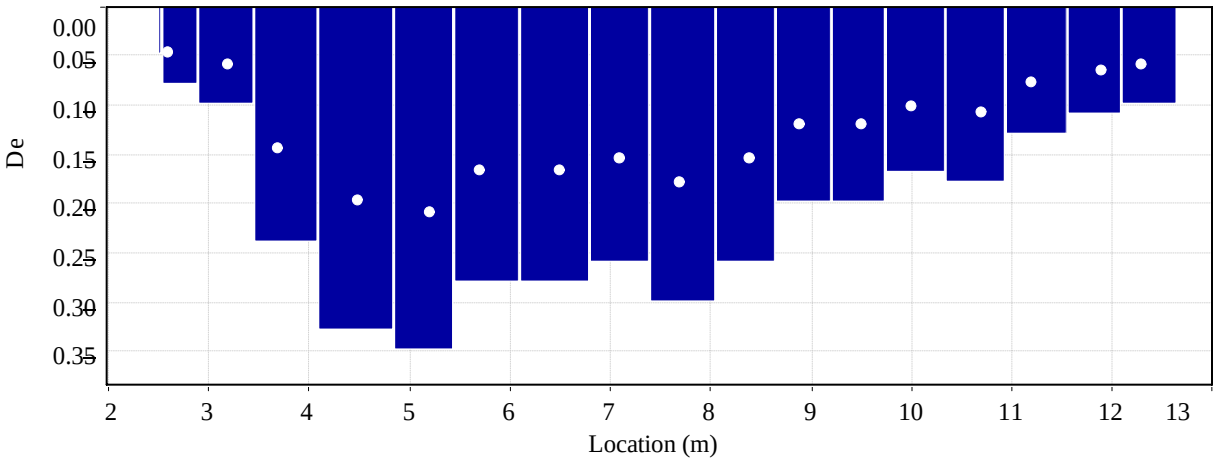
Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	MRW1.MIN.WAD	Site Name	MRW1
Start Date and Time	2007/09/11 13:57:48	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	MRW1.MIN.WAD	Site Name	MRW1
Start Date and Time	2007/09/11 13:57:48	Operator(s)	KR

Quality Control

St	Loc	%Dep	Message
1	2.60	0.6	SNR (38.4) is different from typical SNR (24.2)
		0.6	Boundary QC is Good; possible boundary interference
4	4.50	0.6	High angle: -36
5	5.20	0.6	High standard error: 0.011
10	8.40	0.6	High angle: -22
		0.6	High standard error: 0.010
11	8.90	0.6	High angle: -27
12	9.50	0.6	High differences in beam SNR: 31.3,19.3
		0.6	Boundary QC is Fair; possible boundary interference
13	10.00	0.6	High differences in beam SNR: 57.6,42.5
		0.6	SNR (50.1) is different from typical SNR (24.2)
		0.6	High SNR variation during measurement: 7.7,6.9
14	10.70	0.6	Boundary QC is Fair; possible boundary interference
15	11.20	0.6	High differences in beam SNR: 58.0,41.7
		0.6	SNR (49.9) is different from typical SNR (24.2)
16	11.90	0.6	High number of spikes: 4
		0.6	High differences in beam SNR: 38.2,27.9
17	12.30	0.6	Boundary QC is Fair; possible boundary interference

7.4–87

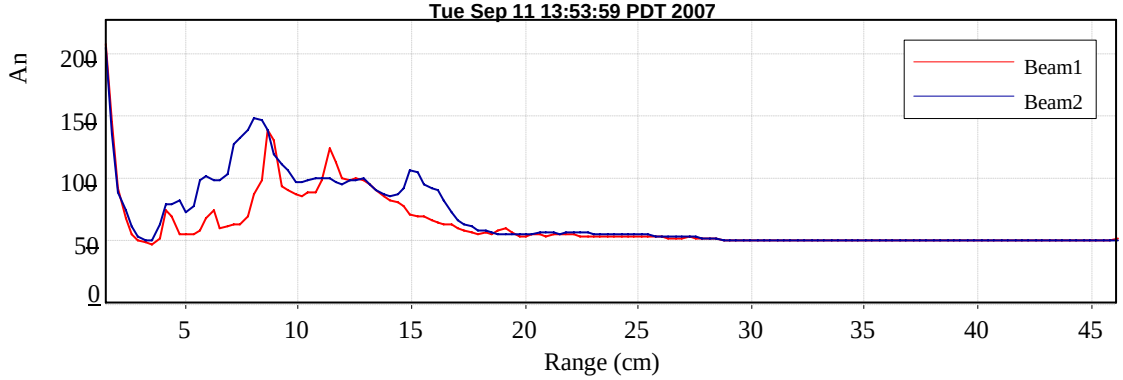
Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	MRW1.MIN.WAD	Site Name	MRW1
Start Date and Time	2007/09/11 13:57:48	Operator(s)	KR

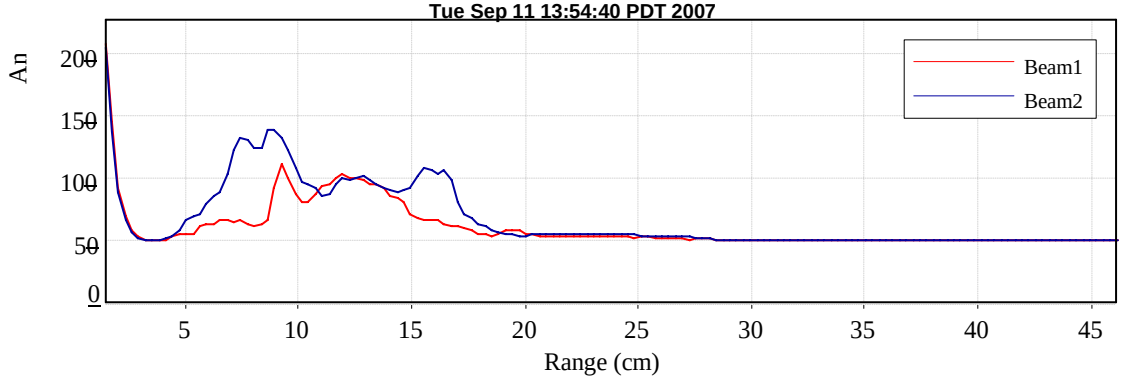
Automatic Quality Control Test (BeamCheck)

Tue Sep 11 13:53:59 PDT 2007



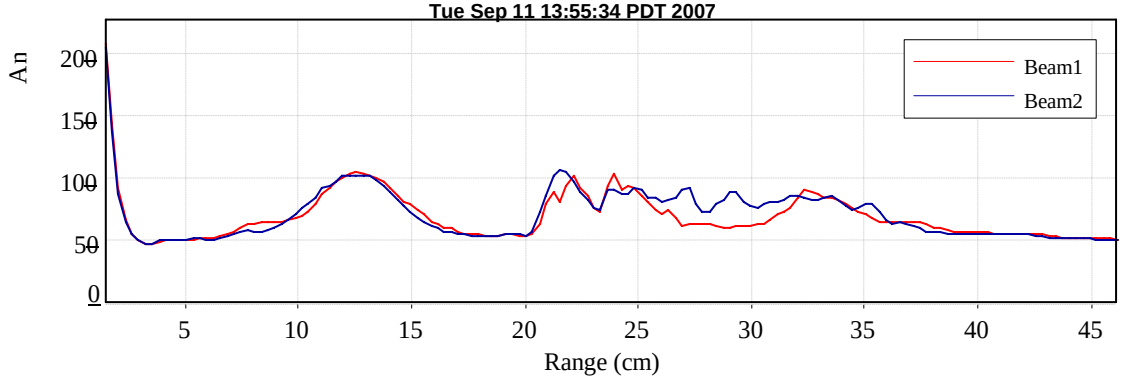
- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Fail

Tue Sep 11 13:54:40 PDT 2007



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Fail
- Peak shape check - Fail

Tue Sep 11 13:55:34 PDT 2007



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

7.4–88

Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information	
File Name	MRW1O1.WAD
Start Date and Time	2007/10/14 13:25:56

Site Details	
Site Name	
Operator(s)	KR

System Information	
Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units	(Metric Units)
Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Summary			
Averaging Int.	10	# Stations	21
Start Edge	LEW	Total Width	12.550
Mean SNR	17.8 dB	Total Area	4.973
Mean Temp	6.14 °C	Mean Depth	0.396
Disch. Equation	Mid-Section	Mean Velocity	0.4828
		Total Discharge	2.4007

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.1%	2.4%
Velocity	1.2%	5.4%
Width	0.1%	0.1%
Method	2.0%	-
# Stations	2.4%	-
Overall	3.5%	6.0%

Measurement Results

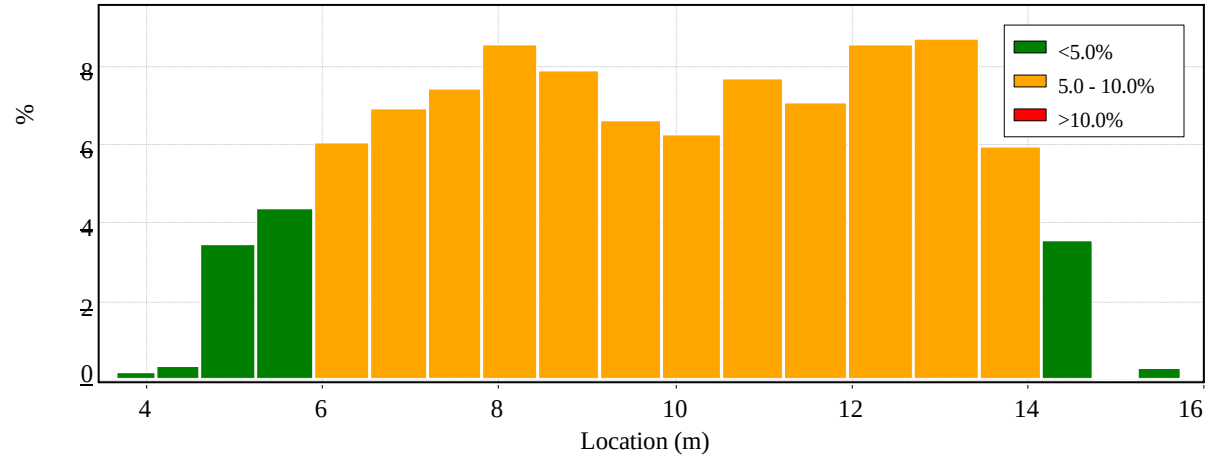
St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area		Flow	%Q
0	13:25	3.45	None	0.000	0.0	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	*13:25*	*3.90*	*0.6*	*0.150*	*0.6*	*0.060*	*0.0581*	*1.00*	*0.0581*	*0.068*	*0.0039*	*0.2*
2	*13:27*	*4.35*	*0.6*	*0.130*	*0.6*	*0.052*	*0.1259*	*1.00*	*0.1259*	*0.065*	*0.0082*	*0.3*
3	*13:28*	*4.90*	*0.6*	*0.320*	*0.6*	*0.128*	*0.4133*	*1.00*	*0.4133*	*0.200*	*0.0827*	*3.4*
4	*13:29*	*5.60*	*0.6*	*0.510*	*0.6*	*0.204*	*0.3185*	*1.00*	*0.3185*	*0.332*	*0.1056*	*4.4*
5	*13:30*	*6.20*	*0.6*	*0.480*	*0.6*	*0.192*	*0.4648*	*1.00*	*0.4648*	*0.312*	*0.1450*	*6.0*
6	13:31	6.90	0.6	0.540	0.6	0.216	0.4740	1.00	0.4740	0.351	0.1664	6.9
7	13:31	7.50	0.6	0.540	0.6	0.216	0.5514	1.00	0.5514	0.324	0.1787	7.4
8	13:32	8.10	0.6	0.510	0.6	0.204	0.6219	1.00	0.6219	0.332	0.2062	8.6
9	13:33	8.80	0.6	0.540	0.6	0.216	0.5009	1.00	0.5009	0.378	0.1893	7.9
10	13:33	9.50	0.6	0.540	0.6	0.216	0.4222	1.00	0.4222	0.378	0.1596	6.6
11	13:35	10.20	0.6	0.500	0.6	0.200	0.4472	1.00	0.4472	0.338	0.1509	6.3
12	13:36	10.85	0.6	0.480	0.6	0.192	0.5506	1.00	0.5506	0.336	0.1850	7.7
13	13:37	11.60	0.6	0.380	0.6	0.152	0.6190	1.00	0.6190	0.276	0.1705	7.1
14	13:38	12.30	0.6	0.460	0.6	0.184	0.5968	1.00	0.5968	0.345	0.2059	8.6
15	*13:39*	*13.10*	*0.6*	*0.400*	*0.6*	*0.160*	*0.6991*	*1.00*	*0.6991*	*0.300*	*0.2097*	*8.7*
16	*13:40*	*13.80*	*0.6*	*0.400*	*0.6*	*0.160*	*0.5124*	*1.00*	*0.5124*	*0.280*	*0.1435*	*6.0*
17	13:41	14.50	0.6	0.300	0.6	0.120	0.4719	1.00	0.4719	0.180	0.0849	3.5
18	*13:42*	*15.00*	*0.6*	*0.240*	*0.6*	*0.096*	*-0.0170*	*1.00*	*-0.0170*	*0.120*	*-0.0020*	*-0.1*
19	*13:43*	*15.50*	*0.6*	*0.120*	*0.6*	*0.048*	*0.1125*	*1.00*	*0.1125*	*0.060*	*0.0068*	*0.3*
20	13:43	16.00	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

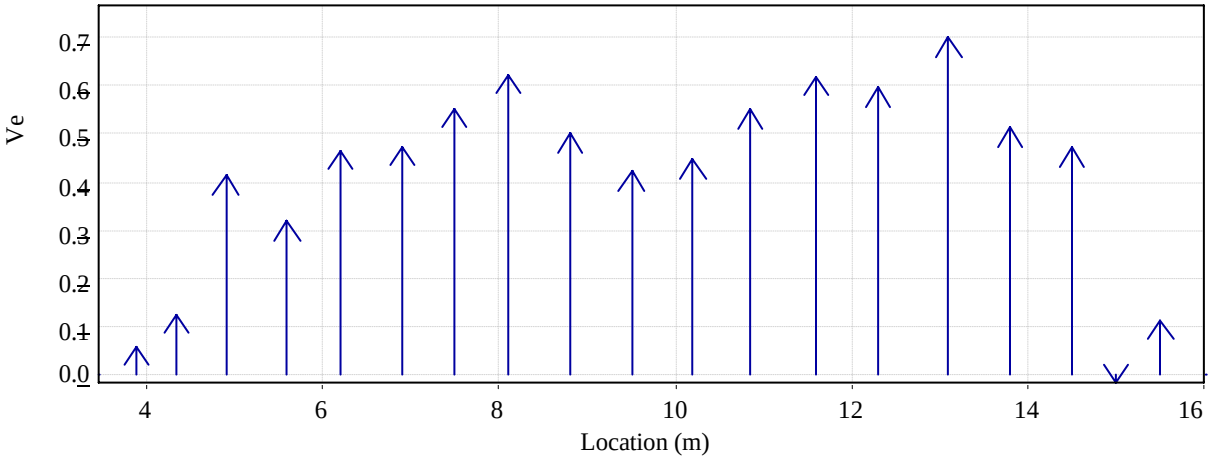
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

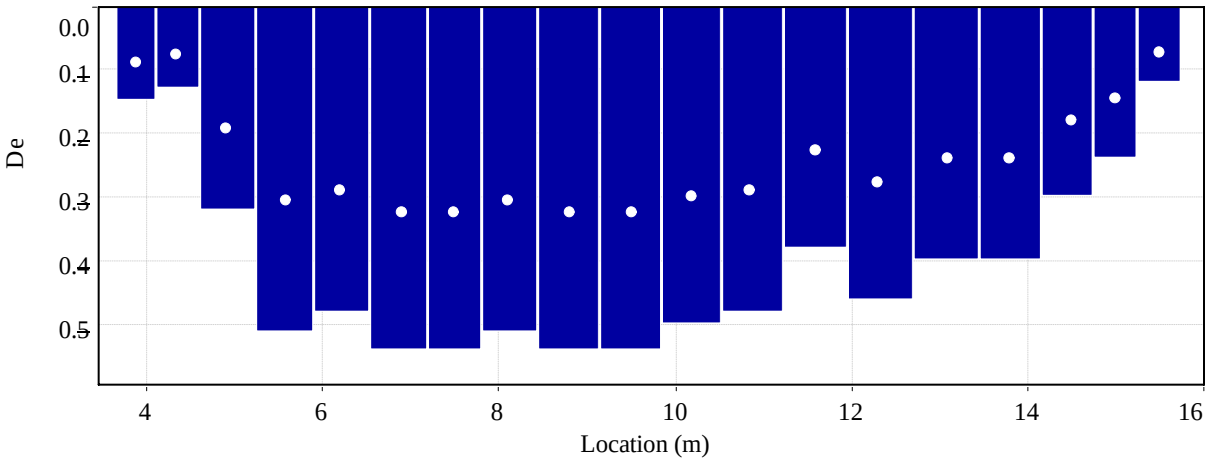
Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	MRW1O1.WAD	Site Name	
Start Date and Time	2007/10/14 13:25:56	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	MRW1O1.WAD	Site Name	
Start Date and Time	2007/10/14 13:25:56	Operator(s)	KR

Quality Control

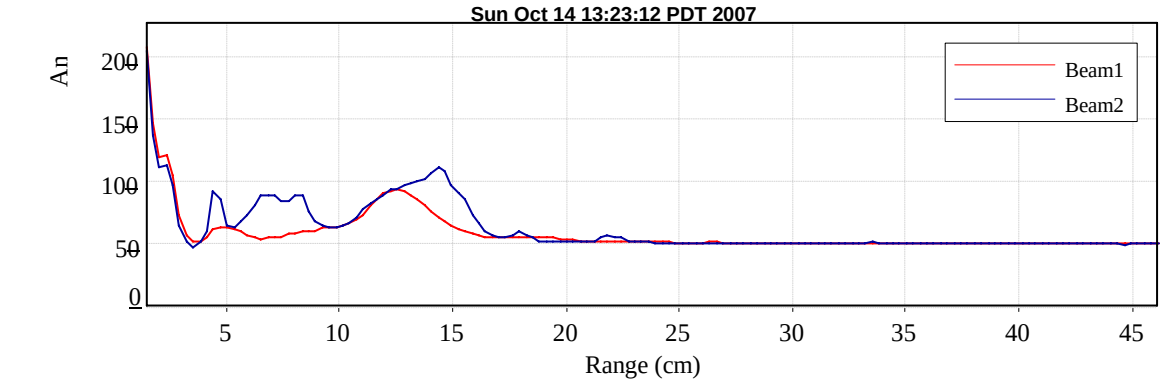
St	Loc	%Dep	Message
1	3.90	0.6	SNR (35.0) is different from typical SNR (17.8)
2	4.35	0.6	High angle: 21
3	4.90	0.6	High angle: 24
4	5.60	0.6	High angle: 24
5	6.20	0.6	High standard error: 0.036
15	13.10	0.6	High standard error: 0.045
16	13.80	0.6	High standard error: 0.046
18	15.00	0.6	High number of spikes: 3
		0.6	High SNR variation during measurement: 4.7,6.0
		0.6	Boundary QC is Poor; possible boundary interference
19	15.50	0.6	High standard error: 0.038
		0.6	Boundary QC is Poor; possible boundary interference

Discharge Measurement Summary

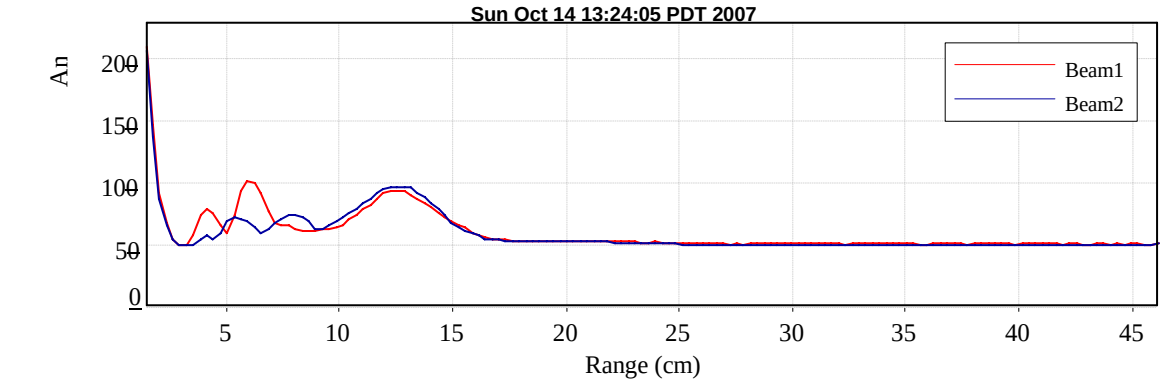
Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	MRW1O1.WAD	Site Name	
Start Date and Time	2007/10/14 13:25:56	Operator(s)	KR

Automatic Quality Control Test (BeamCheck)



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Fail
- Peak shape check - Pass



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

Table 7.4-G-9.1: Discharge Measurement on Minago River at MRW2 on 7/23/2007

DISCHARGE MEASUREMENT NOTES

LOCATION:	Upper Minago River								
Date:	23-Jul	**2007**	**Party:**	James Phibbs, Chris Brown					
Width (m):	14.0	**Area (sq m):**	7.2	**Vel (m/sec):**	0.2	**G.H. (m):**	233.24	**Disch. (cms):**	1.3
No Secs.	22	**G.H. change:**		**in.:**		**hrs.:**		**Susp.:**	
						Sus. Coef.:		**Meter No.**	1

Water Surface Elevation Readings (meters, MSL)		
Time	**Description**	**WSE**
13:09	SG-MRW2	233.24
14:11	SG-MRW2	233.24

Type of meter:	Price AA
Date rated:	NA
Meter:	
Spin before meas.	3 min 11 sec
Spin after meas.	2 min 50 sec
Method:	Back pack rod
Weather:	Clear and hot
Air Temp.	30^{o}C
Precip.	None
Cloud Cover	None
Wind	Light Breeze

Measurement rated:	Fair
Cross section:	Across the downstream (glide) end of a pool.
Flow:	Relatively uniform in thalweg, less uniform along left and right sides of the channel due to beaver activity.
Other:	
Control:	Disctinct gravel "mound" feature immediately downstream from cross section. Beaver activity suggests that the mounded material
	is from a former beaver dam.
Remarks:	

Page 1 of 3

Table 7.4-G-9.1: Discharge Measurement on Minago River at MRW2 on 7/23/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	2.40	0.0	0.0								Left edge of water
	5.00	1.7	0.3	0.6	4	42	0.069	0.069	0.6	0.04	Soft streambed, some grass
	5.70	0.7	0.4	0.6	5	41	0.087	0.087	0.3	0.02	Soft streambed, some grass
	6.40	0.7	0.6	0.6	6	41	0.104	0.104	0.4	0.05	Soft streambed, some grass
	7.10	0.7	0.7	0.6	10	42	0.166	0.166	0.5	0.1	Gravel streambed
	7.80	0.7	0.8	0.6	12	41	0.202	0.202	0.5	0.1	Gravel streambed
	8.50	0.5	0.7	0.6	15	43	0.240	0.240	0.4	0.1	Gravel streambed
	8.85	0.4	0.7	0.6	15	40	0.258	0.258	0.3	0.1	Gravel streambed
	9.20	0.4	0.7	0.6	13	40	0.224	0.224	0.3	0.1	Gravel streambed
	9.55	0.4	0.7	0.6	15	41	0.251	0.251	0.3	0.1	Gravel streambed
	9.90	0.4	0.7	0.6	15	41	0.251	0.251	0.3	0.1	Gravel streambed
	10.25	0.4	0.6	0.6	16	42	0.262	0.262	0.2	0.1	Gravel streambed
	10.60	0.4	0.7	0.6	17	41	0.284	0.284	0.2	0.1	Gravel streambed
	10.95	0.4	0.6	0.6	17	42	0.278	0.278	0.2	0.1	Gravel streambed
	11.30	0.5	0.6	0.6	16	40	0.274	0.274	0.3	0.1	Gravel streambed

Table 7.4-G-9.1: Discharge Measurement on Minago River at MRW2 on 7/23/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	12.00	0.5	0.6	0.6	14	41	0.235	0.235	0.3	0.1	Gravel streambed
	12.35	0.5	0.6	0.6	16	41	0.268	0.268	0.3	0.1	Gravel streambed
	13.05	0.7	0.5	0.6	14	41	0.235	0.235	0.4	0.1	Gravel streambed
											some grass
	13.75	0.5	0.6	0.6	9	41	0.153	0.153	0.3	0.05	Gravel streambed
	14.10	0.5	0.6	0.6	8	42	0.134	0.134	0.3	0.04	Gravel streambed
	14.80	0.7	0.5	0.6	7	41	0.120	0.120	0.3	0.04	Gravel streambed
	15.50	0.8	0.4	0.6	3	50	0.046	0.046	0.3	0.01	Gravel streambed
	16.30	0.4	0.4	0.6	2	76	0.023	0.076	0.2	0.01	Gravel streambed
	16.40	0.0	0.0								Right edge of water
	Total:	**14.0**							**7.2**	**1.3**	

Table 7.4-G-9.2: Discharge Measurement on Minago River at MRW2 on 8/15/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Upper Minago River

Date: 15-Aug **2007** **Party:** James Phibbs, Chris Brown

Width (m): 13.0 **Area (sq m):** 5.9 **Vel (m/sec):** 0.1 **G.H. (m):** 233.11 **Disch. (cms):** 0.4

No Secs. 22 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.**

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
16:15	SG-MRW2	233.11
16:40	SG-MRW2	233.11

Type of meter:	Swoffer
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	
Weather:	
Air Temp.	15°C
Precip.	None
Cloud Cover	None
Wind	Light Breeze

Measurement rated: Fair

Cross section: Across the downstream (glide) end of a pool.

Flow: Relatively uniform in thalweg, less uniform along left and right sides of the channel due to beaver activity.

Other:

Control: Disctinct gravel "mound" feature immediately downstream from cross section. Beaver activity suggests that the mounded material is from a former beaver dam will need to move monitoring site to a new location.

Remarks:

Page 1 of 3

Table 7.4-G-9.2: Discharge Measurement on Minago River at MRW2 on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	4.00	0.0	0.0								Left edge of water
	4.65	0.65	0.27	0.6	NA	NA	0.01	0.01	0.18	0.002	Soft streambed, some grass
	5.30	0.98	0.32	0.6	NA	NA	0.02	0.02	0.31	0.01	Soft streambed, some grass
	6.60	0.98	0.58	0.6	NA	NA	0.04	0.04	0.57	0.02	Weeds
	7.25	0.65	0.62	0.6	NA	NA	0.07	0.07	0.40	0.03	Gravel streambed
	7.90	0.49	0.60	0.6	NA	NA	0.08	0.08	0.29	0.02	Gravel streambed
	8.23	0.33	0.62	0.6	NA	NA	0.08	0.08	0.20	0.02	Gravel streambed
	8.55	0.33	0.63	0.6	NA	NA	0.12	0.12	0.20	0.02	Gravel streambed
	8.88	0.32	0.62	0.6	NA	NA	0.08	0.08	0.20	0.02	Gravel streambed
	9.20	0.33	0.62	0.6	NA	NA	0.11	0.11	0.20	0.02	Gravel streambed
	9.53	0.33	0.60	0.6	NA	NA	0.11	0.11	0.20	0.02	Gravel streambed
	9.85	0.33	0.57	0.6	NA	NA	0.12	0.12	0.19	0.02	Gravel streambed
	10.18	0.33	0.57	0.6	NA	NA	0.12	0.12	0.19	0.02	Gravel streambed
	10.50	0.32	0.52	0.6	NA	NA	0.07	0.07	0.17	0.01	Gravel streambed
	10.83	0.33	0.53	0.6	NA	NA	0.09	0.09	0.17	0.02	Gravel streambed

Table 7.4-G-9.2: Discharge Measurement on Minago River at MRW2 on 8/15/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cmps)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	11.15	0.33	0.52	0.6	NA	NA	0.10	0.10	0.17	0.02	Gravel streambed
	11.48	0.33	0.55	0.6	NA	NA	0.11	0.11	0.18	0.02	Gravel streambed
	11.80	0.49	0.48	0.6	NA	NA	0.11	0.11	0.23	0.03	Gravel streambed
											some grass
	12.45	0.65	0.47	0.6	NA	NA	0.10	0.10	0.31	0.03	Gravel streambed
	13.10	0.65	0.48	0.6	NA	NA	0.04	0.04	0.31	0.01	Gravel streambed
	13.75	0.65	0.49	0.6	NA	NA	0.08	0.08	0.32	0.03	Gravel streambed
	14.40	0.65	0.47	0.6	NA	NA	0.01	0.01	0.31	0.003	Gravel streambed
	15.05	0.65	0.40	0.6	NA	NA	0.02	0.02	0.26	0.01	Gravel streambed
	15.70	0.98	0.37	0.6	NA	NA	0.01	0.01	0.36	0.004	Gravel streambed
	17.00	0.00	0.0								Right edge of water
	Totals	**13.0**							**5.91**	**0.40**	

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Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information	
File Name	MRW2W.WAD
Start Date and Time	2007/10/16 15:12:07

Site Details	
Site Name	
Operator(s)	KR

System Information	
Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units	(Metric Units)
Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.1%	2.4%
Velocity	2.0%	5.2%
Width	0.1%	0.1%
Method	2.1%	-
# Stations	2.3%	-
Overall	3.9%	5.8%

Summary

Averaging Int.	10	# Stations	22
Start Edge	LEW	Total Width	7.700
Mean SNR	26.4 dB	Total Area	3.872
Mean Temp	6.16 °C	Mean Depth	0.503
Disch. Equation	Mid-Section	Mean Velocity	0.1983
		Total Discharge	0.7678

Measurement Results

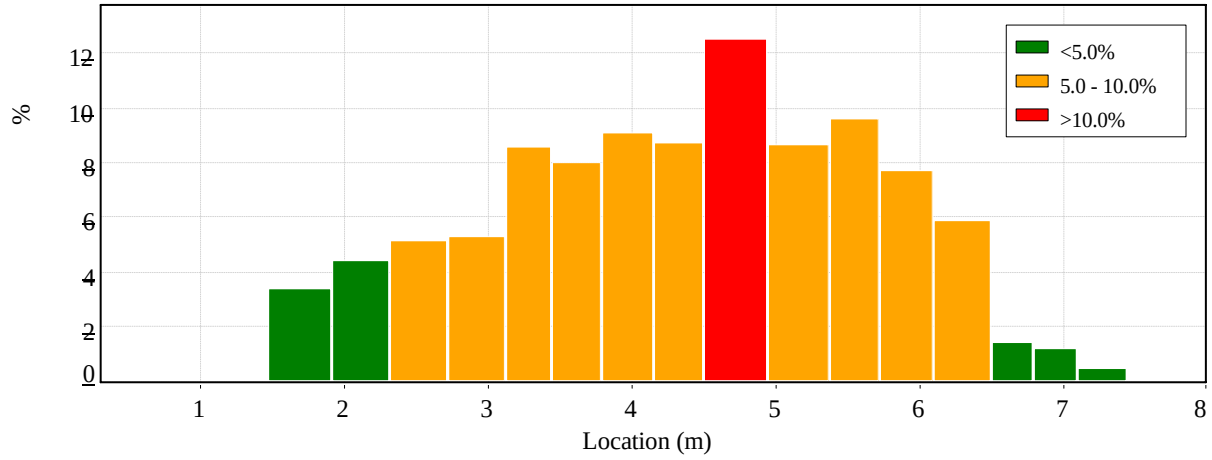
St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area	Flow	%Q
0	15:12	0.30	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	*15:12*	*0.90*	*0.6*	*0.350*	*0.6*	*0.140*	*0.0000*	*1.00*	*0.0000*	*0.166*	*0.0000*	*0.0*
2	*15:13*	*1.25*	*0.6*	*0.405*	*0.6*	*0.162*	*0.0009*	*1.00*	*0.0009*	*0.162*	*0.0001*	*0.0*
3	15:15	1.70	0.6	0.495	0.6	0.198	0.1166	1.00	0.1166	0.223	0.0260	3.4
4	15:16	2.15	0.6	0.505	0.6	0.202	0.1668	1.00	0.1668	0.202	0.0337	4.4
5	15:18	2.50	0.6	0.505	0.6	0.202	0.1952	1.00	0.1952	0.202	0.0394	5.1
6	15:19	2.95	0.6	0.500	0.6	0.200	0.2046	1.00	0.2046	0.200	0.0409	5.3
7	15:20	3.30	0.6	0.640	0.6	0.256	0.3159	1.00	0.3159	0.208	0.0657	8.6
8	*15:22*	*3.60*	*0.6*	*0.670*	*0.6*	*0.268*	*0.2614*	*1.00*	*0.2614*	*0.235*	*0.0613*	*8.0*
9	*15:23*	*4.00*	*0.6*	*0.570*	*0.6*	*0.228*	*0.3488*	*1.00*	*0.3488*	*0.200*	*0.0696*	*9.1*
10	15:24	4.30	0.6	0.680	0.6	0.272	0.2807	1.00	0.2807	0.238	0.0668	8.7
11	*15:25*	*4.70*	*0.6*	*0.560*	*0.6*	*0.224*	*0.3823*	*1.00*	*0.3823*	*0.252*	*0.0963*	*12.5*
12	*15:26*	*5.20*	*0.6*	*0.530*	*0.6*	*0.212*	*0.2942*	*1.00*	*0.2942*	*0.225*	*0.0663*	*8.6*
13	15:28	5.55	0.6	0.580	0.6	0.232	0.3624	1.00	0.3624	0.203	0.0736	9.6
14	15:29	5.90	0.6	0.600	0.6	0.240	0.2639	1.00	0.2639	0.225	0.0594	7.7
15	*15:30*	*6.30*	*0.6*	*0.720*	*0.6*	*0.288*	*0.1577*	*1.00*	*0.1577*	*0.288*	*0.0454*	*5.9*
16	*15:31*	*6.70*	*0.6*	*0.660*	*0.6*	*0.264*	*0.0544*	*1.00*	*0.0544*	*0.198*	*0.0108*	*1.4*
17	15:33	6.90	0.6	0.520	0.6	0.208	0.0581	1.00	0.0581	0.156	0.0091	1.2
18	15:34	7.30	0.6	0.430	0.6	0.172	0.0256	1.00	0.0256	0.151	0.0039	0.5
19	15:35	7.60	0.6	0.350	0.6	0.140	0.0010	1.00	0.0010	0.088	0.0001	0.0
20	*15:36*	*7.80*	*0.6*	*0.260*	*0.6*	*0.104*	*-0.0091*	*1.00*	*-0.0091*	*0.052*	*-0.0005*	*-0.1*
21	15:36	8.00	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

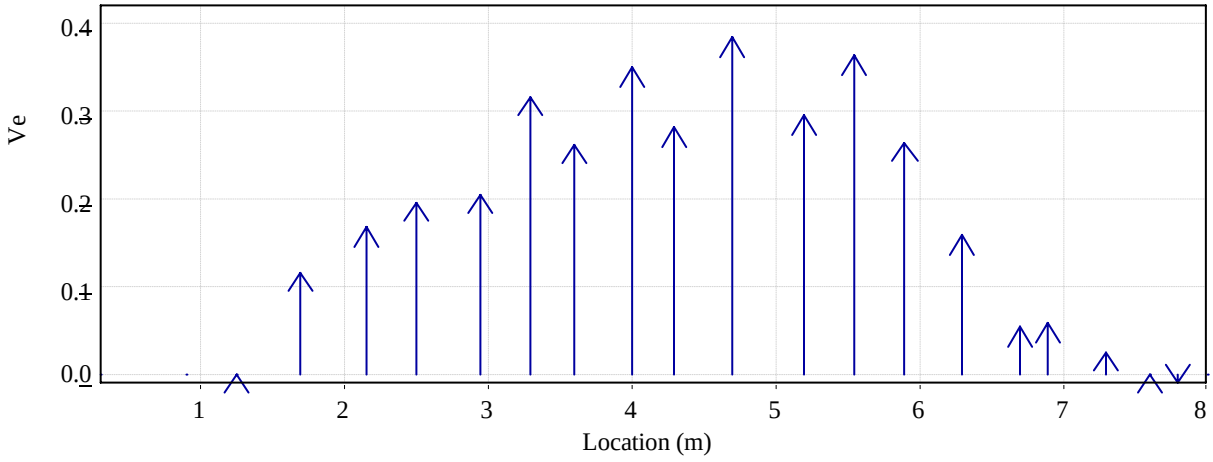
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

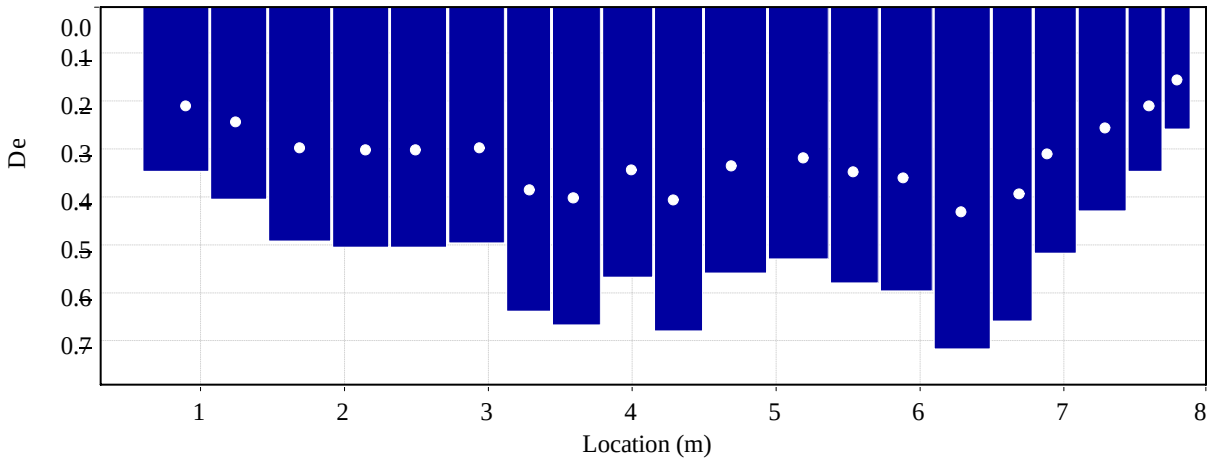
Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	MRW2W.WAD	Site Name	
Start Date and Time	2007/10/16 15:12:07	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	MRW2W.WAD	Site Name	
Start Date and Time	2007/10/16 15:12:07	Operator(s)	KR

Quality Control

St	Loc	%Dep	Message
1	0.90	0.6	High differences in beam SNR: 18.0,39.1
2	1.25	0.6	High differences in beam SNR: 43.0,27.0
		0.6	Boundary QC is Good; possible boundary interference
8	3.60	0.6	High standard error: 0.024
9	4.00	0.6	High standard error: 0.031
11	4.70	0.6	High standard error: 0.027
12	5.20	0.6	High standard error: 0.028
15	6.30	0.6	High angle: -22
16	6.70	0.6	High angle: -25
20	7.80	0.6	High SNR variation during measurement: 10.8,9.9
		0.6	Boundary QC is Fair; possible boundary interference

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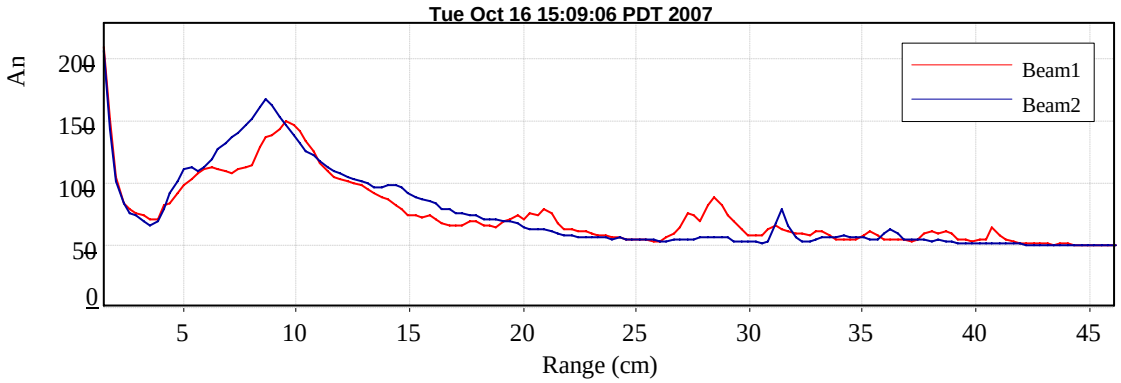
Discharge Measurement Summary

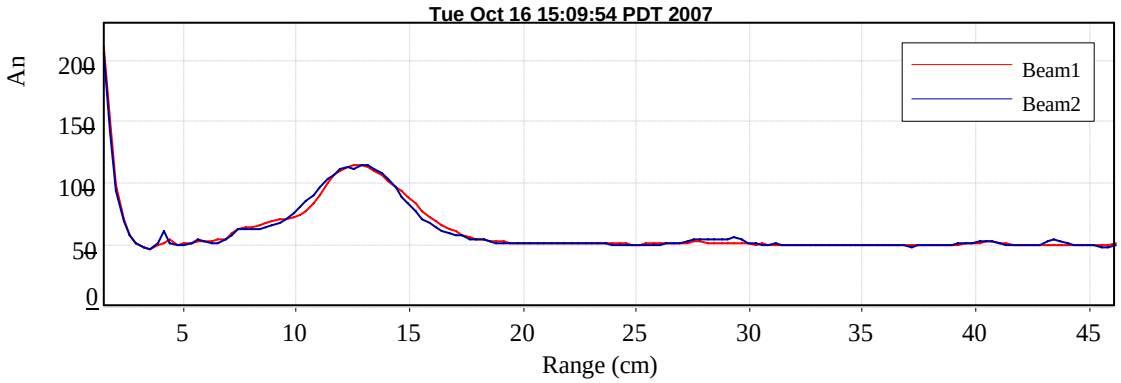
Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	MRW2W.WAD	Site Name	
Start Date and Time	2007/10/16 15:12:07	Operator(s)	KR

Automatic Quality Control Test (BeamCheck)



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Fail
- Peak shape check - Pass



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

Table 7.4-G-10.1: Discharge Measurement on Hargrave River at HRW1 on 7/22/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Hargrave River on upstream side of Highway 6 bridge crossing.

Date: 22-Jul **2007** **Party:** James Dietzmann, James Phibbs, Chris Brown

Width (m): 9.7 **Area (sq m):** 11.2 **Vel (m/sec):** 0.6 **G.H. (m):** 230.23 **Disch. (cms):** 7.0

No Secs. 13 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.** 1

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
16:00	SG-HRW1	230.23
16:38	SG-HRW1	230.23

Type of meter:	Price AA
Date rated:	NA
Meter:	18-inches above 30lb weight
Spin before meas.	3 min 5 sec
Spin after meas.	2 min 50 sec
Method:	Sounding reel from bridge
Weather:	Clear and hot
Air Temp.	30^{o}C
Precip.	None
Cloud Cover	None
Wind	Light Breeze

Measurement rated: Good

Cross section: Upstream side of bridge. The streambed is lined with concrete under the bridge.

Flow: Relatively uniform - flow is less uniform adjacent to the two center support columns (upwelling).

Other: The bridge design divides flow into three separate concrete channels, uniform in dimension.

Control: Bridge abutments.

Remarks: Staff gage and pressure transducer mounted to northwest concrete bridge abutment.

Temporary bench mark is an "X" scratched into the north end of the concrete railing on the upstream side of the bridge

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Table 7.4-G-10.1: Discharge Measurement on Hargrave River at HRW-1 on 7/22/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	0.70	0.0	0.0	0.6							Left edge of water
	1.10	0.4	1.2	0.6	37	40	0.627	0.627	0.5	0.3	Concrete lined bridge
	1.57	0.5	1.2	0.6	40	40	0.678	0.678	0.5	0.4	Concrete lined bridge
	2.00	0.4	1.2	0.6	40	40	0.678	0.678	0.5	0.3	Concrete lined bridge
	2.45	0.5	1.2	0.6	38	40	0.644	0.644	0.5	0.4	Concrete lined bridge
	2.90	0.4	1.2	0.6	37	40	0.627	0.627	0.5	0.3	Concrete lined bridge
	3.30	0.4	1.2	0.6	37	40	0.627	0.627	0.5	0.3	Concrete lined bridge
	3.75	0.4	1.2	0.6	34	41	0.563	0.563	0.4	0.2	Concrete lined bridge
	4.00	0.4	1.2	0.6	22	41	0.366	0.366	0.4	0.2	Concrete lined bridge
											Non-uniform flow (upwelling)
	4.45	0.5	1.2	0.6	30	40	0.510	0.510	0.5	0.3	Concrete lined bridge
	4.90	0.4	1.2	0.6	43	40	0.728	0.728	0.5	0.4	Concrete lined bridge
	5.30	0.4	1.2	0.6	43	40	0.728	0.728	0.5	0.4	Concrete lined bridge
	5.75	0.5	1.2	0.6	40	40	0.678	0.678	0.5	0.4	Concrete lined bridge
	6.20	0.4	1.2	0.6	44	40	0.745	0.745	0.5	0.4	Concrete lined bridge
	6.60	0.4	1.2	0.6	42	40	0.712	0.712	0.5	0.4	Concrete lined bridge

Table 7.4-G-10.1: Discharge Measurement on Hargrave River at HRW-1 on 7/22/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	7.05	0.4	1.2	0.6	39	41	0.645	0.645	0.4	0.3	Concrete lined bridge
	7.30	0.3	1.2	0.6	33	41	0.547	0.547	0.4	0.2	Concrete lined bridge
	7.70	0.5	1.2	0.6	36	41	0.596	0.596	0.5	0.3	Concrete lined bridge
	8.20	0.5	1.2	0.6	37	41	0.612	0.612	0.5	0.3	Concrete lined bridge
	8.60	0.4	1.2	0.6	35	40	0.594	0.594	0.5	0.3	Concrete lined bridge
	9.00	0.5	1.2	0.6	36	41	0.596	0.596	0.5	0.3	Concrete lined bridge
	9.50	0.5	1.2	0.6	36	40	0.611	0.611	0.5	0.3	Concrete lined bridge
	9.90	0.4	1.2	0.6	37	40	0.627	0.627	0.5	0.3	Concrete lined bridge
	10.35	0.0	0.0								Right edge of water
	Total:	**9.7**							**11.2**	**7.0**	

Table 7.4-G-10.2: Discharge Measurement on Hargrave River at HRW1 on 8/13/2007

DISCHARGE MEASUREMENT NOTES

LOCATION: Hargrave River on upstream side of Highway 6 bridge crossing.

Date: 13-Aug **2007** **Party:** James Phibbs, Chris Brown

Width (m): 9.7 **Area (sq m):** 6.5 **Vel (m/sec):** 0.4 **G.H. (m):** 229.68 **Disch. (cms):** 2.6

No Secs. 13 **G.H. change:** NA **in.:** **hrs.:** **Susp.:** NA

Sus. Coef.: **Meter No.**

Water Surface Elevation Readings (meters, MSL)

Time	Description	WSE
10:55	SG-HRW1	229.68
11:15	SG-HRW1	229.68

Type of meter:	Swoffer
Date rated:	NA
Meter:	
Spin before meas.	NA
Spin after meas.	NA
Method:	
Weather:	
Air Temp.	15°C
Precip.	None
Cloud Cover	None
Wind	Light Breeze

Measurement rated: Good

Cross section: Upstream side of bridge. The streambed is lined with concrete under the bridge.

Flow: Relatively uniform - flow is less uniform adjacent to the two center support columns (upwelling).

Other: The bridge design divides flow into three separate concrete channels, uniform in dimension.

Control: Relatively large pools located immediately upstream and downstream of the bridge.

Remarks:

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Table 7.4-G-10.2: Discharge Measurement on Hargrave River at HRW1 on 8/13/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	0.70	0.0	0.0								Left edge of water
	0.90	0.3	0.68	0.6	NA	NA	0.42	0.42	0.2	0.1	Concrete lined bridge
	1.20	0.4	0.68	0.6	NA	NA	0.40	0.40	0.3	0.1	Concrete lined bridge
	1.70	0.5	0.68	0.6	NA	NA	0.40	0.40	0.3	0.1	Concrete lined bridge
	2.20	0.5	0.68	0.6	NA	NA	0.41	0.41	0.3	0.1	Concrete lined bridge
	2.70	0.5	0.68	0.6	NA	NA	0.40	0.40	0.3	0.1	Concrete lined bridge
	3.20	0.5	0.68	0.6	NA	NA	0.45	0.45	0.3	0.2	Concrete lined bridge
	3.70	0.5	0.68	0.6	NA	NA	0.42	0.42	0.3	0.1	Concrete lined bridge
	4.20	0.5	0.68	0.6	NA	NA	0.38	0.38	0.3	0.1	Concrete lined bridge
											Non-uniform flow (upwelling)
	4.70	0.5	0.68	0.6	NA	NA	0.47	0.47	0.3	0.2	Concrete lined bridge
	5.20	0.5	0.68	0.6	NA	NA	0.50	0.50	0.3	0.2	Concrete lined bridge
	5.70	0.5	0.68	0.6	NA	NA	0.40	0.40	0.3	0.1	Concrete lined bridge
	6.20	0.5	0.68	0.6	NA	NA	0.32	0.32	0.3	0.1	Concrete lined bridge
	6.70	0.4	0.68	0.6	NA	NA	0.22	0.22	0.3	0.1	Concrete lined bridge
	7.05	0.4	0.68	0.6	NA	NA	0.32	0.32	0.3	0.1	Concrete lined bridge

Table 7.4-G-10.2: Discharge Measurement on Hargrave River at HRW1 on 8/13/2007 (Continued)

Angle coef.	Dist. From Initial Point (m)	Width (m)	Depth (m)	Observ. Depth	Revo-lutions	Time in Seconds	VELOCITY		Area (s.m.)	Discharge (cms)	Description
							At Point (mps)	Mean In-Vertical (mps)			
	7.5	0.3	0.68	0.6	NA	NA	0.32	0.32	0.22	0.07	Concrete lined bridge
	7.7	0.4	0.68	0.6	NA	NA	0.35	0.35	0.24	0.08	Concrete lined bridge
	8.2	0.5	0.68	0.6	NA	NA	0.41	0.41	0.34	0.14	Concrete lined bridge
	8.7	0.5	0.68	0.6	NA	NA	0.45	0.45	0.34	0.15	Concrete lined bridge
	9.2	0.5	0.68	0.6	NA	NA	0.43	0.43	0.34	0.15	Concrete lined bridge
	9.7	0.5	0.68	0.6	NA	NA	0.45	0.45	0.34	0.15	Concrete lined bridge
	10.2	0.4	0.68	0.6	NA	NA	0.34	0.34	0.24	0.08	Concrete lined bridge
	10.4	0.0	0.0								Right edge of water
	Totals	**9.7**							**6.5**	**2.6**	

7.4–108

Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information	
File Name	HRW1.MIN.WAD
Start Date and Time	2007/09/11 11:25:05

Site Details	
Site Name	HRW1
Operator(s)	KR

System Information	
Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units	(Metric Units)
Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Summary			
Averaging Int.	10	# Stations	26
Start Edge	LEW	Total Width	14.160
Mean SNR	29.9 dB	Total Area	5.400
Mean Temp	8.88 °C	Mean Depth	0.381
Disch. Equation	Mid-Section	Mean Velocity	0.2956
		Total Discharge	1.5965

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.1%	1.4%
Velocity	1.3%	6.4%
Width	0.1%	0.1%
Method	2.2%	-
# Stations	2.0%	-
Overall	3.3%	6.7%

Measurement Results

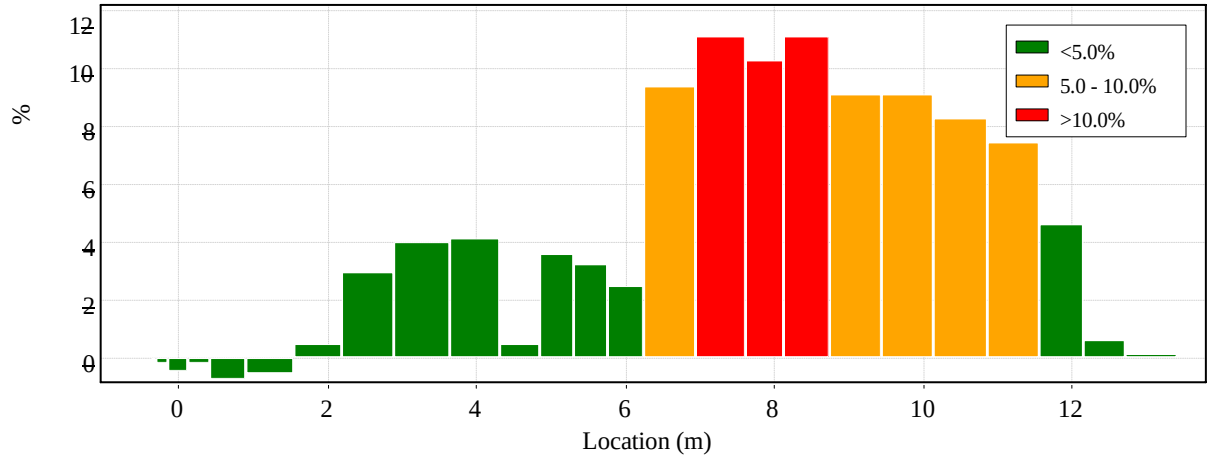
St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area	Flow	%Q
0	11:25	-0.36	None	0.245	0.0	0.0	0.0000	1.00	-0.0767	0.012	-0.0009	-0.1	
1	*11:25*	*-0.26*	*0.6*	*0.245*	*0.6*	*0.098*	*-0.0767*	*1.00*	*-0.0767*	*0.044*	*-0.0034*	*-0.2*	
2	*11:27*	*0.00*	*0.6*	*0.340*	*0.6*	*0.136*	*-0.0887*	*1.00*	*-0.0887*	*0.088*	*-0.0078*	*-0.5*	
3	*11:28*	*0.26*	*0.6*	*0.340*	*0.6*	*0.136*	*-0.0393*	*1.00*	*-0.0393*	*0.102*	*-0.0040*	*-0.3*	
4	*11:29*	*0.60*	*0.6*	*0.380*	*0.6*	*0.152*	*-0.0721*	*1.00*	*-0.0721*	*0.179*	*-0.0129*	*-0.8*	
5	*11:31*	*1.20*	*0.6*	*0.430*	*0.6*	*0.172*	*-0.0314*	*1.00*	*-0.0314*	*0.280*	*-0.0088*	*-0.5*	
6	11:32	1.90	0.6	0.430	0.6	0.172	0.0265	1.00	0.0265	0.280	0.0074	0.5	
7	*11:33*	*2.50*	*0.6*	*0.430*	*0.6*	*0.172*	*0.1582*	*1.00*	*0.1582*	*0.301*	*0.0476*	*3.0*	
8	11:34	3.30	0.6	0.400	0.6	0.160	0.2109	1.00	0.2109	0.300	0.0633	4.0	
9	11:35	4.00	0.6	0.435	0.6	0.174	0.2325	1.00	0.2325	0.283	0.0657	4.1	
10	*11:37*	*4.60*	*0.6*	*0.435*	*0.6*	*0.174*	*0.0329*	*1.00*	*0.0329*	*0.239*	*0.0079*	*0.5*	
11	*11:40*	*5.10*	*0.6*	*0.390*	*0.6*	*0.156*	*0.3220*	*1.00*	*0.3220*	*0.176*	*0.0565*	*3.5*	
12	*11:42*	*5.50*	*0.6*	*0.400*	*0.6*	*0.160*	*0.2855*	*1.00*	*0.2855*	*0.180*	*0.0514*	*3.2*	
13	*11:43*	*6.00*	*0.6*	*0.380*	*0.6*	*0.152*	*0.2092*	*1.00*	*0.2092*	*0.190*	*0.0397*	*2.5*	
14	*11:44*	*6.50*	*0.6*	*0.380*	*0.6*	*0.152*	*0.5623*	*1.00*	*0.5623*	*0.266*	*0.1496*	*9.4*	
15	*11:45*	*7.40*	*0.6*	*0.410*	*0.6*	*0.164*	*0.6422*	*1.00*	*0.6422*	*0.277*	*0.1777*	*11.1*	
16	11:47	7.85	0.6	0.400	0.6	0.160	0.8223	1.00	0.8223	0.200	0.1645	10.3	
17	11:49	8.40	0.6	0.420	0.6	0.168	0.6737	1.00	0.6737	0.263	0.1768	11.1	
18	*11:50*	*9.10*	*0.6*	*0.440*	*0.6*	*0.176*	*0.4735*	*1.00*	*0.4735*	*0.308*	*0.1458*	*9.1*	
19	*11:51*	*9.80*	*0.6*	*0.440*	*0.6*	*0.176*	*0.4721*	*1.00*	*0.4721*	*0.308*	*0.1454*	*9.1*	
20	*11:52*	*10.50*	*0.6*	*0.440*	*0.6*	*0.176*	*0.4280*	*1.00*	*0.4280*	*0.308*	*0.1318*	*8.3*	
21	*11:52*	*11.20*	*0.6*	*0.440*	*0.6*	*0.176*	*0.3849*	*1.00*	*0.3849*	*0.308*	*0.1185*	*7.4*	
22	*11:53*	*11.90*	*0.6*	*0.430*	*0.6*	*0.172*	*0.2837*	*1.00*	*0.2837*	*0.258*	*0.0732*	*4.6*	
23	*11:54*	*12.40*	*0.6*	*0.280*	*0.6*	*0.112*	*0.0642*	*1.00*	*0.0642*	*0.154*	*0.0099*	*0.6*	
24	*11:57*	*13.00*	*0.6*	*0.140*	*0.6*	*0.056*	*0.0145*	*1.00*	*0.0145*	*0.098*	*0.0014*	*0.1*	
25	11:57	13.80	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0	

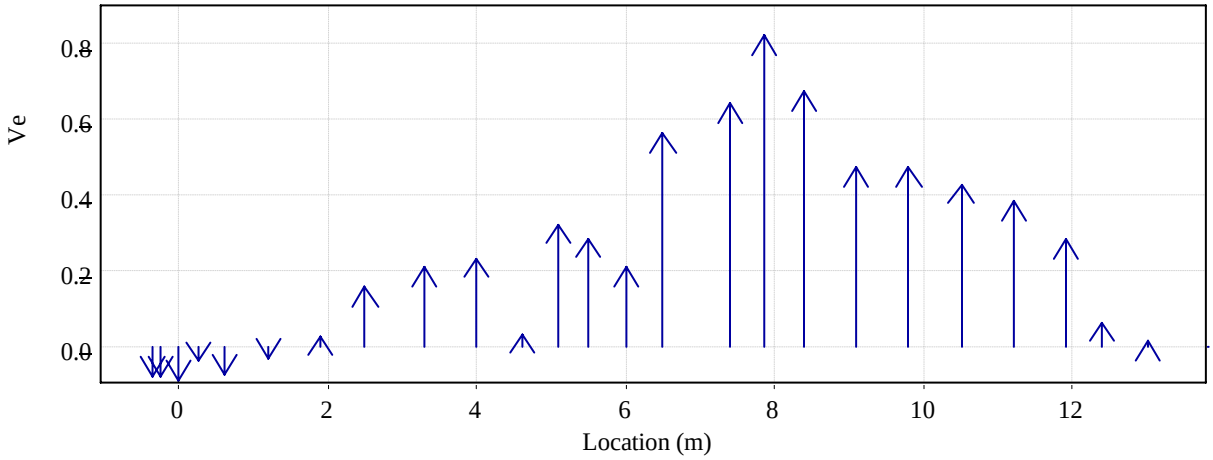
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

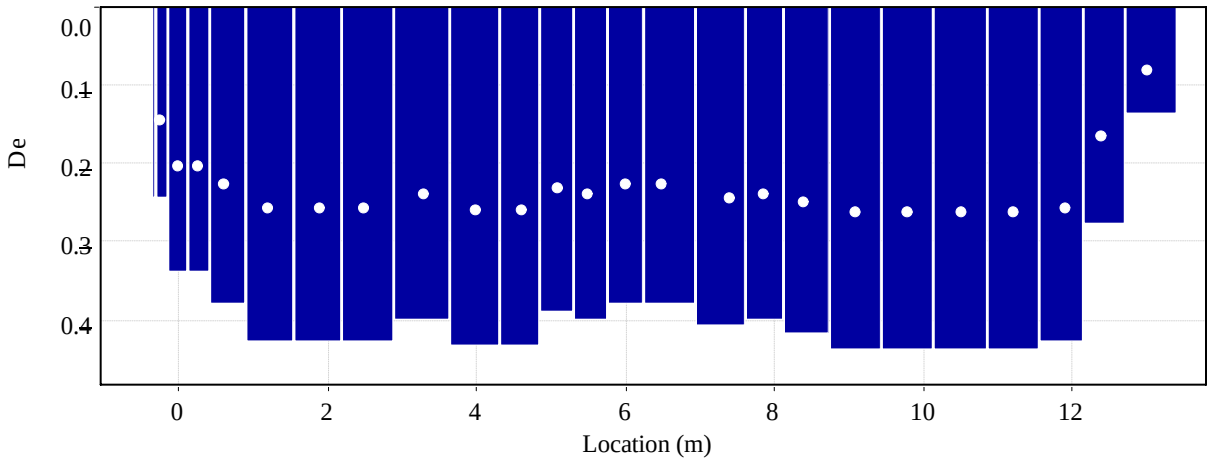
Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	HRW1.MIN.WAD	Site Name	HRW1
Start Date and Time	2007/09/11 11:25:05	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	HRW1.MIN.WAD	Site Name	HRW1
Start Date and Time	2007/09/11 11:25:05	Operator(s)	KR

Quality Control

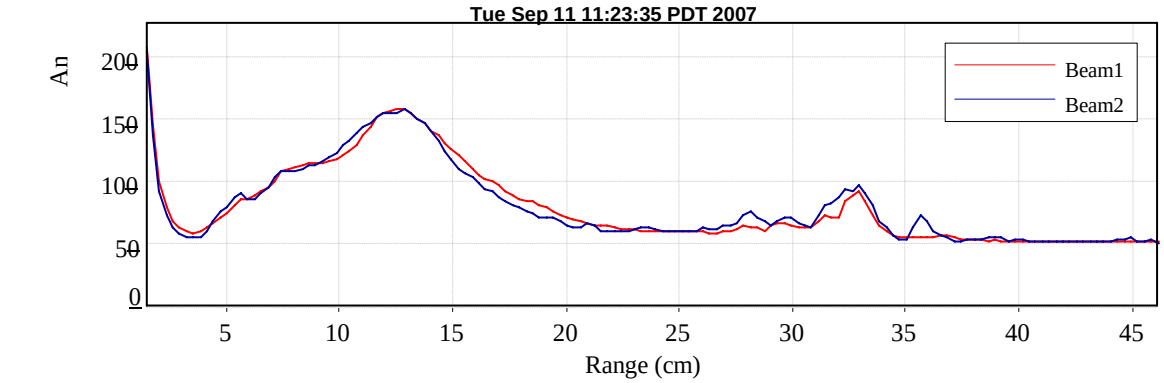
St	Loc	%Dep	Message
1	-0.26	0.6	High angle: 161
2	0.00	0.6	High angle: -163
3	0.26	0.6	High angle: -155
4	0.60	0.6	High angle: -169
5	1.20	0.6	High angle: -110
7	2.50	0.6	High angle: -30
10	4.60	0.6	High angle: 71
11	5.10	0.6	High angle: 25
		0.6	High standard error: 0.041
12	5.50	0.6	High angle: -30
		0.6	High standard error: 0.028
13	6.00	0.6	High standard error: 0.032
14	6.50	0.6	High angle: -28
		0.6	High standard error: 0.034
15	7.40	0.6	High angle: -36
		0.6	High standard error: 0.038
18	9.10	0.6	High angle: -36
19	9.80	0.6	High angle: -27
20	10.50	0.6	High angle: -33
21	11.20	0.6	High angle: -42
22	11.90	0.6	High angle: -37
23	12.40	0.6	High angle: 51
24	13.00	0.6	Boundary QC is Fair; possible boundary interference

Discharge Measurement Summary

Date Generated: Tue Sep 18 2007

File Information		Site Details	
File Name	HRW1.MIN.WAD	Site Name	HRW1
Start Date and Time	2007/09/11 11:25:05	Operator(s)	KR

Automatic Quality Control Test (BeamCheck)



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

7.4–112

Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information	
File Name	HRW1O1.MIN.WAD
Start Date and Time	2007/10/14 11:24:58

Site Details	
Site Name	
Operator(s)	KR

System Information	
Sensor Type	FlowTracker
Serial #	P1616
CPU Firmware Version	3.1
Software Ver	2.11

Units	(Metric Units)
Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.1%	0.5%
Velocity	0.5%	3.6%
Width	0.1%	0.1%
Method	1.8%	-
# Stations	1.8%	-
Overall	4.5%	2.5%

Summary

Averaging Int.	10	# Stations	29
Start Edge	LEW	Total Width	15.200
Mean SNR	24.9 dB	Total Area	13.378
Mean Temp	4.48 °C	Mean Depth	0.880
Disch. Equation	Mid-Section	Mean Velocity	0.4097
		Total Discharge	0.7311

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD		Vel	CorrFact	MeanV	Area	Flow	%Q
0	11:24	0.80	None	0.690		0.0	0.0	0.0000	1.00	0.0523	0.035	0.0018	0.0
1	11:25	0.90	0.6	0.720		0.6	0.288	0.0523	1.00	0.0523	0.288	0.0151	0.3
2	*11:27*	*1.60*	*0.6*	*0.820*		*0.6*	*0.328*	*0.1071*	*1.00*	*0.1071*	*0.492*	*0.0527*	*1.0*
3	11:28	2.10	0.6	0.860		0.6	0.344	0.1821	1.00	0.1821	0.602	0.1096	2.0
4	11:29	3.00	0.6	0.940		0.6	0.376	0.1746	1.00	0.1746	0.799	0.1395	2.5
5	*11:30*	*3.80*	*0.6*	*0.940*		*0.6*	*0.376*	*0.1375*	*1.00*	*0.1375*	*0.658*	*0.0905*	*1.7*
6	11:32	4.40	0.6	0.940		0.6	0.376	0.1823	1.00	0.1823	0.564	0.1028	1.9
7	*11:33*	*5.00*	*0.6*	*0.930*		*0.6*	*0.372*	*0.1881*	*1.00*	*0.1881*	*0.558*	*0.1050*	*1.9*
8	*11:34*	*5.60*	*0.6*	*0.950*		*0.6*	*0.380*	*0.0052*	*1.00*	*0.0052*	*0.523*	*0.0027*	*0.0*
9	*11:35*	*6.10*	*0.6*	*0.950*		*0.6*	*0.380*	*0.1192*	*1.00*	*0.1192*	*0.665*	*0.0793*	*1.4*
10	*11:37*	*7.00*	*0.6*	*0.900*		*0.6*	*0.360*	*0.8129*	*1.00*	*0.8129*	*0.675*	*0.5487*	*10.0*
11	11:38	7.60	0.6	0.940		0.6	0.376	0.8565	1.00	0.8565	0.517	0.4428	8.1
12	11:39	8.10	0.6	0.940		0.6	0.376	0.8032	1.00	0.8032	0.423	0.3398	6.2
13	11:40	8.50	0.6	0.950		0.6	0.380	0.8679	1.00	0.8679	0.356	0.3092	5.6
14	11:41	8.85	0.6	0.940		0.6	0.376	0.8685	1.00	0.8685	0.353	0.3061	5.6
15	11:42	9.25	0.6	0.940		0.6	0.376	0.7634	1.00	0.7634	0.400	0.3050	5.6
16	11:43	9.70	0.6	0.940		0.6	0.376	0.7312	1.00	0.7312	0.447	0.3265	6.0
17	11:45	10.20	0.6	0.960		0.6	0.384	0.5558	1.00	0.5558	0.672	0.3735	6.8
18	11:45	11.10	0.6	0.960		0.6	0.384	0.4887	1.00	0.4887	0.720	0.3519	6.4
19	11:47	11.70	0.6	0.960		0.6	0.384	0.4961	1.00	0.4961	0.528	0.2619	4.8
20	11:47	12.20	0.6	0.960		0.6	0.384	0.4778	1.00	0.4778	0.480	0.2293	4.2
21	11:48	12.70	0.6	0.950		0.6	0.380	0.4950	1.00	0.4950	0.475	0.2351	4.3
22	11:49	13.20	0.6	0.960		0.6	0.384	0.4414	1.00	0.4414	0.528	0.2331	4.3
23	11:50	13.80	0.6	0.960		0.6	0.384	0.4702	1.00	0.4702	0.480	0.2257	4.1
24	11:51	14.20	0.6	0.840		0.6	0.336	0.4475	1.00	0.4475	0.378	0.1692	3.1
25	*11:52*	*14.70*	*0.6*	*0.630*		*0.6*	*0.252*	*0.3569*	*1.00*	*0.3569*	*0.347*	*0.1237*	*2.3*
26	*11:53*	*15.30*	*0.6*	*0.480*		*0.6*	*0.192*	*-0.0023*	*1.00*	*-0.0023*	*0.264*	*-0.0006*	*0.0*
27	*11:55*	*15.80*	*0.6*	*0.440*		*0.6*	*0.176*	*0.0087*	*1.00*	*0.0087*	*0.154*	*0.0013*	*0.0*
28	11:55	16.00	None	0.000		0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

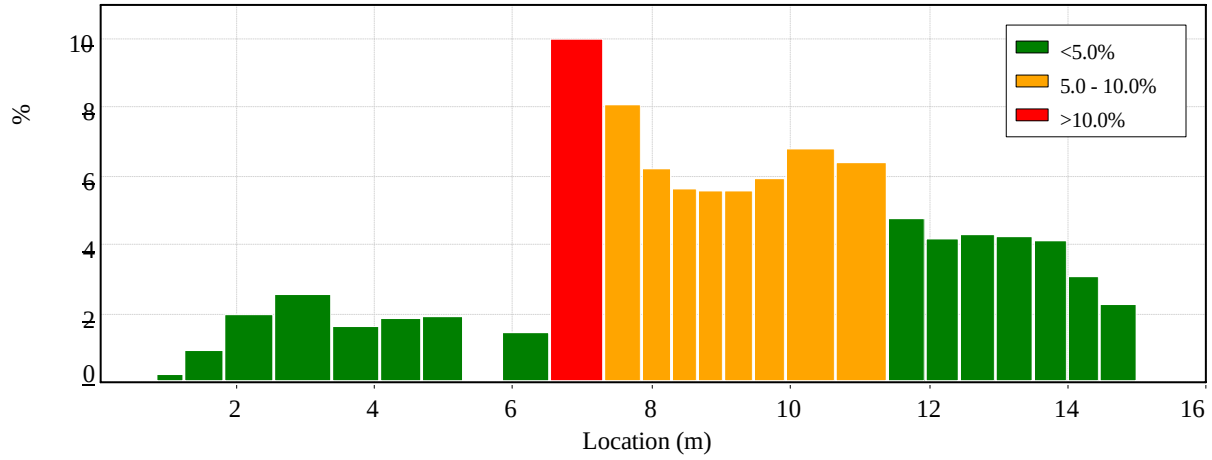
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

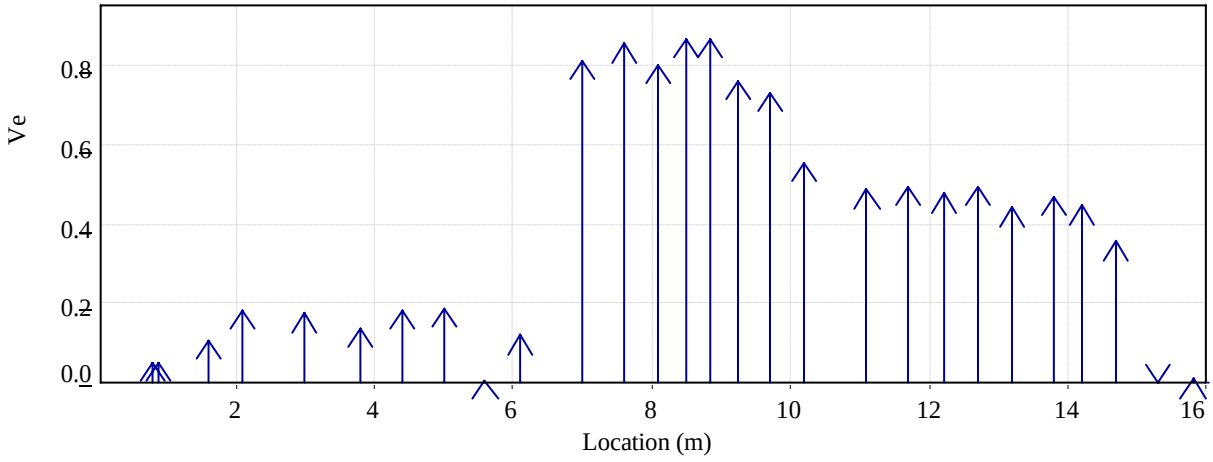
7.4–113

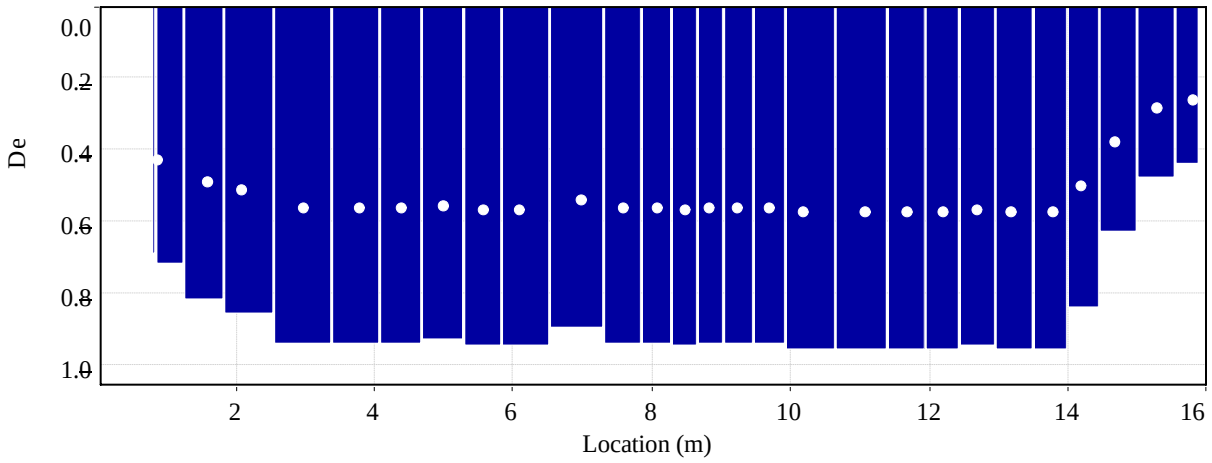
Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	HRW1O1.MIN.WAD	Site Name	
Start Date and Time	2007/10/14 11:24:58	Operator(s)	KR







Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	HRW1O1.MIN.WAD	Site Name	
Start Date and Time	2007/10/14 11:24:58	Operator(s)	KR

Quality Control

St	Loc	%Dep	Message
2	1.60	0.6	High angle: 23
5	3.80	0.6	High angle: 30
7	5.00	0.6	High angle: 26
8	5.60	0.6	High standard error: 0.014
9	6.10	0.6	High number of spikes: 2
		0.6	High angle: 32
		0.6	High standard error: 0.014
10	7.00	0.6	High angle: 31
25	14.70	0.6	High angle: -24
26	15.30	0.6	SNR (37.4) is different from typical SNR (24.9)
27	15.80	0.6	SNR (40.4) is different from typical SNR (24.9)

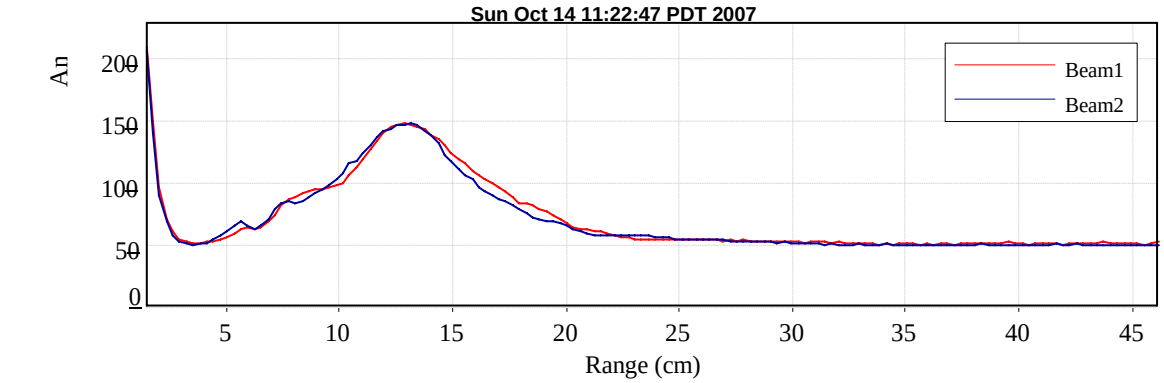
7.4–115

Discharge Measurement Summary

Date Generated: Fri Dec 14 2007

File Information		Site Details	
File Name	HRW1O1.MIN.WAD	Site Name	
Start Date and Time	2007/10/14 11:24:58	Operator(s)	KR

Automatic Quality Control Test (BeamCheck)



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

APPENDIX 7.4-H

2008 Discharge Measurements

Discharge Measurement on Hargrave River at HRW1 on May 9, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	2.70	0.00	0	0	0.000	0.00
1	3.35	0.65	1.16	0.3022	0.379	0.114
2	4.10	1.40	1.16	0.3346	0.867	0.276
3	4.65	1.95	1.16	0.4809	0.638	0.260
4	5.49	2.79	1.16	0.4757	0.970	0.464
5	5.99	3.29	1.16	0.4184	0.589	0.263
6	6.40	3.70	1.16	0.4257	0.470	0.199
7	6.80	4.10	1.16	0.4668	0.464	0.207
8	7.25	4.55	1.16	0.4631	0.522	0.243
9	7.50	4.80	1.16	0.4111	0.290	0.127
10	8.20	5.50	1.16	0.4825	0.812	0.363
Flow Divider	8.25 to 8.65	5.55	0	0	0.000	0.00
		5.95	0	0	0.000	0.00
11	8.65	5.95	1.16	0.7554	0.522	0.000
12	9.10	6.40	1.16	0.7941	0.522	0.404
13	9.60	6.90	1.16	0.7964	0.580	0.461
14	10.00	7.30	1.16	0.7709	0.464	0.364
15	10.30	7.60	1.16	0.7874	0.348	0.271
16	10.80	8.10	1.16	0.6399	0.812	0.414
Flow Divider	11 to 11.40	8.30	0	0	0.000	0.00
		8.70	0	0	0.000	0.00
17	11.70	9.00	1.16	0.4725	0.348	0.082
18	12.20	9.50	1.16	0.3223	0.580	0.230
19	12.90	10.20	1.16	0.4438	0.812	0.311
20	13.30	10.60	1.16	0.4383	0.464	0.205
21	13.90	11.20	1.16	0.3473	0.696	0.273
22	14.20	11.50	1.16	0.3813	0.348	0.127
23	14.80	12.10	1.16	0.3218	0.696	0.245
24	15.30	12.60	1.16	0.3596	0.580	0.198
25	15.80	13.10	1.16	0.3435	0.580	0.204
26	15.95	13.25	1	0.3136	0.162	0.053
27	16.50	13.80	0.95	0.2502	0.536	0.152
REW	16.80	14.10	0	0	0.143	0.036
				TOTAL	15.194	6.55

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Tom Bercier.

Water termperature:	**5.3**	**°C**
Width:	**14.1**	**m**
Average velocity:	**0.474**	**m/s**
Average depth:	**1.146**	**m**
Area:	**15.194**	**m^2**
Flow:	**6.55**	**m^3/s**

Discharge Measurement on Minago River at MRW2x on May 8, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.8	0	0	0	0	0
1	1.20	0.4	0.28	0.003	0.056	0.000
2	1.50	0.7	0.36	0.017	0.096	0.001
3	1.90	1.1	0.38	0.059	0.148	0.006
4	2.20	1.4	0.36	0.079	0.111	0.008
5	2.50	1.7	0.38	0.088	0.111	0.009
6	3.00	2.2	0.38	0.080	0.190	0.016
7	3.55	2.75	0.52	0.120	0.248	0.026
8	3.90	3.1	0.50	0.210	0.179	0.029
9	4.30	3.5	0.44	0.220	0.188	0.040
10	4.70	3.9	0.57	0.140	0.202	0.035
11	5.10	4.3	0.44	0.302	0.202	0.043
12	5.50	4.7	0.40	0.202	0.168	0.043
13	5.85	5.05	0.46	0.320	0.151	0.040
14	6.3	5.5	0.46	0.150	0.207	0.049
15	6.55	5.75	0.67	0.080	0.141	0.015
16	6.9	6.1	0.50	0.110	0.205	0.019
17	7.25	6.45	0.40	0.070	0.158	0.015
18	7.5	6.7	0.32	0.040	0.090	0.005
19	7.82	7.02	0.25	0.040	0.091	0.004
20	8.05	7.25	0.19	0.018	0.051	0.002
REW	8.50	7.7	0.00	0.000	0.043	0.001
				TOTAL	3.034	0.404

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Ominder Singh.

Water termperature:	**7**	**^oC**
Width:	**7.7**	**m**
Average velocity:	**0.117**	**m/s**
Average depth:	**0.413**	**m**
Area:	**3.034**	**m^2**
Flow:	**0.40**	**m^3/s**

Discharge Measurement on Minago River at MRW1 on May 10, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.60	0.00	0	0	0.000	0.00
1	1.75	1.15	0.2	0.25	0.115	0.029
2	2.05	1.45	0.32	0.58	0.078	0.035
3	2.80	2.20	0.4	0.66	0.270	0.169
4	3.35	2.75	0.4	0.68	0.220	0.147
5	3.80	3.20	0.47	0.65	0.196	0.130
6	4.40	3.80	0.46	0.74	0.279	0.194
7	4.85	4.25	0.46	0.72	0.207	0.151
8	5.44	4.84	0.52	0.64	0.289	0.196
9	6.05	5.45	0.54	0.64	0.323	0.207
10	6.70	6.10	0.6	0.56	0.371	0.222
11	7.40	6.80	0.6	0.58	0.420	0.239
12	8.05	7.45	0.58	0.59	0.384	0.224
13	8.75	8.15	0.58	0.69	0.406	0.260
14	9.30	8.70	0.58	0.69	0.319	0.220
15	9.95	9.35	0.56	0.64	0.370	0.247
16	10.55	9.95	0.64	0.6	0.360	0.223
17	11.00	10.40	0.52	0.66	0.261	0.164
18	11.60	11.00	0.54	0.48	0.318	0.181
19	12.15	11.55	0.32	0.51	0.237	0.116
20	12.65	12.05	0.27	0.32	0.148	0.062
21	13.00	12.40	0.16	0.2	0.075	0.021
22	13.50	12.90	0.05	0.01	0.053	0.008
REW	13.80	13.20	0	0	0.008	0.000
				TOTAL	5.705	3.44

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Tom Bercier.

Water termperature:	**5.8**	**^oC**
Width:	**13.2**	**m**
Average velocity:	**0.550**	**m/s**
Average depth:	**0.444**	**m**
Area:	**5.705**	**m^2**
Flow:	**3.44**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW3 on May 8, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	4.84	0	0	0	0	0
1	5.00	0.16	0.30	0.001	0.024	0.00003
2	5.16	0.32	0.28	0.003	0.046	0.00008
3	5.32	0.48	0.26	0.002	0.043	0.00010
4	5.48	0.64	0.29	0.002	0.044	0.00009
5	5.60	0.76	0.31	0.629	0.036	0.01174
6	5.75	0.91	0.21	0.004	0.039	0.01470
7	5.94	1.1	0.24	0.036	0.043	0.00090
8	6.06	1.22	0.20	0.029	0.026	0.00086
9	6.20	1.36	0.20	0.004	0.028	0.00045
REW	6.34	1.5	0.00	0.000	0.014	0.00005
				TOTAL	0.344	0.029

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Ominder Singh.

Water termperature:	**1.2**	**^oC**
Width:	**1.5**	**m**
Average velocity:	**0.079**	**m/s**
Average depth:	**0.254**	**m**
Area:	**0.344**	**m^2**
Flow:	**0.029**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW2 on May 8, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	1.85	0	0	0	0	0
1	2.00	0.15	1.26	0.14	0.094	0.01350
2	2.20	0.35	1.26	0.14	0.252	0.03565
3	2.40	0.55	1.28	0.15	0.254	0.03620
4	2.65	0.8	1.30	0.23	0.323	0.06058
5	2.75	0.9	1.42	0.22	0.136	0.03057
6	3.00	1.15	1.32	0.21	0.343	0.07370
7	3.25	1.4	1.14	0.20	0.308	0.06325
8	3.50	1.65	1.06	0.21	0.275	0.05600
9	3.65	1.8	1.01	0.16	0.155	0.02856
10	3.85	2	0.94	0.16	0.195	0.03120
11	4.10	2.25	0.84	0.15	0.223	0.03455
12	4.20	2.35	0.76	0.16	0.080	0.01236
13	4.30	2.45	0.70	0.18	0.073	0.01236
14	4.40	2.55	0.60	0.13	0.065	0.01020
15	4.50	2.65	0.40	0.077	0.050	0.00544
16	4.65	2.8	0.35	0.02	0.056	0.00284
REW	4.90	3.05	0.00	0.00	0.044	0.00088
				TOTAL	2.925	0.508

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Ominder Singh.

Water termperature:	**1.7**	**^oC**
Width:	**3.05**	**m**
Average velocity:	**0.158**	**m/s**
Average depth:	**0.978**	**m**
Area:	**2.925**	**m^2**
Flow:	**0.508**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on May 10, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	1.70	0.00	0	0	0.000	0.00
1	1.90	0.20	0.095	0.20	0.010	0.00190
2	2.05	0.35	0.13	0.27	0.017	0.00406
3	2.40	0.70	0.19	0.28	0.056	0.01545
4	2.65	0.95	0.10	0.42	0.036	0.01190
5	3.05	1.35	0.22	1.05	0.064	0.05460
6	3.45	1.75	0.24	1.23	0.092	0.10524
7	3.65	1.95	0.26	0.89	0.050	0.05266
8	4.00	2.30	0.28	1.18	0.095	0.09832
9	4.20	2.50	0.29	1.05	0.057	0.06349
10	4.45	2.75	0.29	0.95	0.073	0.07250
11	4.80	3.10	0.22	0.88	0.089	0.08209
12	5.15	3.45	0.20	0.74	0.074	0.05978
13	5.45	3.75	0.16	0.66	0.054	0.03804
REW	5.64	3.94	0	0	0.015	0.01003
				TOTAL	0.781	0.670

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Tom Bercier.

Water termperature:	**3.5**	**^oC**
Width:	**3.94**	**m**
Average velocity:	**0.754**	**m/s**
Average depth:	**0.206**	**m**
Area:	**0.781**	**m^2**
Flow:	**0.670**	**m^3/s**

Discharge Measurement on Oakley/McBain Creek at OCAWR on May 7, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.5	0	0	0	0	0
1	1.00	0.5	0.87	0.09	0.218	0.01958
2	1.20	0.7	0.96	0.02	0.183	0.01003
3	1.70	1.2	0.92	0.03	0.470	0.01240
4	2.10	1.6	1.00	0.10	0.384	0.02552
5	2.70	2.2	1.04	0.32	0.612	0.12984
6	3.10	2.6	1.40	0.31	0.488	0.15336
7	3.40	2.9	1.54	0.26	0.441	0.12516
8	3.70	3.2	1.56	0.18	0.465	0.10218
9	4.00	3.5	1.54	0.15	0.465	0.07677
10	4.40	3.9	1.56	0.31	0.620	0.14292
11	4.90	4.4	1.57	0.25	0.783	0.22036
12	5.20	4.7	1.58	0.26	0.473	0.12130
13	5.60	5.1	1.60	0.25	0.636	0.16216
14	6.00	5.5	1.50	0.24	0.620	0.15200
15	6.40	5.9	1.47	0.18	0.594	0.12492
16	6.80	6.3	1.44	0.15	0.582	0.09612
17	7.20	6.7	1.34	0.14	0.556	0.08072
18	7.50	7	1.22	0.13	0.384	0.05193
19	7.90	7.4	0.90	0.20	0.424	0.06772
20	8.40	7.9	0.88	0.17	0.445	0.08240
21	8.90	8.9	0.68	0.11	0.780	0.11220
22	9.60	9.1	0.30	0.11	0.098	0.01078
REW	10.20	9.7	0.00	0.00	0.090	0.00990
				TOTAL	10.810	2.09

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Tom Bercier.

Water termperature:	**5.3**	**^oC**
Width:	**9.7**	**m**
Average velocity:	**0.180**	**m/s**
Average depth:	**1.221**	**m**
Area:	**10.810**	**m^2**
Flow:	**2.090**	**m^3/s**

Discharge Measurement on William River at just west of Highway #6 on May 10, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.70	0.00	0	0	0.000	0.00
1	1.10	0.40	0.295	0.005	0.059	0.00030
2	1.60	0.90	0.32	-0.0078	0.154	-0.00026
3	1.85	1.15	0.38	-0.0136	0.088	-0.00096
4	2.25	1.55	0.42	0.07	0.160	0.00485
5	2.90	2.20	0.42	0.15	0.273	0.03003
6	3.45	2.75	0.42	0.22	0.231	0.04274
7	3.95	3.25	0.52	0.25	0.235	0.05574
8	4.65	3.95	0.51	0.23	0.361	0.08743
9	5.35	4.65	0.52	0.34	0.361	0.10361
10	6.15	5.45	0.52	0.38	0.416	0.14976
11	6.90	6.20	0.6	0.34	0.420	0.15152
12	7.55	6.85	0.62	0.44	0.397	0.15536
13	8.30	7.60	0.64	0.43	0.473	0.20504
14	8.85	8.15	0.66	0.44	0.358	0.15596
15	9.55	8.85	0.66	0.42	0.462	0.19919
16	10.15	9.45	0.69	0.45	0.405	0.17631
17	10.80	10.10	0.75	0.40	0.468	0.19841
18	11.55	10.85	0.79	0.43	0.578	0.23844
19	12.23	11.53	0.75	0.42	0.524	0.22182
20	12.95	12.25	0.79	0.27	0.554	0.18979
21	13.50	12.80	0.86	0.29	0.454	0.12599
22	14.20	13.50	0.85	0.37	0.598	0.19671
23	14.88	14.18	0.84	0.34	0.575	0.20403
24	15.65	14.95	0.74	0.19	0.608	0.16266
25	16.15	15.45	0.63	0.15	0.342	0.05831
26	16.65	15.95	0.49	0.18	0.280	0.04656
27	17.25	16.55	0.43	0.02	0.276	0.02940
28	17.65	16.95	0.34	0.01	0.154	0.00255
Ice Overhang (17.7 to 18.55 m)	17.70	17.00	0.34	0.01	0.017	0.00020
REW	18.55	17.85	0	0	0.000	0.00145
				TOTAL	10.278	3.19

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Tom Bercier.

Water termperature:	**7.9**	**°C**
Width:	**17.85**	**m**
Average velocity:	**0.249**	**m/s**
Average depth:	**0.579**	**m**
Area:	**10.278**	**m^2**
Flow:	**3.193**	**m^3/s**

Discharge Measurement on William River at WRAOC on May 7, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	1	0	0	0	0	0
1	1.60	0.6	0.40	0.02	0.120	0.00286
2	2.40	1.4	0.81	0.18	0.484	0.06213
3	2.80	1.8	0.94	0.17	0.350	0.06112
4	3.40	2.4	1.20	0.25	0.642	0.13960
5	4.40	3.4	1.44	0.27	1.320	0.34932
6	4.70	3.7	1.40	0.32	0.426	0.12604
7	5.10	4.1	1.36	0.33	0.552	0.17919
8	5.70	4.7	1.35	0.26	0.813	0.23994
9	6.20	5.2	1.32	0.39	0.668	0.21744
10	6.50	5.5	1.30	0.23	0.393	0.12266
11	6.90	5.9	1.28	0.32	0.516	0.14172
12	7.20	6.2	1.28	0.15	0.384	0.09024
13	8.00	7	1.38	0.21	1.064	0.19272
14	8.50	7.5	1.36	0.33	0.685	0.18557
15	9.00	8	1.34	0.33	0.675	0.22367
16	9.50	8.5	1.35	0.39	0.673	0.24218
17	10.20	9.2	1.36	0.31	0.948	0.33184
18	11.00	10	1.29	0.33	1.060	0.33892
19	11.70	10.7	1.16	0.36	0.857	0.29516
20	12.20	11.2	0.98	0.27	0.535	0.17057
21	12.60	11.6	0.57	0.15	0.310	0.07039
22	13.15	12.15	0.42	0.03	0.272	0.02769
REW	13.80	12.8	0.00	0.00	0.137	0.00437
				TOTAL	13.884	3.82

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Tom Bercier.

Water termperature:	**5.8**	**^oC**
Width:	**12.8**	**m**
Average velocity:	**0.256**	**m/s**
Average depth:	**1.150**	**m**
Area:	**13.884**	**m^2**
Flow:	**3.815**	**m^3/s**

Discharge Measurement on Minago River at MRW2x on Aug. 6, 2008

(on datalogger as MR1x)

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.05	0.00	0	0	0.000	0.000
1	0.35	0.30	0.320	0.005	0.048	0.00024
2	0.60	0.55	0.410	0.013	0.091	0.0009
3	1.0	0.95	0.500	0.023	0.182	0.003
4	1.5	1.45	0.540	0.096	0.260	0.016
5	1.9	1.85	0.600	0.261	0.228	0.042
6	2.6	2.55	0.580	0.296	0.413	0.115
7	3.3	3.25	0.700	0.365	0.448	0.150
8	3.8	3.75	0.720	0.407	0.355	0.137
9	4.3	4.25	0.660	0.364	0.345	0.133
10	4.8	4.75	0.580	0.495	0.310	0.132
11	5.4	5.35	0.620	0.393	0.360	0.159
12	5.9	5.85	0.650	0.176	0.318	0.090
13	6.2	6.15	0.700	0.092	0.203	0.027
14	6.6	6.55	0.600	0.088	0.260	0.023
15	7.1	7.05	0.580	0.054	0.295	0.021
16	7.4	7.35	0.480	0.064	0.159	0.009
17	7.7	7.65	0.330	0.034	0.122	0.006
REW	8.40	8.35	0.00	0.000	0.116	0.004
				TOTAL	4.511	1.068

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken, Ken Budd, and Mercedes Markowski.

Water termperature:	**20.3**	**^oC**
Width:	**8.35**	**m**
Average velocity:	**0.190**	**m/s**
Average depth:	**0.563**	**m**
Area:	**4.511**	**m^2**
Flow:	**1.07**	**m^3/s**

Discharge Measurement on Minago River at MRW1 on Aug. 4, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	1.00	0.00	0	0	0.000	0.00
1	2.20	1.20	0.23	0.2379	0.138	0.033
2	2.80	1.80	0.3	0.348	0.159	0.048
3	3.20	2.20	0.4	0.4185	0.140	0.054
4	3.80	2.80	0.44	0.639	0.252	0.135
5	4.40	3.40	0.5	0.6897	0.282	0.188
6	5.00	4.00	0.46	0.7672	0.288	0.209
7	5.60	4.60	0.42	0.8492	0.264	0.213
8	6.30	5.30	0.5	0.7288	0.322	0.252
9	6.70	5.70	0.64	0.77	0.228	0.171
10	7.10	6.10	0.66	0.773	0.260	0.201
11	7.50	6.50	0.6	0.6169	0.252	0.176
12	7.90	6.90	0.62	0.651	0.244	0.155
13	8.40	7.40	0.57	0.7018	0.298	0.201
14	8.90	7.90	0.62	0.7035	0.298	0.209
15	9.40	8.40	0.59	0.7065	0.303	0.213
16	9.90	8.90	0.6	0.8368	0.298	0.230
17	10.40	9.40	0.68	0.6143	0.320	0.230
18	11.00	10.00	0.62	0.5938	0.390	0.236
19	11.40	10.40	0.6	0.5322	0.244	0.137
20	12.00	11.00	0.44	0.4459	0.312	0.155
21	12.60	11.60	0.4	0.5984	0.252	0.131
22	13.10	12.10	0.32	0.4554	0.180	0.096
23	13.80	12.80	0.14	0.0426	0.161	0.053
REW	14.40	13.40	0	0	0.042	0.002
				TOTAL	5.925	3.73

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Mercedes Markowski.

Water termperature:	**20.4**	**^oC**
Width:	**13.4**	**m**
Average velocity:	**0.597**	**m/s**
Average depth:	**0.493**	**m**
Area:	**5.925**	**m^2**
Flow:	**3.73**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW3 on Aug. 6, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.34	0	0	0	0	0
1	0.49	0.15	0.23	0.025	0.0173	0.0004
2	0.61	0.27	0.20	0.005	0.0258	0.0004
3	0.70	0.36	0.20	0.002	0.0180	0.0001
4	0.80	0.46	0.24	0.009	0.0220	0.0001
5	0.90	0.56	0.26	0.002	0.0250	0.0001
6	1.00	0.66	0.40	0.048	0.0330	0.0010
7	1.10	0.76	0.40	0.416	0.0400	0.0093
8	1.20	0.86	0.29	0.639	0.0345	0.0176
9	1.30	0.96	0.26	0.222	0.0275	0.0122
10	1.40	1.06	0.20	0.188	0.0230	0.0048
11	1.50	1.16	0.2	0.075	0.0200	0.0026
12	1.60	1.26	0.14	0.060	0.0170	0.0012
REW	1.90	1.56	0	0.000	0.0210	0.0013
				TOTAL	0.324	0.051

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken, Ken Budd, and Mercedes Markowski.

Water termperature:	**17.5**	**^oC**
Width:	**1.56**	**m**
Average velocity:	**0.141**	**m/s**
Average depth:	**0.252**	**m**
Area:	**0.324**	**m^2**
Flow:	**0.051**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW2 on Aug. 6, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	1.5	0	0	0	0	0
1	1.85	0.35	1.33	0.113	0.2328	0.0263
2	2.10	0.6	1.37	0.195	0.3375	0.0522
3	2.50	1	1.47	0.206	0.5680	0.1140
4	2.80	1.3	1.25	0.200	0.4080	0.0829
5	3.05	1.55	1.15	0.225	0.3000	0.0636
6	3.45	1.95	1.04	0.192	0.4380	0.0917
7	3.60	2.1	0.97	0.156	0.1508	0.0263
8	3.90	2.4	0.89	0.115	0.2790	0.0381
9	4.10	2.6	0.67	0.140	0.1560	0.0196
10	4.20	2.7	0.56	0.084	0.0615	0.0070
11	4.55	3.05	0.56	0.047	0.1960	0.0128
12	4.60	3.1	0.50	0.024	0.0265	0.0010
REW	4.90	3.4	0.00	0.000	0.0750	0.0018
				TOTAL	3.229	0.537

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken, Ken Budd, and Mercedes Markowski.

Water termperature:	**18**	**^oC**
Width:	**3.4**	**m**
Average velocity:	**0.141**	**m/s**
Average depth:	**0.980**	**m**
Area:	**3.229**	**m^2**
Flow:	**0.537**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 2, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.63	0.00	0	0	0.000	0.00
1	1.00	0.37	0.14	0.17	0.0259	0.0044
2	1.30	0.67	0.20	0.28	0.0510	0.0119
3	1.60	0.97	0.25	0.32	0.0675	0.0203
4	1.95	1.32	0.22	1.06	0.0822	0.0549
5	2.15	1.52	0.26	0.68	0.0480	0.0411
6	2.45	1.82	0.31	1.19	0.0855	0.0821
7	2.75	2.12	0.36	0.86	0.1005	0.1018
8	3.05	2.42	0.34	1.25	0.1050	0.1100
9	3.40	2.77	0.26	1.24	0.1050	0.1308
10	3.70	3.07	0.38	1.18	0.0960	0.1156
11	4.00	3.37	0.30	1.09	0.1020	0.1163
12	4.20	3.57	0.28	0.92	0.0580	0.0584
13	4.40	3.77	0.24	1.02	0.0520	0.0501
14	4.56	3.93	0.18	1.0549	0.0336	0.0347
REW	4.77	4.14	0	0.00	0.0189	0.0199
				TOTAL	1.031	0.952

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken and Mercedes Markowski.

Water termperature:	**18.1**	**^oC**
Width:	**4.14**	**m**
Average velocity:	**0.879**	**m/s**
Average depth:	**0.266**	**m**
Area:	**1.031**	**m^2**
Flow:	**0.952**	**m^3/s**

Discharge Measurement on Oakley/McBain Creek at OCAWR on Aug. 3, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	2.2	0	0	0	0	0
1	2.40	0.2	1.00	-0.03	0.1000	-0.0031
2	2.90	0.7	1.13	0.07	0.5325	0.0124
3	3.55	1.35	1.33	0.17	0.7995	0.0997
4	4.15	1.95	1.37	0.285	0.8100	0.1851
5	4.80	2.6	1.49	0.176	0.9295	0.2123
6	5.30	3.1	1.75	0.20	0.8100	0.1533
7	6.05	3.85	1.64	0.21	1.2713	0.2606
8	6.70	4.5	1.75	0.30	1.1018	0.2847
9	7.50	5.3	1.75	0.19	1.4000	0.3446
10	8.14	5.94	1.55	0.25	1.0560	0.2315
11	8.65	6.45	1.50	0.20	0.7778	0.1772
12	8.90	6.7	1.49	0.18	0.3738	0.0710
13	9.50	7.3	1.34	0.13	0.8490	0.1329
14	9.80	7.6	1.30	0.25	0.3960	0.0757
15	10.40	8.2	1.16	0.19	0.7380	0.1646
16	10.70	8.5	0.94	0.16	0.3150	0.0561
17	11.20	9	0.56	0.20	0.3750	0.0658
18	11.35	9.15	0.40	0.13	0.0720	0.0122
19	11.75	9.55	0.26	0.044	0.1320	0.0128
REW	12.35	10.15	0.00	0.00	0.0780	0.0034
				TOTAL	12.92	2.55

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken, Mercedes Markowski, and Ken Budd.

Water termperature:	**16.9**	**^oC**
Width:	**10.15**	**m**
Average velocity:	**0.175**	**m/s**
Average depth:	**1.248**	**m**
Area:	**12.92**	**m^2**
Flow:	**2.55**	**m^3/s**

Discharge Measurement on William River at just west of Highway #6 on Aug. 5, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.25	0.00	0	0	0.000	0.00
1	0.70	0.45	0.4	-0.0041	0.0900	-0.0004
2	1.10	0.85	0.4	0.0354	0.1600	0.0025
3	1.70	1.45	0.55	0.0117	0.2850	0.0062
4	2.50	2.25	0.65	0.007	0.4800	0.0045
5	3.20	2.95	0.56	0.012	0.4235	0.0040
6	4.10	3.85	0.52	0.037	0.4860	0.0118
7	5.00	4.75	0.6	0.093	0.5040	0.0338
8	5.55	5.30	0.62	0.207	0.3355	0.0506
9	6.40	6.15	0.66	0.139	0.5440	0.0936
10	6.90	6.65	0.7	0.139	0.3400	0.0474
11	7.80	7.55	0.72	0.235	0.6390	0.1200
12	8.60	8.35	0.77	0.301	0.5960	0.1603
13	9.60	9.35	0.8	0.213	0.7850	0.2010
14	10.80	10.55	0.87	0.295	1.0020	0.2561
15	11.80	11.55	0.84	0.273	0.8550	0.2430
16	12.50	12.25	0.91	0.205	0.6125	0.1456
17	13.30	13.05	0.94	0.280	0.7400	0.1799
18	14.00	13.75	0.92	0.249	0.6510	0.1721
19	14.80	14.55	0.88	0.173	0.7200	0.1523
20	15.60	15.35	0.76	0.068	0.6560	0.0815
21	16.30	16.05	0.56	0.022	0.4620	0.0225
22	17.00	16.75	0.51	0.014	0.3745	0.0067
23	17.70	17.45	0.38	0.006	0.3115	0.0032
REW	18.20	17.95	0	0.00	0.0950	0.0006
				TOTAL	12.148	2.00

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Karin Renken.

Water termperature:	**19.6**	**^oC**
Width:	**17.95**	**m**
Average velocity:	**0.131**	**m/s**
Average depth:	**0.675**	**m**
Area:	**12.148**	**m^2**
Flow:	**1.999**	**m^3/s**

Discharge Measurement on William River at WRAOC on Aug. 3, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	1	0	0	0	0	0
1	1.35	0.35	0.48	0.011	0.0840	0.0009
2	1.60	0.6	0.60	0.047	0.1350	0.0042
3	2.10	1.1	0.76	0.037	0.3400	0.0141
4	2.60	1.6	0.94	0.057	0.4250	0.0205
5	3.00	2	1.15	0.160	0.4180	0.0476
6	3.30	2.3	1.46	0.244	0.3915	0.0810
7	3.45	2.45	1.45	0.238	0.2183	0.0526
8	4.10	3.1	1.52	0.241	0.9652	0.2310
9	4.35	3.35	1.52	0.270	0.3800	0.0969
10	4.85	3.85	1.42	0.259	0.7350	0.1943
11	5.45	4.45	1.36	0.175	0.8340	0.1817
12	5.80	4.8	1.36	0.335	0.4760	0.1215
13	6.05	5.05	1.35	0.366	0.3388	0.1188
14	7.10	6.1	1.35	0.247	1.4175	0.4344
15	8.30	7.3	1.38	0.337	1.6380	0.4793
16	9.50	8.5	1.52	0.365	1.7400	0.6119
17	10.30	9.3	1.52	0.281	1.2160	0.3928
18	11.05	10.05	1.38	0.317	1.0875	0.3246
19	11.20	10.2	1.36	0.120	0.2055	0.0451
20	11.90	10.9	1.24	0.280	0.9100	0.1786
21	12.00	11	1.00	0.207	0.1120	0.0277
22	12.60	11.6	0.88	0.139	0.5640	0.0990
23	13.00	12	0.50	0.041	0.2760	0.0286
24	13.20	12.2	0.5	0.005	0.1000	0.0023
REW	13.65	12.65	0	0.00	0.1125	0.0006
				TOTAL	15.120	3.79

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken, Mercedes Markowski, and Ken Budd.

Water termperature:	**16.3**	**°C**
Width:	**12.65**	**m**
Average velocity:	**0.199**	**m/s**
Average depth:	**1.167**	**m**
Area:	**15.120**	**m^2**
Flow:	**3.790**	**m^3/s**

Discharge Measurement on William River at WRAOC on Aug. 3, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	2.95	0	0	0	0	0
1	3.70	0.75	0.28	0.012	0.1050	0.0013
2	4.40	1.45	0.31	-0.015	0.2065	-0.0004
3	5.00	2.05	0.45	0.006	0.2280	-0.0006
4	5.90	2.95	0.54	0.022	0.4455	0.0064
5	6.70	3.75	0.55	0.005	0.4360	0.0057
6	7.40	4.45	0.63	0.097	0.4130	0.0222
7	8.30	5.35	0.86	0.038	0.6705	0.0422
8	9.25	6.3	1.06	0.069	0.9120	0.0505
9	9.90	6.95	1.20	0.013	0.7345	0.0288
10	10.30	7.35	1.36	0.266	0.5120	0.0755
11	11.30	8.35	1.55	0.035	1.4550	0.2084
12	12.70	9.75	1.58	0.370	2.1910	0.4475
13	14.20	11.25	1.68	0.375	2.4450	0.9116
14	15.40	12.45	1.84	0.499	2.1120	0.9288
15	17.00	14.05	1.72	0.575	2.8480	1.5257
16	17.50	14.55	1.66	0.347	0.8450	0.3915
17	18.70	15.75	1.38	0.468	1.8240	0.7331
18	19.40	16.45	1.10	0.457	0.8680	0.4020
19	20.00	17.05	0.92	0.224	0.6060	0.2126
REW	21.20	18.25	0.00	0.000	0.5520	0.1235
				TOTAL	20.409	6.12

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Karin Renken, Mercedes Markowski, and Ken Budd.

Water termperature:	**17**	**^oC**
Width:	**18.25**	**m**
Average velocity:	**0.203**	**m/s**
Average depth:	**1.088**	**m**
Area:	**20.409**	**m^2**
Flow:	**6.12**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 10, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.25	0.25	0.04	0.340	0.005	0.0017
2	0.50	0.50	0.12	0.257	0.020	0.0056
3	0.80	0.80	0.18	0.251	0.045	0.0114
4	1.10	1.10	0.20	1.064	0.057	0.0387
5	1.60	1.60	0.20	0.987	0.100	0.1026
6	1.90	1.90	0.22	0.648	0.063	0.0510
7	2.20	2.20	0.24	1.086	0.069	0.0605
8	2.40	2.40	0.24	1.041	0.048	0.0510
9	2.60	2.60	0.20	0.885	0.044	0.0427
10	2.90	2.90	0.16	0.858	0.054	0.0471
11	3.10	3.10	0.16	0.668	0.032	0.0244
12	3.40	3.40	0.16	0.688	0.048	0.0325
13	3.60	3.60	0.12	0.751	0.028	0.0200
REW	3.90	3.90	0	0.000	0.018	0.0135
				TOTAL	0.631	0.503

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**18.25**	**^oC**
Width:	**3.9**	**m**
Average velocity:	**0.733**	**m/s**
Average depth:	**0.172**	**m**
Area:	**0.631**	**m^2**
Flow:	**0.503**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 11, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.25	0.25	0.08	0.115	0.010	0.001
2	0.50	0.50	0.10	0.178	0.023	0.003
3	0.80	0.80	0.10	0.195	0.030	0.006
4	1.10	1.10	0.16	0.320	0.039	0.011
5	1.40	1.40	0.18	0.644	0.051	0.025
6	1.70	1.70	0.26	0.910	0.066	0.053
7	1.90	1.90	0.20	0.567	0.046	0.035
8	2.20	2.20	0.22	0.920	0.063	0.047
9	2.50	2.50	0.22	0.916	0.066	0.061
10	2.80	2.80	0.20	0.818	0.063	0.055
11	3.00	3.00	0.20	0.662	0.040	0.030
12	3.30	3.30	0.16	0.812	0.054	0.039
13	3.50	3.50	0.14	0.490	0.030	0.020
14	3.80	3.80	0.12	0.710	0.039	0.023
REW	3.90	3.90	0	0.000	0.006	0.004
				TOTAL	0.626	0.413

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**18.03**	**^oC**
Width:	**3.9**	**m**
Average velocity:	**0.590**	**m/s**
Average depth:	**0.167**	**m**
Area:	**0.626**	**m^2**
Flow:	**0.413**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 12, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.25	0.25	0.1	0.405	0.013	0.005
2	0.50	0.50	0.18	0.291	0.035	0.012
3	0.75	0.75	0.18	0.245	0.045	0.012
4	1.00	1.00	0.18	0.208	0.045	0.010
5	1.25	1.25	0.18	0.517	0.045	0.016
6	1.50	1.50	0.10	0.495	0.035	0.018
7	1.75	1.75	0.10	0.927	0.025	0.018
8	2.00	2.00	0.10	0.738	0.025	0.021
9	2.25	2.25	0.16	0.866	0.033	0.027
10	2.50	2.50	0.16	0.788	0.040	0.033
11	2.75	2.75	0.16	0.898	0.040	0.034
12	3.00	3.00	0.12	0.739	0.035	0.029
13	3.25	3.25	0.16	0.716	0.035	0.025
14	3.50	3.50	0.18	0.697	0.043	0.030
15	3.75	3.75	0.12	0.535	0.038	0.024
REW	3.80	3.80	0	0.000	0.003	0.002
				TOTAL	0.533	0.315

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**17.4**	**^oC**
Width:	**3.8**	**m**
Average velocity:	**0.604**	**m/s**
Average depth:	**0.145**	**m**
Area:	**0.533**	**m^2**
Flow:	**0.315**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 13, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.25	0.25	0.18	0.492	0.023	0.011
2	0.50	0.50	0.20	0.324	0.048	0.019
3	0.80	0.80	0.20	0.286	0.060	0.018
4	1.20	1.20	0.24	0.786	0.088	0.049
5	1.50	1.50	0.24	0.955	0.072	0.063
6	1.70	1.70	0.28	1.076	0.052	0.053
7	1.90	1.90	0.28	0.808	0.056	0.053
8	2.20	2.20	0.28	1.179	0.084	0.083
9	2.50	2.50	0.28	1.059	0.084	0.094
10	2.80	2.80	0.30	1.107	0.087	0.094
11	3.10	3.10	0.30	0.914	0.090	0.091
12	3.40	3.40	0.26	0.747	0.084	0.070
13	3.60	3.60	0.24	0.828	0.050	0.039
14	3.90	3.90	0.2	0.666	0.066	0.050
REW	3.95	3.95	0	0.000	0.005	0.003
				TOTAL	0.948	0.792

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**16.2**	**^oC**
Width:	**3.95**	**m**
Average velocity:	**0.802**	**m/s**
Average depth:	**0.249**	**m**
Area:	**0.948**	**m^2**
Flow:	**0.792**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 14, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.50	0.50	0.16	0.372	0.040	0.015
2	0.70	0.70	0.20	0.246	0.036	0.011
3	1.00	1.00	0.24	0.363	0.066	0.020
4	1.40	1.40	0.26	0.778	0.100	0.058
5	1.70	1.70	0.26	1.055	0.078	0.071
6	2.00	2.00	0.28	1.052	0.081	0.085
7	2.30	2.30	0.28	1.239	0.084	0.096
8	2.60	2.60	0.30	1.037	0.087	0.099
9	2.90	2.90	0.28	0.968	0.087	0.087
10	3.20	3.20	0.24	0.938	0.078	0.074
11	3.50	3.50	0.22	0.833	0.069	0.061
12	3.70	3.70	0.18	0.713	0.040	0.031
REW	3.90	3.90	0.00	0.000	0.018	0.013
				TOTAL	0.864	0.723

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**18.7**	**^oC**
Width:	**3.9**	**m**
Average velocity:	**0.800**	**m/s**
Average depth:	**0.242**	**m**
Area:	**0.864**	**m^2**
Flow:	**0.723**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 15, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.25	0.25	0.1	0.193	0.013	0.002
2	0.50	0.50	0.12	0.243	0.028	0.006
3	0.80	0.80	0.20	0.248	0.048	0.012
4	1.10	1.10	0.20	0.453	0.060	0.021
5	1.30	1.30	0.22	0.946	0.042	0.030
6	1.50	1.50	0.24	0.813	0.046	0.040
7	1.80	1.80	0.26	1.212	0.075	0.077
8	2.00	2.00	0.28	0.794	0.054	0.054
9	2.20	2.20	0.28	1.138	0.056	0.054
10	2.40	2.40	0.28	1.095	0.056	0.063
11	2.70	2.70	0.30	1.109	0.087	0.096
12	2.90	2.90	0.22	0.974	0.052	0.055
13	3.20	3.20	0.22	1.006	0.066	0.065
14	3.50	3.50	0.24	0.781	0.069	0.061
15	3.70	3.70	0.18	0.669	0.042	0.031
REW	3.90	3.90	0	0	0.018	0.012
				TOTAL	0.811	0.678

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**18.1**	**^oC**
Width:	**3.9**	**m**
Average velocity:	**0.778**	**m/s**
Average depth:	**0.223**	**m**
Area:	**0.811**	**m^2**
Flow:	**0.678**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 16, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.25	0.25	0.1	0.403	0.013	0.005
2	0.50	0.50	0.16	0.413	0.033	0.013
3	0.90	0.90	0.16	0.191	0.064	0.019
4	1.10	1.10	0.24	0.674	0.040	0.019
5	1.40	1.40	0.22	0.857	0.069	0.053
6	1.70	1.70	0.20	0.982	0.063	0.058
7	2.00	2.00	0.26	0.719	0.069	0.058
8	2.20	2.20	0.22	1.106	0.048	0.043
9	2.50	2.50	0.22	1.022	0.066	0.070
10	2.80	2.80	0.26	1.164	0.072	0.079
11	3.00	3.00	0.26	0.869	0.052	0.053
12	3.30	3.30	0.20	0.890	0.069	0.061
13	3.50	3.50	0.18	0.703	0.038	0.030
14	3.80	3.80	0.12	0.682	0.045	0.031
REW	3.90	3.90	0	0.000	0.006	0.004
				TOTAL	0.746	0.596

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**18.1**	**^oC**
Width:	**3.9**	**m**
Average velocity:	**0.763**	**m/s**
Average depth:	**0.200**	**m**
Area:	**0.746**	**m^2**
Flow:	**0.596**	**m^3/s**

Discharge Measurement on Oakley Creek at OCW1 on Aug. 17, 2008

	Distance along Tape (m)	Location (m)	Depth (m)	Mean Velocity (m/s)	Area (m^2)	Flow (m^3/s)
LEW	0.00	0.00	0	0	0.000	0.00
1	0.25	0.25	0.1	0.328	0.013	0.004
2	0.50	0.50	0.12	0.271	0.028	0.008
3	0.80	0.80	0.14	0.246	0.039	0.010
4	1.10	1.10	0.14	0.452	0.042	0.015
5	1.40	1.40	0.20	0.653	0.051	0.029
6	1.70	1.70	0.22	0.996	0.063	0.052
7	2.00	2.00	0.22	0.763	0.066	0.058
8	2.30	2.30	0.26	0.955	0.072	0.062
9	2.60	2.60	0.26	0.881	0.078	0.072
10	2.90	2.90	0.26	0.931	0.078	0.071
11	3.20	3.20	0.20	0.866	0.069	0.062
12	3.50	3.50	0.18	0.815	0.057	0.048
13	3.70	3.70	0.18	0.703	0.036	0.027
REW	3.90	3.90	0	0.000	0.018	0.013
				TOTAL	0.709	0.532

Note: The 0.6 Method was used for the streamflow measurements.
Data was recorded by Mercedes Markowski and Ken Budd.

Water termperature:	**19.9**	**^oC**
Width:	**3.9**	**m**
Average velocity:	**0.682**	**m/s**
Average depth:	**0.191**	**m**
Area:	**0.709**	**m^2**
Flow:	**0.532**	**m^3/s**

APPENDIX 7.5

Supplemental Material for Surface Water Quality

APPENDIX 7.5-A

Field Sampling Protocol - Minago Surface Water Program

Wardrop (2007) SAMPLING PROTOCOL FOR THE VICTORY NICKEL MINAGO PROJECT, MANITOBA

Bottles and caps were triple rinsed in the water source prior to sample collection. Field personnel wore disposable nitrile gloves while handling the bottles and collecting samples. Gloves were changed between stations. Water samples were collected by submerging the sample bottles and allowing the bottles to fill. All grab samples were taken at mid-depth in the water column.

The field Quality Assurance/Quality Control (QA/QC) program involved the use of one trip blank and one set of field duplicate samples from one station during each monthly sampling trip. The trip blank consisted of a sample of distilled-deionized water prepared by the lab, taken to and returned from the field unopened (Environment Canada, 2002). Preservative was added to water samples, as required, and the samples were refrigerated or stored on ice until delivered to the respective analytical laboratories.

URS (2008g) SAMPLING PROTOCOL FOR THE VICTORY NICKEL MINAGO PROJECT, MANITOBA

STATION LOCATIONS

- Permanent sampling locations were selected during the first site visit in May 2007. Each location was chosen based on local hydrology and site access.
- Surface water sampling stations access was by foot, canoe, Argo, or helicopter.
- On the first site visit station locations were located on an area map and station location coordinates recorded using a hand-held Global Positioning System (GPS) unit.

SURFACE WATER SAMPLING

- Surface water samples were collected at each site from the river/creek directly into laboratory (ALS) supplied sampling containers.
- All sample containers were dedicated and were used only once.
- Care was taken during sample collection and subsequent handling to ensure that samples did not become contaminated.
- Dissolved metals samples required field filtering, which was carried out in the field using a field vacuum filtration container and hand pump. A 0.45 micron filter paper was used for the filtering of all dissolved metals samples
- Samples requiring preservation were prepared in the field following laboratory instructions and using laboratory supplied preservatives (see Table).
- Samples were immediately stored on ice in laboratory provided coolers until they were shipped to analytical lab in Vancouver. Whenever possible (especially during hot periods) samples were refrigerated until the samples could be packaged up in coolers for transport to the analytical lab in Vancouver.
- Field parameters consisting of stream pH, conductivity, dissolved oxygen, ORP, and temperature were recorded at the time of sampling.
- One field duplicate was collected during each sampling period. These samples were collected from one of the permanent sampling locations concurrent with the regular sample.

	Container	Quantity	Prep & Preservative
Total metals	**250 ml plastic**	**1**	**HNO3**
Dissolved metals	**250 ml plastic**	**1**	**Filtered and HNO3**
Radium 226	**1L plastic**	**1**	**HNO3**
Total K Nitrogen	**250 ml amber glass**	**1**	**H2SO4**
Ammonia Nitrogen	**250 ml amber glass**	**1**	**H2SO4**
Cyanide	**1L plastic**	**1**	**NaOH**
General Parameters	**1L plastic**	**1**	**None**

Samples were submitted to the analytical laboratory following standard chain of custody procedures.

Exerpt from URS (2008g) regarding

QUALITY ASSURANCE / QUALITY CONTROL PROTOCOL FOR SURFACE WATER SAMPLING AT MINAGO

Precision

Precision measures the reproducibility of repetitive measurements. Analytical precision is a measurement of the variability associated with duplicate or replicate analyses of the same sample in the laboratory and is determined by analysis of matrix spike duplicates or laboratory duplicates. Total precision depends on the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and incorporates variability introduced by the analytical procedures, sample collection and handling, and matrix factors (adapted from URS, 2008g).

Excerpt:

"In this program, analytical precision was measured in the laboratory by the analysis of laboratory duplicates, in which the same sample was analyzed twice. Total precision was determined by the collection and analysis of field duplicate samples. A total of four (4) field duplicate samples were collected: one each month or approximately 10%. The relative percent difference (RPD) was calculated for all of the duplicate measurements where the analytical result was at least five times the method detection limit. Ideally, RPD values for soils should be less than 35% for metals and less than 50% for organics.

Samples

RPDs for field duplicate samples of surface water quality are presented in Appendix L7.5. Total precision for total metals in surface water was acceptable, with RPDs ranging from 0% to 118% and an average RPD of 12.9%. Analytical precision for total metals in surface water was acceptable, with RPDs ranging from 0% to 13%.

Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (i.e., variability due to imprecision) and systematic error (i.e. bias). Therefore, accuracy reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ beyond acceptable limits from the true value or known concentration of a spike or standard. Analytical accuracy is typically measured by determining the percent recovery of known target analytes that are spiked into a field sample (i.e. a surrogate or matrix spike) or reagent water (i.e. Laboratory Control Sample [LCS] or blank spike) before extraction at known concentrations. The individual analytical methods provide equations for acceptance criteria at lower spiking levels.

The percent recoveries are not provided in the laboratory reports. Any comments with regard to QAQC are provided on the second page of the laboratory reports. Since there were no comments, all QAQC data passed ALS Data Quality Objectives. Hence, the percent recoveries were within the acceptable range.

Completeness

No samples were invalidated during the surface water quality environmental investigation. Completeness for this project was 100%" (URS, 2008g).

KR DESIGN INC. SAMPLING PROTOCOL FOR THE VICTORY NICKEL MINAGO PROJECT, MANITOBA

SURFACE WATER SAMPLING

- Surface water samples were collected at each site from the river/creek directly into laboratory (ALS) supplied sampling containers or intermediate dedicated sampling containers for transfer into laboratory supplied sampling containers.

- Bottles and caps were triple rinsed with the water prior to sample collection, except when preservatives were in the bottle (This was the case for some of the cyanide bottles). Field personnel wore disposal nitrile gloves while handling the bottles and collecting samples. Gloves were changed between stations. Water samples were collected by submerging the sample bottles. All grab samples were taken at an approximate depth of 0.3 m.

- The field Quality Assurance/Quality Control (QA/QC) program involved the use of trip and field blanks. The trip and field blanks consisted of samples of deionized water prepared by the lab, taken to and returned to the lab from the field. The trip blank was returned unopened to the lab (Environment Canada, 2002), while the field blank was opened in the field during sample collection.

- Care was taken during sample collection and subsequent handling to ensure that samples did not become contaminated.

- Dissolved metals samples required filtering, which was carried out using a vacuum filtration container and hand pump. A 0.45 micron filter paper was used for the filtering of all dissolved metals samples.

- Samples requiring preservation were prepared following laboratory instructions and using laboratory supplied preservatives (see Table below).

- Samples were immediately stored on ice in laboratory provided coolers until they were shipped to analytical lab in Vancouver. Whenever possible (especially during hot periods) samples were refrigerated until the samples could be packaged up in coolers for transport to the analytical lab in Vancouver.

- Field parameters consisting of stream pH, conductivity, dissolved oxygen, ORP, Total Dissolved Solids, temperature, and barometric pressure were recorded at the time of sampling.

- Samples were submitted to the analytical laboratory following standard chain of custody procedures.

Parameter	Container	Quantity	Prep & Preservative
Total metals	**250 mL plastic**	**1**	**Ultrapure HNO3**
Dissolved metals	**250 mL plastic**	**1**	**Filtered and ultrapure HNO3**
Radium 226	**1L plastic**	**5**	**HNO3**
Total K Nitrogen (TKN)	**250 mL amber glass**	**1**	**H2SO4**
Ammonia Nitrogen[1]	**250 mL amber glass**	**1**	**H2SO4**
Cyanide	**1L plastic**	**1**	**NaOH**
Total Organic Carbon	**125 mL amber glass**	**1**	**HCl**
Diss. Organic Carbon	**125 mL amber glass**	**1**	**Filtered and HCl**
General Parameters	**1L plastic**	**1**	**None**

NOTE: 1 Nitrite and nitrate were determined based on a 1:100 dilution of sample from this bottle to ensure that holding times were not exceeded for these parameters.

APPENDIX 7.5-B

Summary Graphs of Minago Surface Water Quality

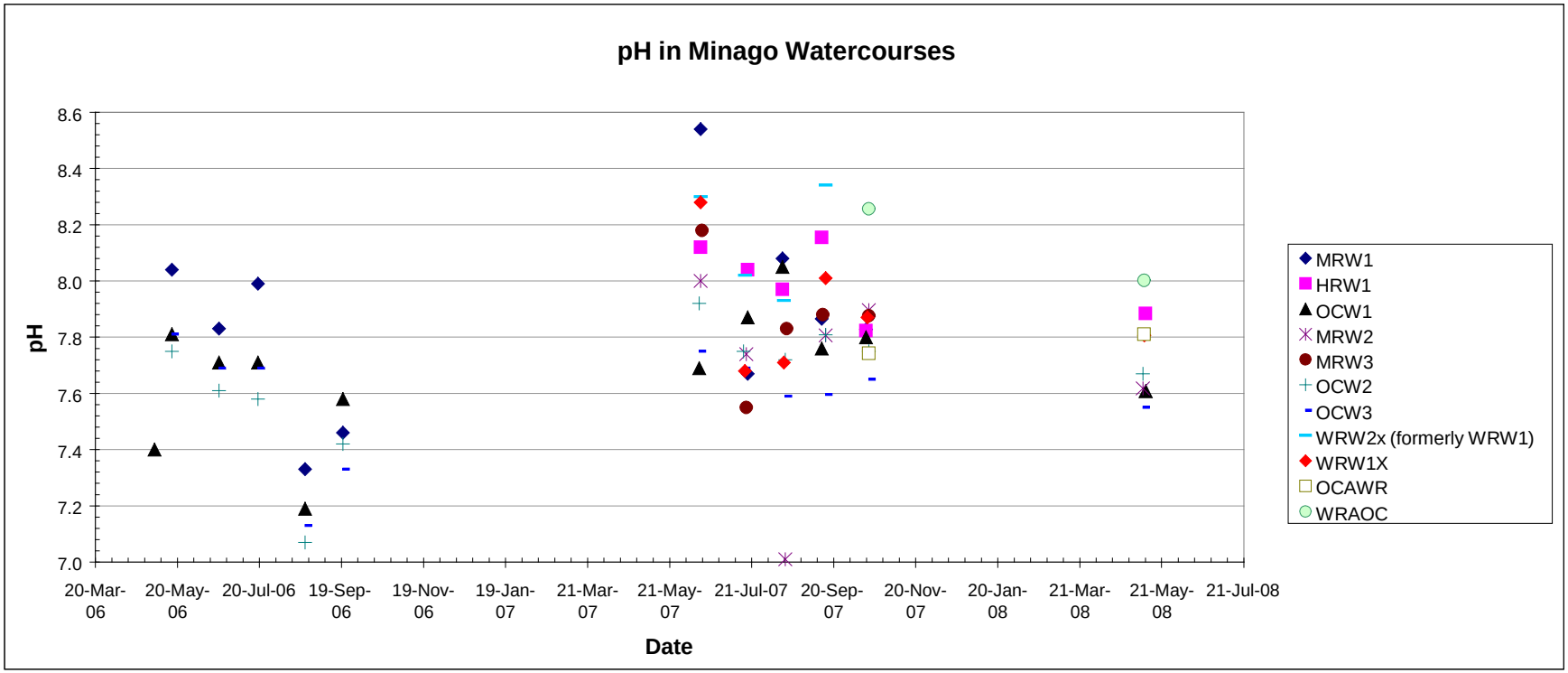


Figure A7.5-B-1 pH in Minago Surface Watercourses

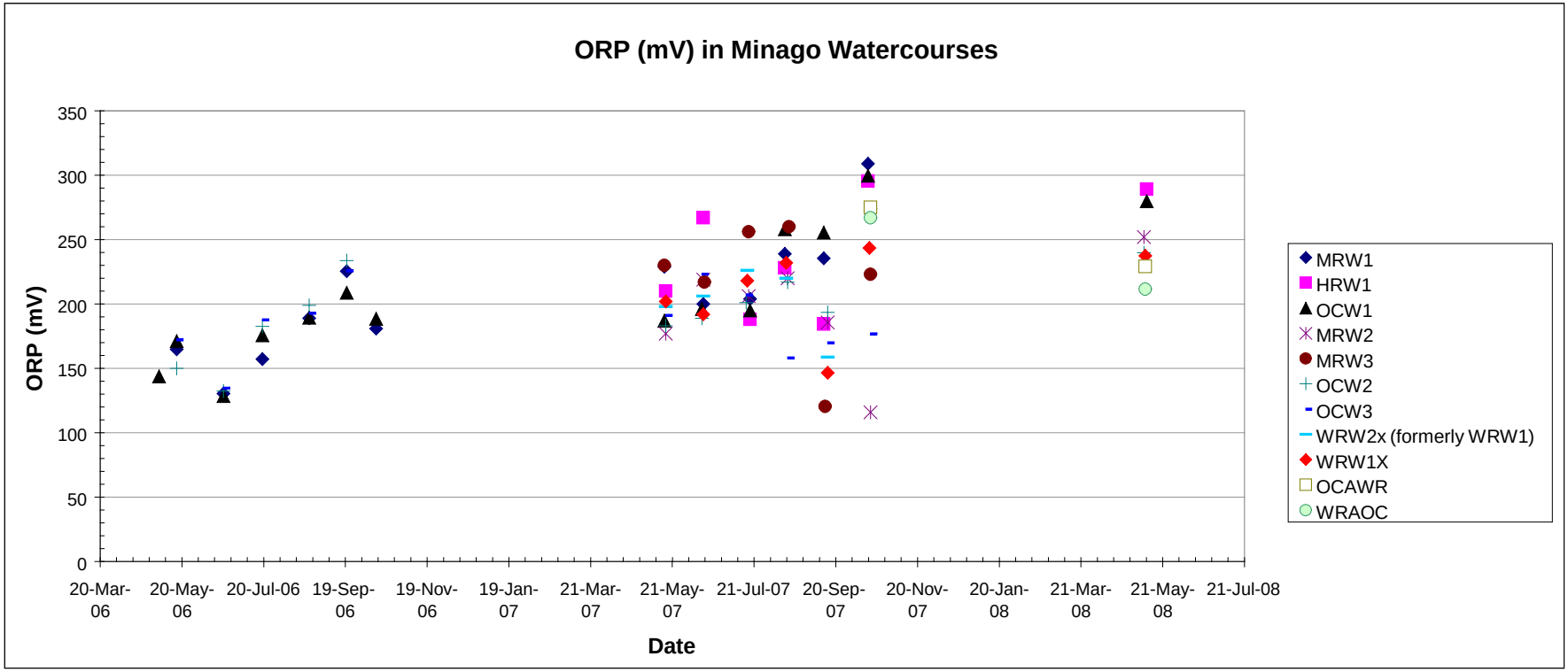


Figure A7.5-B-2 ORP in Minago Surface Watercourses

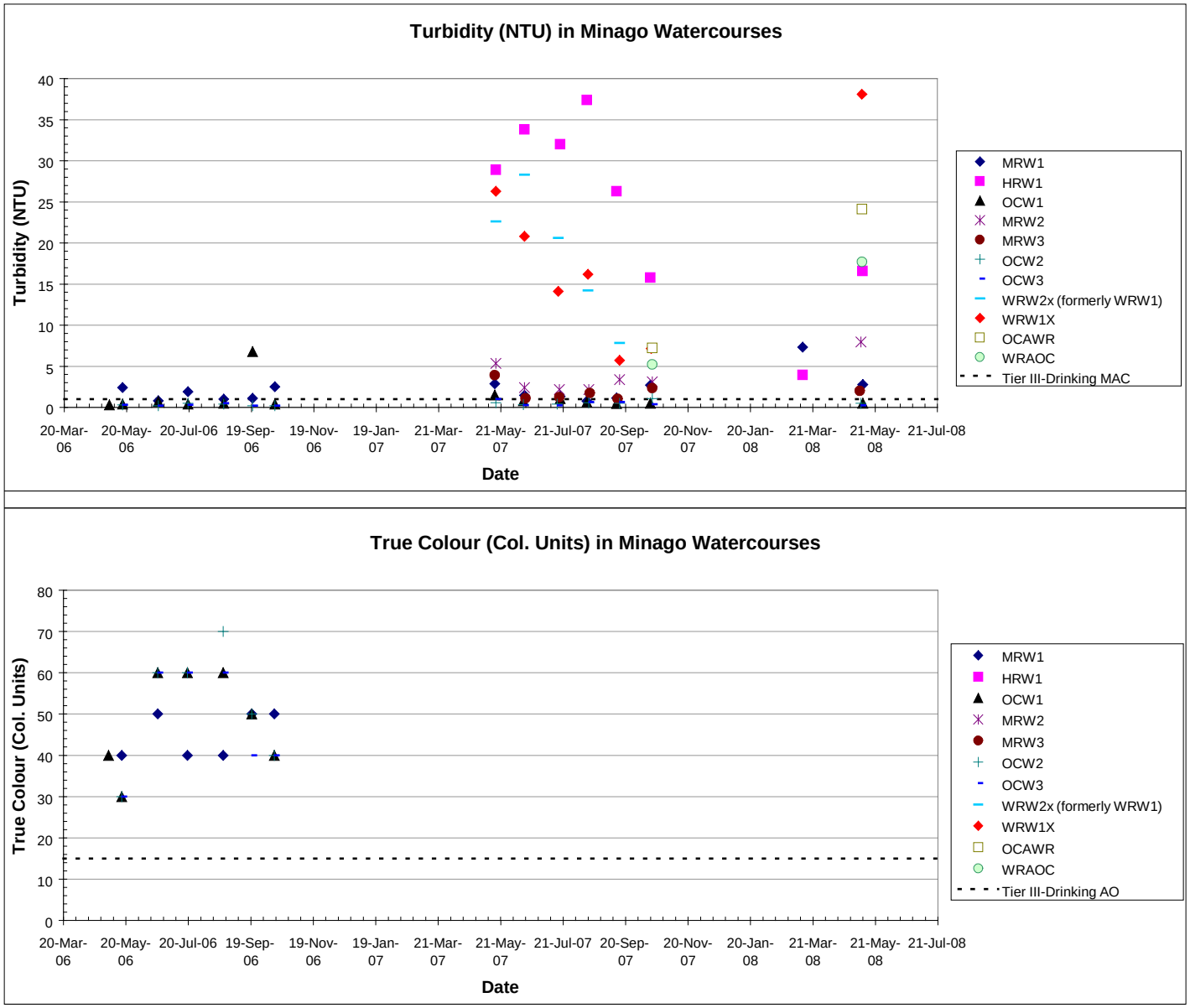


Figure A7.5-B-3 Turbidity and True Colour in Minago Surface Watercourses

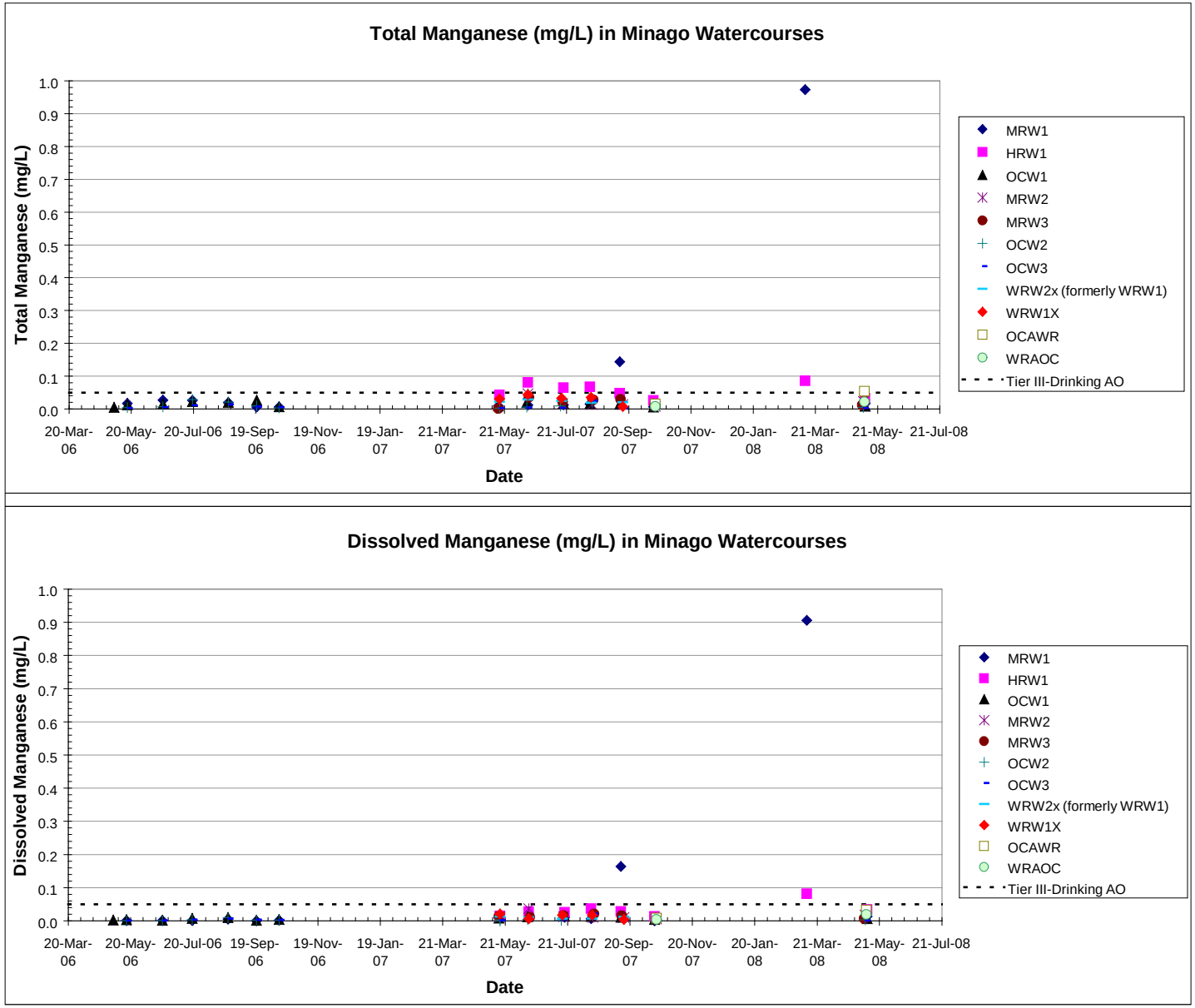


Figure A7.5-B-4 Manganese in Minago Surface Watercourses

APPENDIX 7.5-C

Detailed Water Quality Results – Correlation Graphs

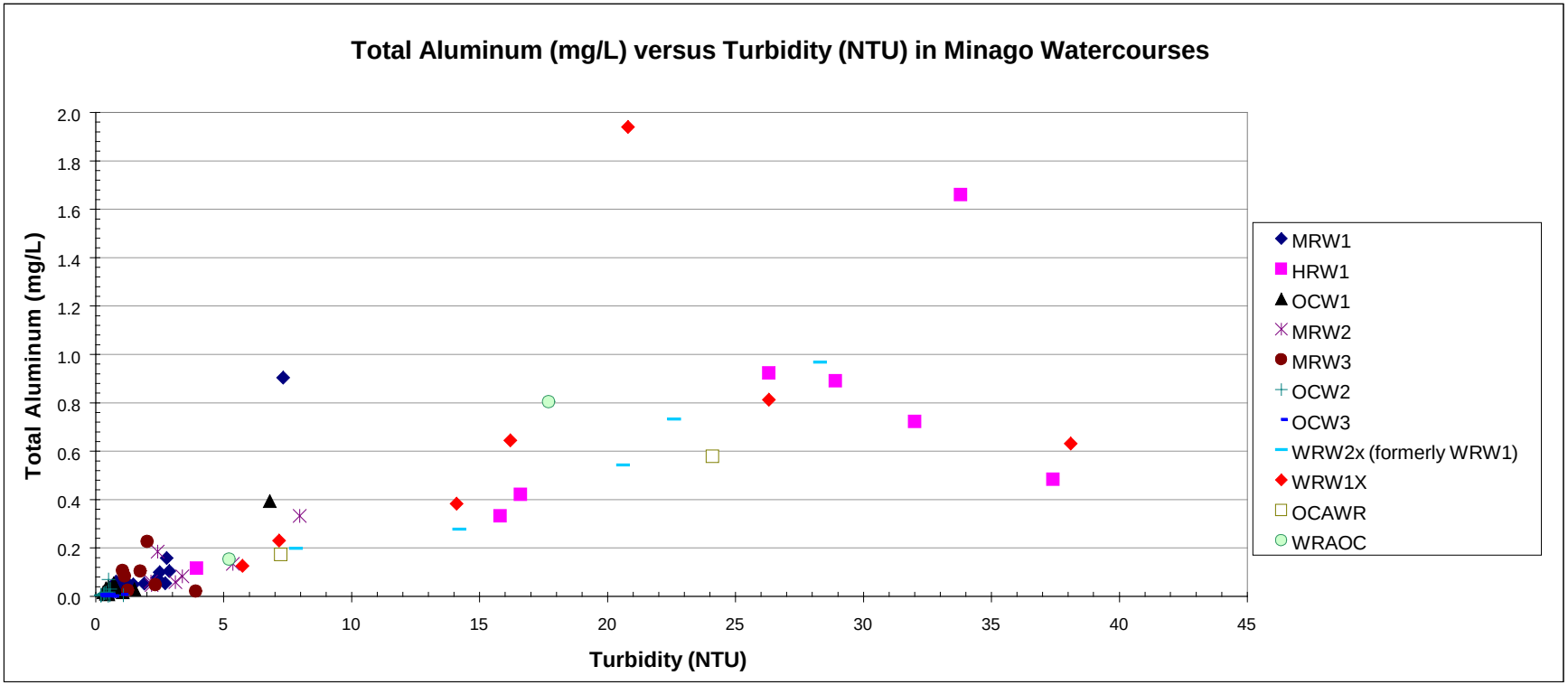
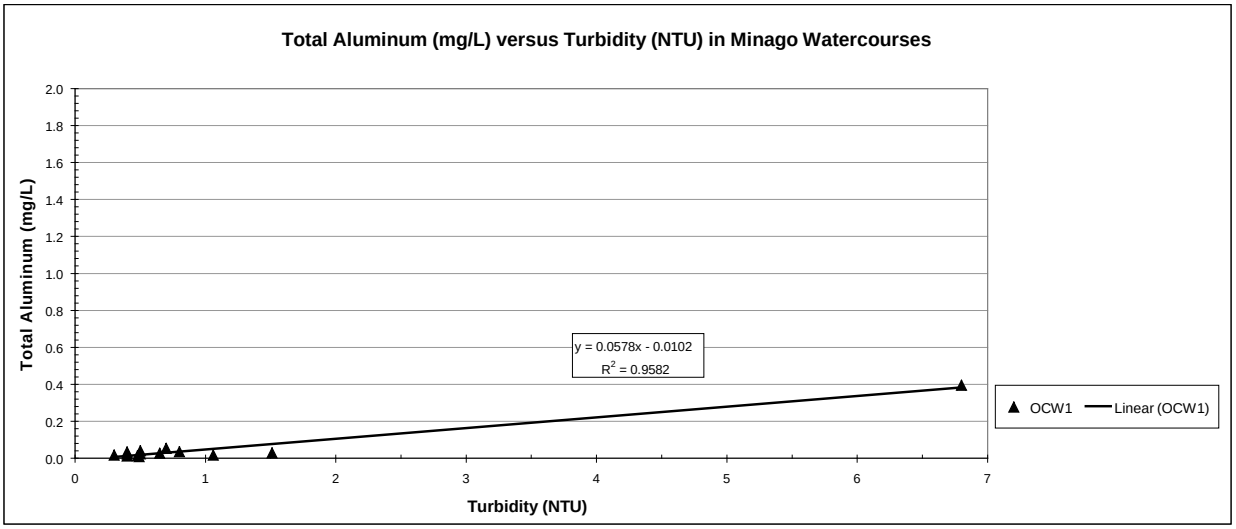
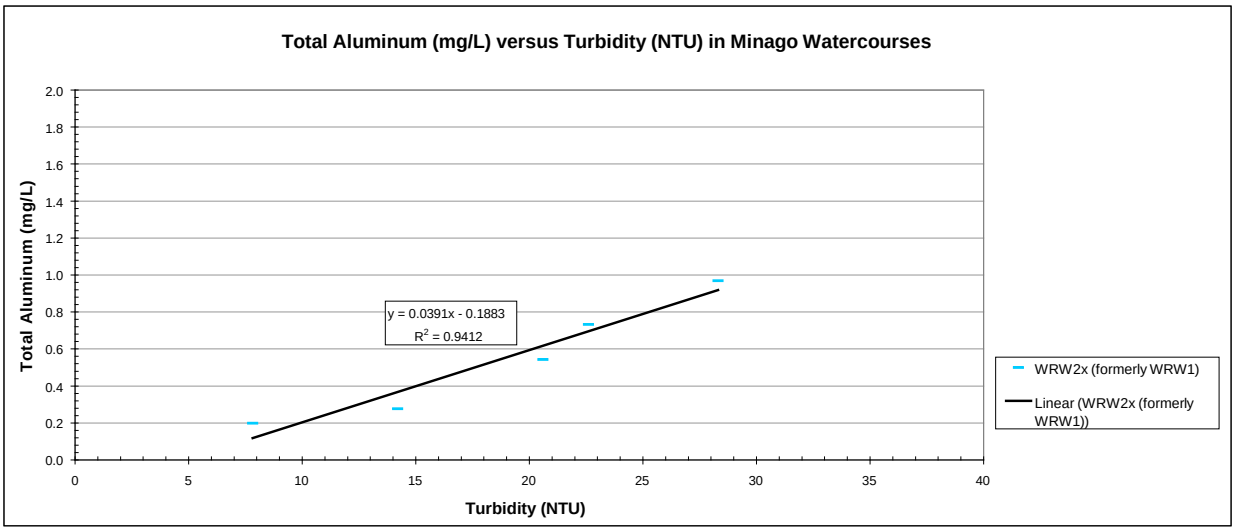


Figure A7.5-D-1 Total Aluminum (mg/L) versus Turbidity (NTU)





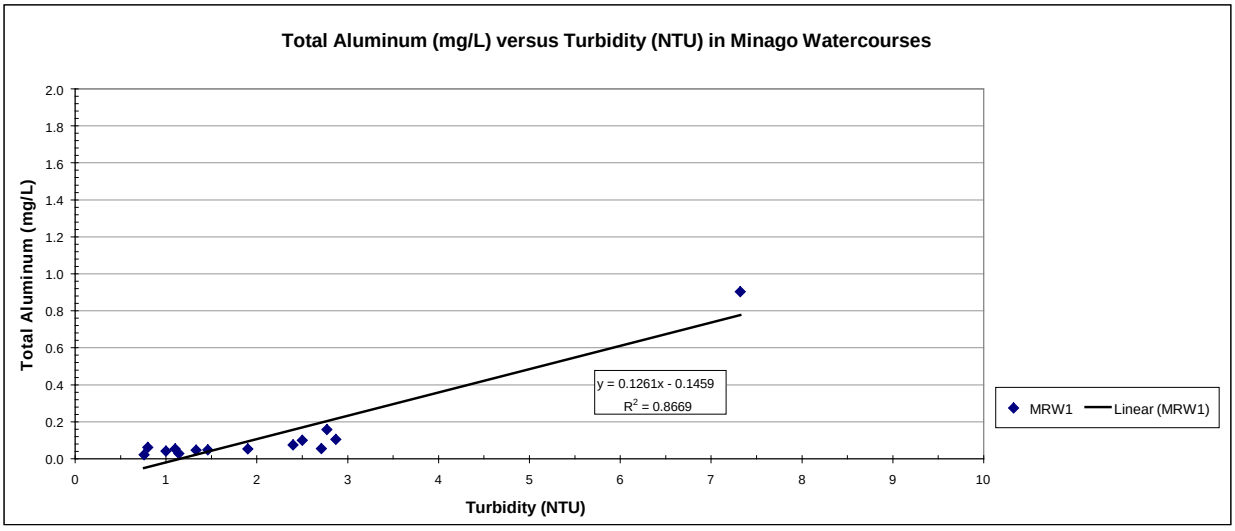
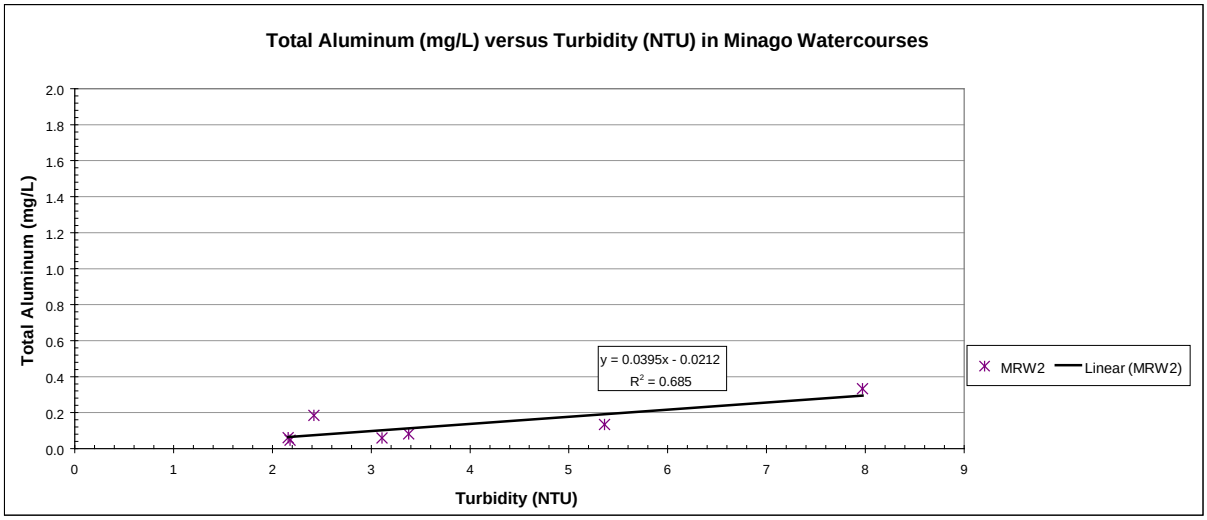
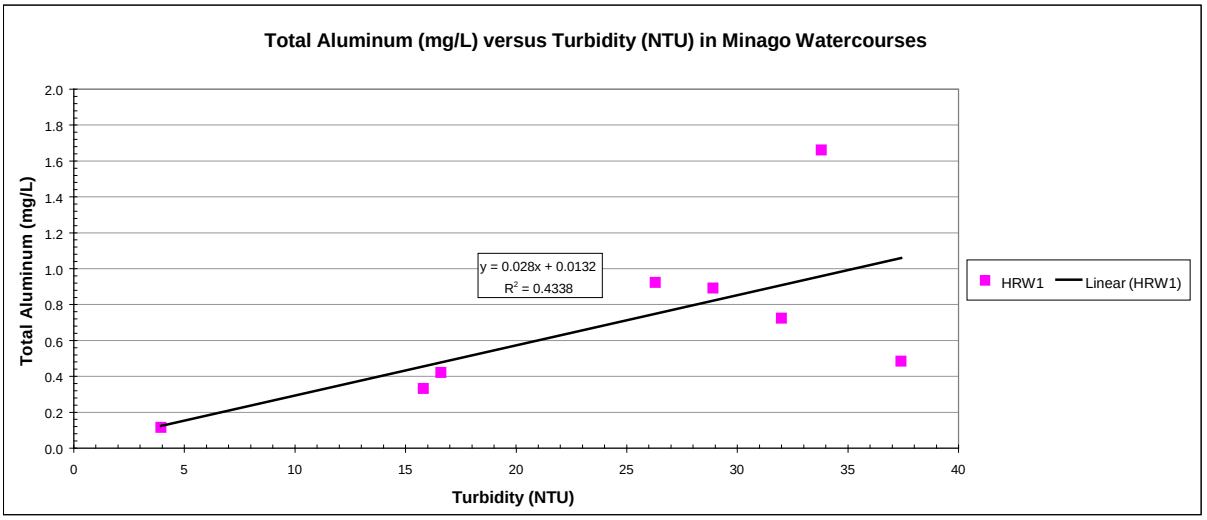


Figure A7.5-D-2 Total Aluminum (mg/L) versus Turbidity (NTU) at OCW1, WRW2x, MRW1

NOTE: For a perfect correlation, the correlation coefficient R is 1 and R^2 is also 1 and the correlation graph is a straight line with a y-intercept of 0.





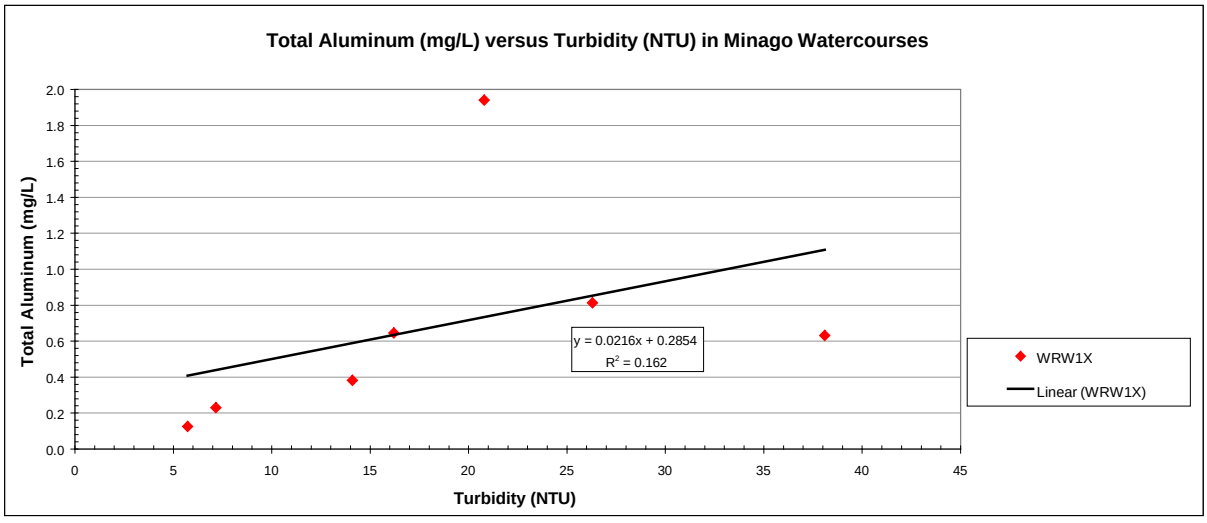


Figure A7.5-D-3 Total Aluminum (mg/L) versus Turbidity (NTU) at MRW2, HRW1, WRW1x

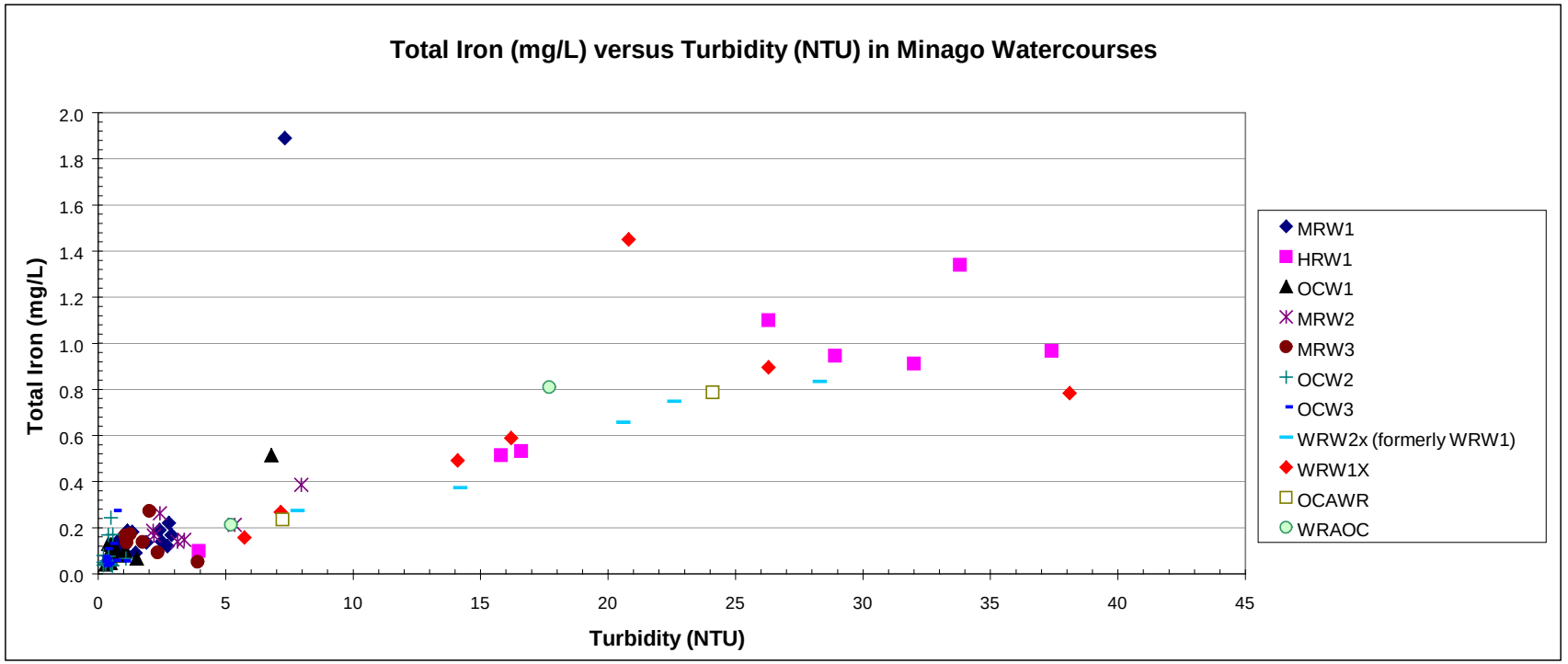


Figure A7.5-D-4 Total Iron (mg/L) versus Turbidity (NTU)

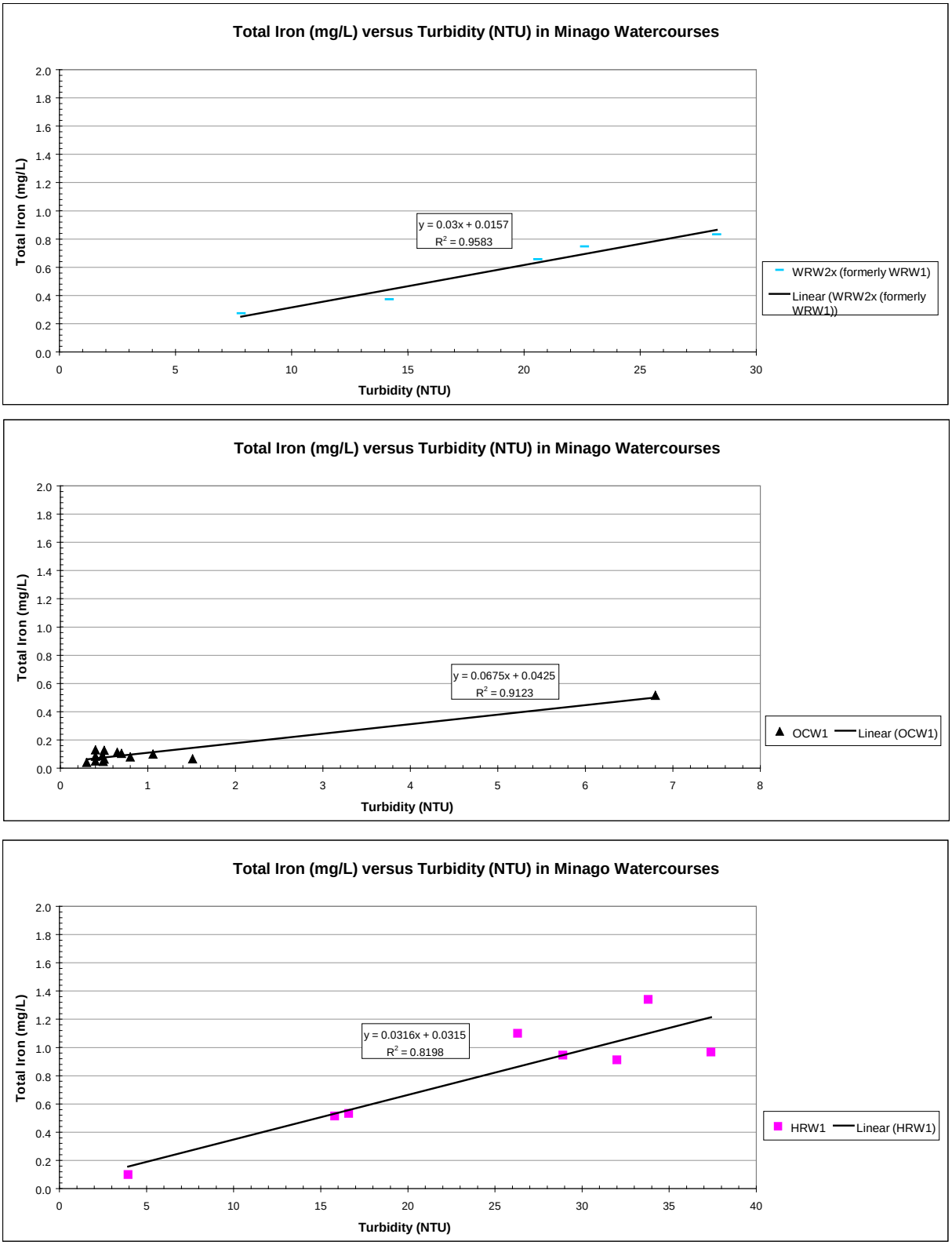


Figure A7.5-D-5 Total Iron (mg/L) versus Turbidity (NTU) at WRW2x, OCW1, HRW1

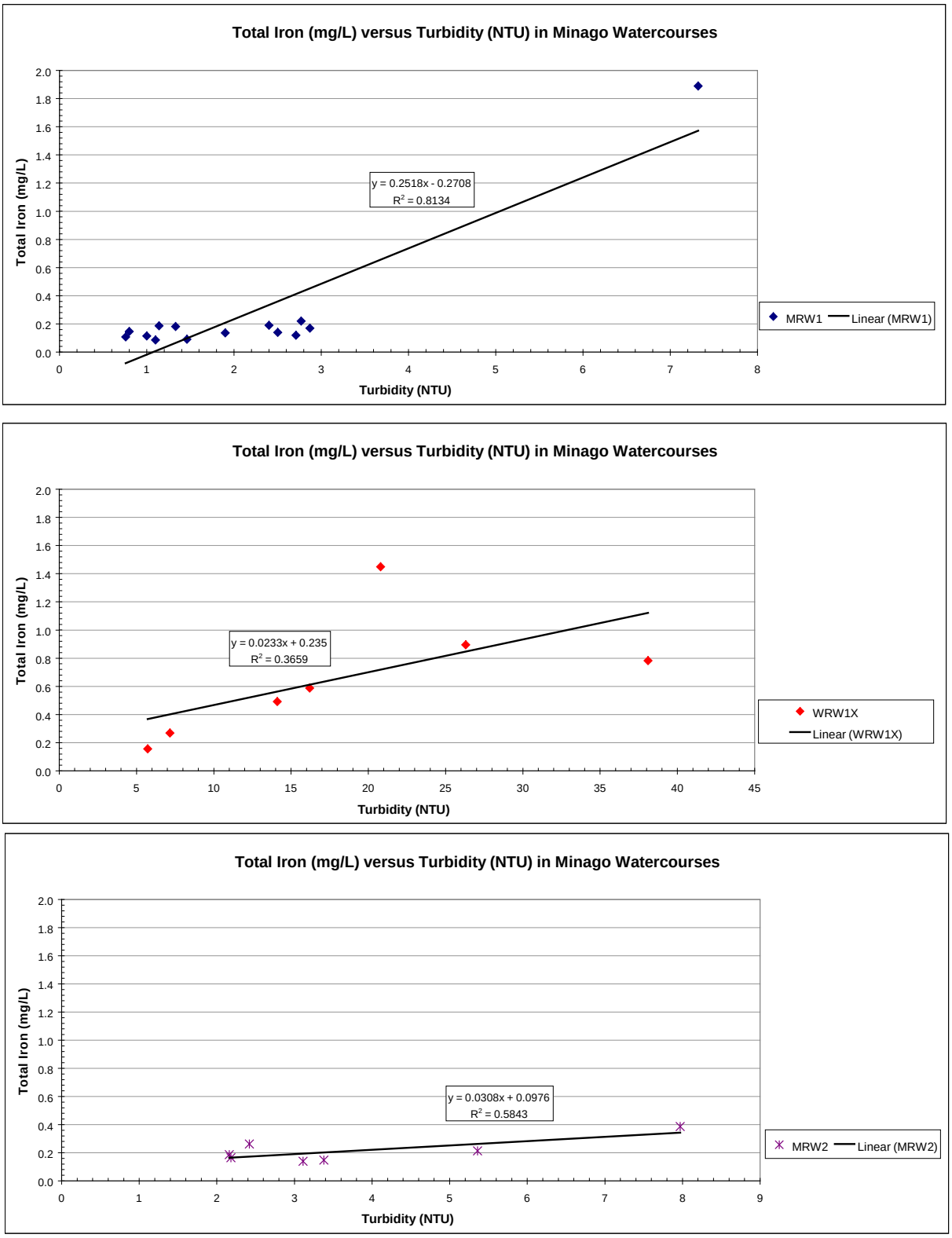


Figure A7.5-D-6 Total Iron (mg/L) versus Turbidity (NTU) at MRW1, WRW1x, MRW2

APPENDIX 7.5-D

Detailed Water Quality Results – All Stations – Total Metal

Table 7.5-D-1 Total Metals at Minago Sampling Station MRW1

Sample ID		MRW-1	MRW-1	MRW-1	MRW-1	MRW-1	MRW-1	MRW-1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-May-06	20-Jun-06	18-20 Jul-06	22-24 Aug-06	19-21 Sep-06	12-Oct-06	15-May-07	13-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	11-Mar-08	09-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines			
UTM (NAD 83) Easting		488684	488684	488684	488684	488684	488684	488694	488694	488694	488694	488671	488671	488671	488671				Drinking			
UTM (NAD 83) Northing		6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005277	6005277	6005277	6005277			(CCME, 2007)				
Lab Sample ID								L507178-1	L518885-5	L532666-9	L544316-4	L557287-1	L569390-6	L610409-2	L632454-11							
Matrix	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water			(see Footness for details)	MAC	IMAC	AO	Freshwater
Physical Tests																						
Hardness (as CaCO3)	mg/L	110	130	160	170	160	140	107	139	141	161	172	153	256	87.2	**87.2**	**256.0**					
Conductivity (in laboratory)	uS/cm							184	211	219	280	314	317	467	153	**153.0**	**467.0**					
pH	pH Units							7.84	8.05	7.93	8.15	7.91	8.18	7.92	7.87	**7.84**	**8.18**	**6.5-9**			6.5-8.5	
Total Elements																						
Aluminum (Al)-Total	mg/L	0.0753	0.061	0.0526	0.0419	0.0528	0.0996	**0.104**	0.0488	0.046	0.021	0.0286	0.0545	**0.904**	**0.158**	**0.021**	**0.904**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00054	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	0.000827	<0.000050	**0.00054**	**0.000827**			0.006		
Arsenic (As)-Total	mg/L	0.0006	0.0008	<0.002	0.0009	0.0008	0.0009	0.00063	0.00081	0.00096	0.00093	0.00105	0.000706	0.00144	0.000417	**0.000417**	**0.00144**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.0093	0.0114	0.0097	0.0112	0.0120	0.0104	0.0109	0.0115	0.0101	0.0101	0.0095	0.0149	0.0298	0.008	**0.008**	**0.0298**		1			
Beryllium (Be)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	**<0.0002**	**<0.0005**					
Bismuth (Bi)-Total	mg/L	0.00008	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**0.00008**	**0.00008**					
Boron (B)-Total	mg/L	0.009	0.013	0.015	0.016	0.016	0.015	0.01	0.013	0.011	0.015	0.0113	0.128	0.0286	0.0074	**0.0074**	**0.128**			5		
Cadmium (Cd)-Total	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.000333**	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	<0.000017	**0.000333**	**0.000333**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	23.5	30.2	35.7	37.3	36.4	34.3	23.8	31.8	32.4	37.4	37.5	34.6	56.0	16.7	**16.7**	**56.0**					
Chromium (Cr)-Total	mg/L	0.0005	0.001	<0.004	0.0006	0.0009	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	0.00051	0.00045	0.0004	0.00032	**0.00032**	**0.0010**		0.05			
Trivalent Chromium (Cr-III)	mg/L																	**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L																	**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.00008	0.00011	0.00008	0.00007	0.0001	0.00004	<0.00010	<0.00010	<0.00010	<0.00010	0.0001	<0.00010	0.0010	0.00011	**0.00004**	**0.0010**					
Copper (Cu)-Total	mg/L	**0.0056**	0.0007	0.0003	0.0016	0.0003	0.0005	0.00068	0.00068	0.00032	0.00027	<0.00050	0.0005	0.0005	0.00194	**0.00027**	**0.0056**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.189	0.146	0.136	0.115	0.086	0.139	0.169	0.091	0.182	0.108	0.186	0.120	**1.890**	0.22	**0.086**	**1.890**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.00073	0.00004	0.00005	0.00004	0.00004	0.00006	0.000138	0.000052	0.000096	<0.000050	<0.000050	<0.000050	0.00008	0.000137	**0.00004**	**0.0007**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	0.0027	0.0034	0.0033	0.004	0.0038	0.0032	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0064	<0.0050	**0.0027**	**0.0064**					
Magnesium (Mg)-Total	mg/L	11.6	13.2	16.0	16.6	15.7	14.7	11.8	14.7	14.0	17.0	20.5	16.4	29.2	7.76	**7.76**	**29.20**					
Manganese (Mn)-Total	mg/L	0.0169	0.0271	0.0257	0.0195	0.00553	0.00616	0.00967	0.012	0.0127	0.0155	**0.144**	0.006	**0.973**	0.0168	**0.00553**	**0.9730**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000010	<0.000010	<0.000010	**<0.00001**	**<0.00005**		0.001			0.0001
Inorganic Mercury	mg/L																	**0.000026**				
Methylmercury	mg/L																	**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.00008	0.0001	0.00094	0.0001	0.00008	0.00011	0.000081	0.000089	0.000057	0.000063	0.000115	0.000079	<0.000050	0.000057	**<0.30**	**<0.30**					0.073
Nickel (Ni)-Total	mg/L	0.0006	0.0009	<0.0005	0.001	0.0006	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.0009	0.0004	0.00054	0.00051	**0.0004**	**0.0010**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	0.017	0.027	0.019	0.011	0.013	0.01	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.01**	**0.0270**	**narrative**[x]				
Potassium (K)-Total	mg/L	0.66	0.59	0.441	0.453	0.705	0.928	<2.0	<2.0	<2.0	<2.0	0.764	1.29	2.06	1.03	**0.441**	**2.0600**					
Selenium (Se)-Total	mg/L	<0.0005	<0.0005	<0.01	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.00032	<0.00010	0.00012	<0.00010	**0.00012**	**0.0003**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	2.65	2.10	2.82	3.42	4.56	4.87	3.52	2.36	4.02	4.48	5.64	5.04	8.16	1.95	**1.95**	**8.16**					
Silver (Ag)-Total	mg/L	<0.00001	<0.00001	<0.00001	0.00004	0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	<0.000010	**0.00001**	**0.000040**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	3.33	4.03	4.71	5.32	6.06	5.43	2.8	4.5	2.5	3.8	4.57	5.64	10.4	2.25	**2.25**	**10.40**				≤200	
Strontium (Sr)-Total	mg/L	0.0323	0.0526	0.0528	0.0593	0.0571	0.0499	0.0337	0.0518	0.0402	0.0515	0.0691	0.0582	0.0965	0.0246	**0.0246**	**0.0965**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	**<0.0001**	**<0.00005**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	0.00060	0.00005	0.00006	0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.00005**	**0.0006**					
Titanium (Ti)-Total	mg/L	0.0035	0.002	<0.0005	0.0019	0.002	0.0038	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**0.0019**	**0.0038**					
Uranium (U)-Total	mg/L	0.00012	0.00012	0.00015	0.00011	0.00012	0.00015	0.00008	0.00012	0.00005	0.00008	0.00010	0.00015	0.00011	0.00007	**0.000048**	**0.0002**			0.02		
Vanadium (V)-Total	mg/L	0.00044	0.00044	0.00055	0.00027	0.00037	0.00038	<0.0010	<0.0010	<0.0010	<0.0010	0.00027	0.00037	0.00046	0.000489	**0.00027**	**0.0006**					
Zinc (Zn)-Total	mg/L	0.0048	<0.0005	<0.01	0.0011	<0.0005	0.0007	0.0015	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0040	**0.0007**	**0.0048**	**0.03**[d]			≤5	

Note: **0.0056** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-2 Total Metals at Minago Sampling Station MRW2

Sample ID		MRW2	MRW2	MRW2	MRW2	MRW2	MRW2X	MRW2X	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-May-07	13-Jun-07	17-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life	Manitoba Water Quality Standards, Objectives (Williamson, 2002)			
UTM (NAD 83) Easting		472484	472484	472484	472484	472476	472571	472571				TIER III - Water Quality Guidelines			
UTM (NAD 83) Northing		6001209	6001209	6001209	6001209	6001212	6001166	6001166							
Lab Sample ID		L507178-2	L518885-6	L532666-5	L544316-5	L555597-1	L569390-20	L632454-4			(CCME, 2007)	Drinking			
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water			(see Footness for details)	**MAC**	**IMAC**	**AO**	**Freshwater**
Physical Tests															
Hardness (as CaCO3)	mg/L	184	205	192	213	205	176	169	**169.0**	**213.0**					
Conductivity (in laboratory)	uS/cm	306	305	302	366	386	344	326	**302.0**	**386.0**					
pH	pH Units	8.12	8.16	7.94	8.17	8.23	8.24	8.07	**7.94**	**8.24**	**6.5-9**			6.5-8.5	
Total Elements															
Aluminum (Al)-Total	mg/L	**0.135**	**0.185**	0.047	0.061	0.0824	0.059	**0.333**	**0.047**	**0.3330**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	0.00015	<0.00010	<0.000050	<0.000050	0.000064	**0.000064**	**0.00015**			0.006		
Arsenic (As)-Total	mg/L	0.00049	0.00061	0.00081	0.00071	0.000521	0.000512	0.000386	**0.000386**	**0.00081**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.0221	0.0269	0.0213	0.0253	0.0249	0.0212	0.0242	**0.0212**	**0.0269**		1			
Beryllium (Be)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	0.013	0.02	0.015	0.017	0.0154	0.0115	0.0123	**0.0115**	**0.02**			5		
Cadmium (Cd)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**<0.000017**	**<0.000050**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	41.8	45.1	44.9	47.2	43.8	37.2	32.5	**32.5**	**47.2**					
Chromium (Cr)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00013	0.00038	0.00064	**0.00013**	**0.00064**		0.05			
Trivalent Chromium (Cr-III)	mg/L										**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L										**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.00011	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	0.0002	**0.00011**	**0.0002**					
Copper (Cu)-Total	mg/L	0.00046	0.00055	<0.00090	0.00059	<0.00050	0.00028	0.00067	**0.00028**	**0.00067**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.213	0.262	0.165	0.187	0.148	0.140	**0.386**	**0.14**	**0.3860**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.0001	0.000095	0.000333	0.000089	0.000051	<0.000050	0.000256	**0.000051**	**0.000333**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Total	mg/L	19.5	21.9	19.6	22.8	24.0	19.9	16.4	**16.4**	**24.0**					
Manganese (Mn)-Total	mg/L	0.0175	0.0464	0.0164	0.0138	0.0131	0.00811	0.023	**0.00811**	**0.0464**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	-	<0.000010	**<0.000050**	**<0.00010**		0.001			0.0001
Inorganic Mercury	mg/L										**0.000026**				
Methylmercury	mg/L										**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.000123	0.00017	0.000115	0.000111	0.000129	0.000107	0.000139	**0.00011**	**0.00017**					0.073
Nickel (Ni)-Total	mg/L	<0.00050	0.00055	0.00592	<0.00050	0.00044	0.00027	0.00063	**0.00027**	**0.00592**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**	**narrative** [x]				
Potassium (K)-Total	mg/L	<2.0	<2.0	12.2	<2.0	1.2	1.17	1.26	**1.17**	**12.20**					
Selenium (Se)-Total	mg/L	<0.00050	0.00061	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	**0.00061**	**0.00061**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	3.67	2.75	3.68	4.66	4.64	4.80	3.8	**2.75**	**4.80**					
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	**0.000833**	<0.000010	<0.00010	<0.000010	<0.000010	**0.00083**	**0.00083**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	3.1	5.3	2.5	4.3	4.54	3.55	3.55	**2.5**	**5.3**				≤200	
Strontium (Sr)-Total	mg/L	0.0466	0.0718	0.0489	0.0617	0.0680	0.0520	0.0448	**0.0448**	**0.0718**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00010	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	0.00051	**0.00011**	**0.00051**					
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.016	**0.0160**	**0.0160**					
Uranium (U)-Total	mg/L	0.00018	0.00021	0.00009	0.00013	0.00020	0.00016	0.000258	**0.00009**	**0.00026**			0.02		
Vanadium (V)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.00044	0.00037	0.000918	**0.00037**	**0.00092**					
Zinc (Zn)-Total	mg/L	0.0011	0.0011	<0.0040	<0.0010	0.0012	<0.0010	<0.0030	**0.0011**	**0.0012**	**0.03**[d]			≤5	

Note: **0.135** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-3 Total Metals at Minago Sampling Station MRW3

Sample ID		MRW3	MRW3	MRW3	MRW3	MRW3	MRW3	MRW3	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		15-May-07	14-Jun-07	17-Jul-07	16-Aug-07	12-Sep-07	16-Oct-07	06-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007) (see Footnote for details)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines			
UTM (NAD 83) Easting		494327	494327	494327	494327	494274	494274	494274							
UTM (NAD 83) Northing		6007867	6007867	6007867	6007867	6007895	6007895	6007895							
Lab Sample ID		L507178-3	L518885-7	L532666-6	L544316-6	L557035-1	L569390-21	L632454-1				Drinking			
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water				**MAC**	**IMAC**	**AO**	**Freshwater**
Physical Tests															
Hardness (as CaCO3)	mg/L	106	139	135	163	177	154	89.5	**89.5**	**177.0**					
Conductivity (in laboratory)	uS/cm	188	213	212	282	304	315	155	**155.0**	**315.0**					
pH	pH Units	7.95	7.94	7.81	8.12	7.78	8.23	7.77	**7.77**	**8.23**	**6.5-9**			6.5-8.5	
Total Elements															
Aluminum (Al)-Total	mg/L	0.0214	0.0842	0.0251	**0.104**	**0.107**	0.0475	**0.227**	**0.0214**	**0.2270**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	0.00039	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**0.00039**	**0.00039**			0.006		
Arsenic (As)-Total	mg/L	0.00072	0.00077	0.001	0.00096	0.000853	0.000691	0.00049	**0.00049**	**0.00100**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.0130	0.0112	0.0095	0.0099	0.0116	0.0129	0.00974	**0.00946**	**0.01300**		1			
Beryllium (Be)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	0.012	0.013	0.011	0.016	0.0159	0.0126	0.009	**0.009**	**0.016**			5		
Cadmium (Cd)-Total	mg/L	0.00118	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**0.00118**	**0.00118**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	24.1	31.6	31.1	37.6	37.9	35.3	18	**18.0**	**37.9**					
Chromium (Cr)-Total	mg/L	0.00082	<0.00050	<0.00050	<0.00050	0.00028	0.00041	0.00063	**0.00028**	**0.00082**		0.05			
Trivalent Chromium (Cr-III)	mg/L										**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L										**0.001**[k]				
Cobalt (Co)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	0.00012	**0.00012**	**0.00013**					
Copper (Cu)-Total	mg/L	0.00063	<0.0010	0.00036	0.00046	0.00053	0.00044	0.00091	**0.00036**	**0.00091**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.052	0.137	0.172	0.138	0.166	0.093	0.272	**0.052**	**0.2720**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.00016	<0.00020	0.000051	0.000067	0.00008	<0.000050	0.000245	**0.000051**	**0.000245**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Total	mg/L	11.7	13.9	13.2	16.9	20.1	16.3	8.16	**8.2**	**20.1**					
Manganese (Mn)-Total	mg/L	0.000842	0.0355	0.0213	0.0281	0.0298	0.0109	0.0117	**0.000842**	**0.0355**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000010	<0.000010	**<0.000010**	**<0.00005**		0.001			0.0001
Inorganic Mercury	mg/L										**0.000026**				
Methylmercury	mg/L										**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.000095	0.000129	0.000071	0.000053	0.000073	0.000065	0.000135	**0.00005**	**0.00014**					0.073
Nickel (Ni)-Total	mg/L	0.00053	0.00102	0.00052	<0.00050	0.0008	0.0004	0.00066	**0.00038**	**0.00102**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**	**narrative**[x]				
Potassium (K)-Total	mg/L	<2.0	<2.0	<2.0	<2.0	0.918	1.29	1.47	**0.92**	**1.47**					
Selenium (Se)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00015	<0.00010	0.00016	**0.00015**	**0.00016**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	3.36	2.35	4.03	4.44	3.73	4.91	2.31	**2.31**	**4.91**					
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**<0.00010**	**<0.00010**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	2.8	4.4	2.6	3.9	5.19	5.6	2.36	**2.4**	**5.6**				≤200	
Strontium (Sr)-Total	mg/L	0.0378	0.0615	0.0423	0.0578	0.0807	0.0628	0.0293	**0.0293**	**0.0807**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	**0.00012**	**0.00012**					
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.010**	**<0.010**					
Uranium (U)-Total	mg/L	0.00008	0.00012	0.00005	0.00007	0.00014	0.00014	0.000078	**0.00005**	**0.00014**			0.02		
Vanadium (V)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.00052	0.00033	0.000614	**0.00033**	**0.00061**					
Zinc (Zn)-Total	mg/L	0.0018	<0.0040	<0.0010	0.0018	<0.0010	<0.0010	<0.0040	**0.0018**	**0.0018**	**0.03**[d]			≤5	

Note: **0.104** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-4 Total Metals at Minago Sampling Station HRW1

Sample ID		HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-May-07	13-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	11-Mar-08	09-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007) (see Footness for details)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines Drinking MAC	IMAC	AO	Freshwater
UTM (NAD 83) Easting		495457	495457	495457	495457	495606	495606	495606	495606							
UTM (NAD 83) Northing		6027815	6027815	6027815	6027815	6028072	6028072	6028072	6028072							
Lab Sample ID		L507178-4	L518885-4	L532666-8	L544316-8	L557285-1	L569390-8	L610409-1	L632454-10							
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water	Water							
Physical Tests																
Hardness (as CaCO3)	mg/L	74.5	103	105	118	108	79	715	91.3	**74.5**	**715.0**					
Conductivity (in laboratory)	uS/cm	129	155	177	203	210	156	**1170**	171	**129.0**	**1170.0**					
pH	pH Units	7.9	7.99	8.05	8.07	8.11	8.04	8.15	8.05	**7.90**	**8.15**	**6.5-9**			6.5-8.5	
Total Elements																
Aluminum (Al)-Total	mg/L	**0.891**	**1.66**	**0.723**	**0.484**	**0.923**	**0.333**	**0.116**	**0.421**	**0.116**	**1.660**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	0.0011	<0.000050	**0.0011**	**0.0011**			0.006		
Arsenic (As)-Total	mg/L	0.00079	0.00096	0.00129	0.00153	0.00112	0.00080	0.00452	0.000621	**0.000621**	**0.00452**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[^]
Barium (Ba)-Total	mg/L	0.0147	0.0199	0.0160	0.0159	0.0178	0.0100	0.0656	0.0127	**0.0100**	**0.0656**		1			
Beryllium (Be)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00040	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	<0.010	0.01	0.012	0.012	0.0263	0.0061	0.0681	0.0092	**0.0061**	**0.0681**			5		
Cadmium (Cd)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000034	<0.000017	**<0.000017**	**<0.000034**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	19.9	24.9	26.1	30.3	27.4	19.9	142.0	20.2	**19.9**	**142.0**					
Chromium (Cr)-Total	mg/L	0.00167	0.00256	0.00143	0.00109	0.0015	0.00082	0.00062	0.00091	**0.00062**	**0.00256**		0.05			
Trivalent Chromium (Cr-III)	mg/L											**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L											**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.00045	0.00069	0.00048	0.00048	0.00045	0.00022	0.00022	0.0003	**0.00022**	**0.00069**					
Copper (Cu)-Total	mg/L	0.00136	0.002	0.00148	0.00149	**0.00643**	0.00079	**0.00621**	0.00133	**0.00079**	**0.00643**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	**0.945**	**1.340**	**0.912**	**0.967**	**1.100**	**0.514**	0.099	**0.532**	**0.099**	**1.3400**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.00046	0.000643	0.000453	0.000485	0.000487	0.00022	0.00221	0.000362	**0.000219**	**0.00221**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.018	<0.0050	**0.018**	**0.0180**					
Magnesium (Mg)-Total	mg/L	8.1	11.0	11.5	12.0	11.0	8.1	81.6	8.8	**8.1**	**81.6**					
Manganese (Mn)-Total	mg/L	0.0427	**0.0805**	**0.0644**	**0.0671**	0.0476	0.0258	**0.0854**	0.0327	**0.0258**	**0.0854**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	-	<0.000010	<0.000010	**<0.000010**	**<0.00005**		0.001			0.0001
Inorganic Mercury	mg/L											**0.000026**				
Methylmercury	mg/L											**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.00007	0.000147	0.000057	0.000064	0.000064	<0.000050	0.00067	0.000051	**0.00005**	**0.00067**					0.073
Nickel (Ni)-Total	mg/L	0.00133	0.00217	0.00168	0.00145	0.00623	0.00090	0.00215	0.00096	**0.00090**	**0.00623**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**	**narrative**[x]				
Potassium (K)-Total	mg/L	<2.0	<2.0	<2.0	<2.0	1.01	0.907	5.43	1.21	**0.91**	**5.43**					
Selenium (Se)-Total	mg/L	0.00072	0.00063	<0.00050	<0.00050	0.00011	<0.00010	0.00036	0.00017	**0.00011**	**0.00072**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	4.16	5.46	4.37	5.65	5.82	4.84	18.8	3.14	**3.14**	**18.80**					
Silver (Ag)-Total	mg/L	<0.000010	0.000012	0.00001	<0.000010	<0.00010	<0.000010	<0.000020	<0.000010	**0.000010**	**0.000012**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	<2.0	3.1	2.6	3.2	3.73	3.16	21.2	2.44	**2.4**	**21.2**				≤200	
Strontium (Sr)-Total	mg/L	0.0305	0.0473	0.0443	0.0475	0.0514	0.0345	0.2640	0.0321	**0.0305**	**0.2640**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.00010	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	0.00012	<0.00010	<0.00010	<0.00010	0.00039	<0.00010	0.00022	0.00052	**0.00012**	**0.00052**					
Titanium (Ti)-Total	mg/L	0.04	0.051	0.032	0.029	0.035	0.019	0.01	0.02	**0.01**	**0.0510**					
Uranium (U)-Total	mg/L	0.00010	0.00015	0.00008	0.00010	0.00012	0.00006	0.00098	0.000148	**0.00006**	**0.00098**			0.02		
Vanadium (V)-Total	mg/L	0.00210	0.00320	0.00210	0.00170	0.00250	0.00097	0.00440	0.00139	**0.00097**	**0.00440**					
Zinc (Zn)-Total	mg/L	0.0055	0.0059	<0.0050	0.0037	0.0041	0.0021	0.0033	<0.0040	**0.0021**	**0.0059**	**0.03**[d]			≤5	

Note: **0.484** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-5 Total Metals at Minago Sampling Station OCW1

Sample ID		OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW1	OCW1	OCW1	OCW1	OCW1	OCW1	OCW1	MINIMUM	MAXIMUM	REGULATIONS			
Date Sampled		May 3, 2006	May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	15-May-07	12-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	09-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007) (see Footness for details)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines			
UTM (NAD 83) Easting		489238	489238	489238	489238	489238	489238	489238	489238	489238	489238	489238	489322	489322	489322						
UTM (NAD 83) Northing		5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990510	5990510	5990510						
Lab Sample ID									L507178-5	L518885-1	L532666-7	L544316-18	L557283-1	L569390-7	L632454-9				Drinking		
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water				**MAC**	**IMAC**	**AO**	**Freshwater**
Physical Tests																						
Hardness (as CaCO3)	mg/L	140.0	160.0	180.0	240.0	250.0	220.0	170.0	158.0	191.0	183.0	244.0	224.0	156.0	150	**140.0**	**250.0**					
Conductivity (in laboratory)	uS/cm°								253.0	260.0	290.0	404.0	402.0	307.0	258	**253.0**	**404.0**					
pH	pH Units								8.0	8.1	8.0	8.2	8.1	8.2	8.1	**8.01**	**8.20**	**6.5-9**			6.5-8.5	
Total Elements																						
Aluminum (Al)-Total	mg/L	0.017	0.024	0.053	0.033	0.039	**0.394**	0.011	0.029	0.035	0.017	0.027	0.013	0.009	0.024	**0.009**	**0.394**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00082	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**0.00082**	**0.00082**			0.006		
Arsenic (As)-Total	mg/L	0.00030	0.00030	0.00040	<0.002	0.00050	0.00040	0.00050	0.00038	0.00041	0.00060	0.00050	0.00039	0.00034	0.00030	**0.000297**	**0.00060**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.01820	0.01880	0.02540	0.02690	0.02890	0.02660	0.01510	0.01800	0.02320	0.02180	0.02940	0.02730	0.01760	0.01720	**0.0151**	**0.0294**		1			
Beryllium (Be)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	<0.00005	<0.00005	0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**0.00012**	**0.00012**					
Boron (B)-Total	mg/L	<0.008	<0.008	0.0180	<0.008	<0.008	<0.008	0.0090	<0.010	0.0110	0.0120	<0.010	0.0070	0.0049	0.0060	**0.0049**	**0.018**			5		
Cadmium (Cd)-Total	mg/L	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**0.000010**	**0.000010**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	32.2	33.1	44.4	51.9	55.2	48.3	38.6	34.7	42.5	43.0	55.0	50.4	33.5	30.6	**30.6**	**55.2**					
Chromium (Cr)-Total	mg/L	0.0005	0.0003	0.0009	<0.004	0.0005	0.0016	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.0004	0.0002	**0.00015**	**0.0016**		0.05			
Trivalent Chromium (Cr-III)	mg/L																	**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L																	**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.00006	0.00004	0.00007	0.00003	0.00004	0.00025	<0.00002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.00003**	**0.00025**					
Copper (Cu)-Total	mg/L	0.0003	0.0006	0.0003	0.0001	0.0009	0.0005	0.0001	0.0003	0.0003	0.0002	0.0001	<0.00050	0.0001	0.0002	**0.0001**	**0.0009**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.0410	0.0840	0.1040	0.1300	0.1260	**0.5150**	0.0510	0.0660	0.0790	0.0990	0.1130	0.0870	0.0470	0.0640	**0.041**	**0.5150**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	<0.00002	0.00004	0.00003	0.00004	0.00004	0.00020	<0.00002	0.00008	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**0.00003**	**0.0002**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	0.00190	0.00270	0.00280	0.00230	0.00340	0.00350	0.00270	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0019**	**0.0035**					
Magnesium (Mg)-Total	mg/L	15.5	16.5	20.1	23.4	25.5	23.1	19.1	16.9	20.8	18.8	26.5	25.8	17.9	16.3	**15.5**	**26.5**					
Manganese (Mn)-Total	mg/L	0.00519	0.01270	0.01500	0.02250	0.02050	0.02670	0.00658	0.00914	0.01920	0.01700	0.01600	0.01420	0.00564	0.00840	**0.00519**	**0.0267**				≤0.05	
Mercury (Hg)-Total	mg/L	0.00006	0.00007	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000010	<0.000010	**0.00006**	**0.00007**		0.001			0.0001
Inorganic Mercury	mg/L																	**0.000026**				
Methylmercury	mg/L																	**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.00012	0.00008	0.00022	0.00088	0.00011	0.00009	0.00008	0.00009	0.00013	0.00006	0.00009	0.00006	0.00007	0.00012	**0.00006**	**0.00088**					0.073
Nickel (Ni)-Total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	0.00080	0.00100	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.00021	0.00011	0.00017	**0.00011**	**0.00100**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	0.005	0.008	0.009	0.010	0.008	0.013	<0.002	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.005**	**0.013**	**narrative**[x]				
Potassium (K)-Total	mg/L	0.65	0.54	0.20	0.23	0.59	1.04	1.08	<2.0	<2.0	<2.0	<2.0	0.70	0.72	1.09	**0.20**	**1.09**					
Selenium (Se)-Total	mg/L	<0.0005	<0.0005	<0.0005	<0.01	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.01**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	2.20	1.90	3.13	4.79	5.48	5.81	4.43	3.08	2.99	2.76	4.74	4.29	4.14	2.48	**1.90**	**5.81**					
Silver (Ag)-Total	mg/L	<0.00001	<0.00001	0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**0.000010**	**0.000010**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	1.9	1.9	2.2	2.3	2.6	2.6	2.5	<2.0	2.4	<2.0	2.1	2.2	2.1	1.8	**1.8**	**2.6**				≤200	
Strontium (Sr)-Total	mg/L	0.0331	0.0350	0.0496	0.0528	0.0589	0.0498	0.0359	0.0321	0.0483	0.0390	0.0516	0.0536	0.0356	0.0308	**0.0308**	**0.0589**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00030	**0.00015**	**0.00030**					
Titanium (Ti)-Total	mg/L	0.00090	0.00150	0.00250	<0.01	0.00180	0.01960	<0.0005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**0.0009**	**0.0196**					
Uranium (U)-Total	mg/L	0.00013	0.00017	0.00015	0.00018	0.00021	0.00015	0.00015	0.00011	0.00019	0.00008	0.00017	0.00023	0.00015	0.00031	**0.00008**	**0.00031**			0.02		
Vanadium (V)-Total	mg/L	0.00009	0.00011	0.00018	0.00041	0.00018	0.00081	0.00008	<0.0010	<0.0010	<0.0010	<0.0010	0.00009	0.00009	0.00015	**0.00008**	**0.00081**					
Zinc (Zn)-Total	mg/L	<0.0005	0.0012	<0.0005	<0.01	0.0010	0.0014	<0.0005	0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.001**	**0.0014**	**0.03**[d]			≤5	

Note: **0.394** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-6 Total Metals at Minago Sampling Station OCAWR

Sample ID		OCAWR	OCAWR	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-Oct-07	08-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007) (see Footness for details)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines			
UTM (NAD 83) Easting		498457	498457							
UTM (NAD 83) Northing		5986744	5986744							
Lab Sample ID		L569390-3	L632454-7				Drinking			
Matrix	Units	Water	Water				MAC	IMAC	AO	Freshwater
Physical Tests										
Hardness (as CaCO3)	mg/L	89.6	73.8	**73.8**	**89.6**					
Conductivity (in laboratory)	uS/cm	181.0	137	**137.0**	**181.0**					
pH	pH Units	8.0	7.99	**7.99**	**8.02**	**6.5-9**			6.5-8.5	
Total Elements										
Aluminum (Al)-Total	mg/L	0.173000	**0.579**	**0.173**	**0.579**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.000050	<0.000050	**<0.000050**	**<0.000050**			0.006		
Arsenic (As)-Total	mg/L	0.000616	0.000482	**0.000482**	**0.00062**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.009900	0.0153	**0.0099**	**0.0153**		1			
Beryllium (Be)-Total	mg/L	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	0.004400	0.0054	**0.0044**	**0.0054**			5		
Cadmium (Cd)-Total	mg/L	<0.000017	<0.000017	**<0.000017**	**<0.000017**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	19.8	16.1	**16.1**	**19.8**					
Chromium (Cr)-Total	mg/L	0.000370	0.00135	**0.00037**	**0.00135**		0.05			
Trivalent Chromium (Cr-III)	mg/L					**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L					**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.000120	0.00053	**0.00012**	**0.00053**					
Copper (Cu)-Total	mg/L	0.000370	0.00148	**0.00037**	**0.00148**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.236	**0.787**	**0.236**	**0.787**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.000107	0.000592	**0.000107**	**0.000592**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Total	mg/L	10.1	7.47	**7.5**	**10.1**					
Manganese (Mn)-Total	mg/L	0.0148	**0.0536**	**0.0148**	**0.0536**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.000010	<0.000010	**<0.000010**	**<0.000010**		0.001			0.0001
Inorganic Mercury	mg/L					**0.000026**				
Methylmercury	mg/L					**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	<0.000050	<0.000050	**<0.000050**	**<0.000050**					0.073
Nickel (Ni)-Total	mg/L	0.0004	0.00138	**0.00040**	**0.00138**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	<0.30	<0.30	**<0.30**	**<0.30**	**narrative**[x]				
Potassium (K)-Total	mg/L	0.7	1.04	**0.69**	**1.04**					
Selenium (Se)-Total	mg/L	<0.00010	<0.00010	**<0.00010**	**<0.00010**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	4.9	2.96	**2.96**	**4.91**					
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	**<0.000010**	**<0.000010**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	3.16	1.87	**1.9**	**3.2**				≤200	
Strontium (Sr)-Total	mg/L	0.03010	0.0214	**0.0214**	**0.0301**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00010	0.0001	**0.0001**	**0.00010**					
Titanium (Ti)-Total	mg/L	0.010	0.023	**0.01**	**0.0230**					
Uranium (U)-Total	mg/L	0.000081	0.000182	**0.00008**	**0.00018**			0.02		
Vanadium (V)-Total	mg/L	0.000449	0.00168	**0.00045**	**0.00168**					
Zinc (Zn)-Total	mg/L	0.001700	<0.0050	**0.0017**	**0.0017**	**0.03**[d]			≤5	

Note: **0.579** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-7 Total Metals at Minago Sampling Station OCW2

Sample ID		OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW2	OCW2	OCW2	OCW2	OCW2	OCW2	OCW2	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	16-May-07	12-Jun-07	15-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007) (see Footness for details)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines			
UTM (NAD 83) Easting		487559	487559	487559	487559	487559	487559	487344	487344	487344	487344	487463	487463	487463							
UTM (NAD 83) Northing		5990974	5990974	5990974	5990974	5990974	5990974	5990878	5990878	5990878	5990878	5990961	5990961	5990961							
Lab Sample ID								L507178-6	L518885-2	L532666-1	L544316-1	L555597-6	L569390-19	L632454-2				Drinking			
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water				**MAC**	**IMAC**	**AO**	**Freshwater**
Physical Tests																					
Hardness (as CaCO3)	mg/L	170.0	190.0	250.0	260.0	230.0	180.0	179.0	209.0	195.0	265.0	195.0	169.0	171	**169.0**	**265.0**					
Conductivity (in laboratory)	uS/cm							290.0	284.0	291.0	417.0	366.0	327.0	295	**284.0**	**417.0**					
pH	pH Units							8.0	8.1	7.9	8.0	8.2	8.2	8.03	**7.94**	**8.17**	**6.5-9**			6.5-8.5	
Total Elements																					
Aluminum (Al)-Total	mg/L	0.009300	0.005600	0.069100	0.014200	0.006400	0.002800	0.004500	0.013400	0.015900	0.030500	0.002800	0.005400	0.0181	**0.003**	**0.069**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**			0.006		
Arsenic (As)-Total	mg/L	0.000400	0.000400	<0.002	0.000500	0.001000	0.000500	0.000270	0.000330	0.000430	0.000450	0.000291	0.000280	0.000282	**0.00027**	**0.00100**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.020500	0.027900	0.029200	0.030600	0.022200	0.014800	0.021000	0.028200	0.024100	0.031800	0.022900	0.018700	0.0216	**0.0148**	**0.03180**		1			
Beryllium (Be)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	0.012000	0.010000	0.008000	<0.008	<0.008	<0.008	<0.010	0.012000	0.012000	<0.010	0.006600	0.005400	0.0071	**0.0054**	**0.012**			5		
Cadmium (Cd)-Total	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**<0.00001**	**<0.000050**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	35.1	46.5	53.8	57.4	49.3	41.5	40.6	46.4	40.7	56.7	42.0	35.7	38.2	**35.1**	**57.4**					
Chromium (Cr)-Total	mg/L	0.000300	0.000900	<0.004	0.000500	<0.002	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.000170	0.00015	**0.00015**	**0.0009**		0.05			
Trivalent Chromium (Cr-III)	mg/L																**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L																**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.000030	0.000050	0.000070	0.000030	0.000030	<0.00002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.00003**	**0.00007**					
Copper (Cu)-Total	mg/L	0.000200	0.000300	0.000200	0.000300	<0.0001	<0.0001	<0.00010	0.000270	<0.00030	0.000130	<0.00050	<0.00010	0.00013	**0.00013**	**0.0003**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.043000	0.050000	0.244000	0.168000	0.079000	0.037000	0.035000	0.056000	0.076000	0.170000	0.045000	0.066000	0.04	**0.035**	**0.244**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.000040	<0.00002	0.000070	<0.00002	0.000020	<0.00002	<0.000050	0.000073	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**0.00002**	**0.000073**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	0.002700	0.002900	0.002600	0.003300	0.003700	0.002700	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0026**	**0.00370**					
Magnesium (Mg)-Total	mg/L	18.0	21.0	24.3	26.8	23.7	20.9	19.4	22.0	18.1	28.7	23.5	19.5	19.8	**18.0**	**28.7**					
Manganese (Mn)-Total	mg/L	0.004220	0.006780	0.028500	0.020900	0.009170	0.003320	0.002730	0.005610	0.008880	0.021100	0.006640	0.008620	0.00464	**0.00273**	**0.0285**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000010	<0.000010	**<0.000010**	**<0.000050**		0.001			0.0001
Inorganic Mercury	mg/L																**0.000026**				
Methylmercury	mg/L																**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.0001	0.0002	0.0009	0.0001	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.000167	**0.000064**	**0.00094**					0.073
Nickel (Ni)-Total	mg/L	<0.0005	0.0006	0.0007	<0.0005	0.0006	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.0002	<0.00010	<0.00010	**0.00023**	**0.00070**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	0.006000	0.011000	0.008000	0.005000	0.005000	0.003000	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.003**	**0.01100**	**narrative**[x]				
Potassium (K)-Total	mg/L	0.6	0.2	0.3	0.6	0.9	1.2	<2.0	<2.0	<2.0	<2.0	1.0	0.8	1.2	**0.19**	**1.20**					
Selenium (Se)-Total	mg/L	<0.0005	<0.0005	<0.01	<0.0005	<0.005	<0.0005	0.000520	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	0.00021	**0.00021**	**0.00052**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	1.8	3.0	5.0	5.8	4.9	4.5	3.0	2.9	2.2	4.5	4.0	4.1	2.76	**1.77**	**5.84**					
Silver (Ag)-Total	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**<0.000010**	**<0.000010**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	1.95	2.07	2.19	2.57	2.57	2.48	<2.0	2.20	<2.0	2.10	2.09	2.12	1.92	**1.9**	**2.6**				≤200	
Strontium (Sr)-Total	mg/L	0.03540	0.05110	0.05100	0.05810	0.04460	0.03640	0.03510	0.05360	0.04260	0.05290	0.04300	0.03720	0.038	**0.0351**	**0.0581**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00005	0.000050	0.000050	<0.00005	<0.00005	<0.00005	<0.00010	0.000180	<0.00010	<0.00010	<0.00010	<0.00010	0.0005	**0.00005**	**0.00050**					
Titanium (Ti)-Total	mg/L	0.000500	<0.0005	<0.01	0.000600	<0.0005	<0.0005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**0.0005**	**0.0006**					
Uranium (U)-Total	mg/L	0.000220	0.000150	0.000180	0.000150	0.000130	0.000160	0.000186	0.000209	0.000113	0.000200	0.000213	0.000188	0.000419	**0.00011**	**0.00042**			0.02		
Vanadium (V)-Total	mg/L	0.000080	0.000060	0.000530	0.000090	0.000410	<0.00005	<0.0010	<0.0010	<0.0010	<0.0010	0.000073	0.000056	0.000129	**0.00006**	**0.00053**					
Zinc (Zn)-Total	mg/L	0.001500	<0.0005	<0.01	<0.0005	<0.005	<0.0005	<0.0010	0.001800	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	**0.0015**	**0.0018**	**0.03**[d]			≤5	

Table 7.5-D-8 Total Metals at Minago Sampling Station OCW3

Sample ID		OCW-3A	OCW-3A	OCW-3A-1	OCW-3A	OCW-3A	OCW-3A	OCW3	OCW3	OCW3	OCW3	OCW3	OCW3	OCW3	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	16-May-07	12-Jun-07	15-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007) (see Footness for details)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines			
UTM (NAD 83) Easting		487048	487048	487048	487048	487048	487048	487230	487230	487230	487230	487230	487230	487230				Drinking			
UTM (NAD 83) Northing		5990931	5990931	5990931	5990931	5990931	5990931	5990892	5990892	5990892	5990892	5990892	5990892	5990892							
Lab Sample ID								L507178-7	L518885-3	L532666-2	L544316-2	L555597-5	L569390-18	L632454-3							
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water				**MAC**	**IMAC**	**AO**	**Freshwater**
Physical Tests																					
Hardness (as CaCO3)	mg/L	190	210	260	270	230	180	163	179	173	226	163	146	157	**146.0**	**270.0**					
Conductivity (in laboratory)	uS/cm							259	269	258	373	301	285	258	**258.0**	**373.0**					
pH	pH Units							7.97	8.03	7.89	8	8.11	8.11	7.97	**7.89**	**8.11**	**6.5-9**			6.5-8.5	
Total Elements																					
Aluminum (Al)-Total	mg/L	0.0084	0.0067	0.0048	0.0081	0.0062	0.0048	0.007	0.0088	0.0032	<0.011	0.003	0.0019	0.0011	**0.001**	**0.009**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**			0.006		
Arsenic (As)-Total	mg/L	0.0003	0.0003	<0.002	0.0004	0.0002	0.0005	0.00028	0.00032	0.00038	0.00051	0.000319	0.00027	0.000293	**0.0002**	**0.00051**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.0244	0.0308	0.0327	0.0315	0.0223	0.0150	0.0166	0.0209	0.0184	0.0232	0.0156	0.0136	0.0172	**0.0136**	**0.03270**		1			
Beryllium (Be)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	0.0002	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**0.0002**	**0.00020**					
Boron (B)-Total	mg/L	<0.008	0.016	0.009	0.008	<0.008	<0.008	<0.010	0.011	<0.010	<0.010	0.0055	0.0045	0.0052	**0.0045**	**0.016**			5		
Cadmium (Cd)-Total	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**<0.00001**	**<0.000050**	**0.000017**[c,J]	0.005			
Calcium (Ca)-Total	mg/L	40.5	49.0	57.2	59.5	51.0	41.1	36.6	40.3	40.7	52.3	33.9	31.1	34.6	**31.1**	**59.5**					
Chromium (Cr)-Total	mg/L	0.0005	0.0009	<0.004	0.0005	0.0007	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.00025	0.00016	**0.00016**	**0.0009**		0.05			
Trivalent Chromium (Cr-III)	mg/L																**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L																**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.00003	0.00005	<0.0002	<0.0002	0.00002	<0.00002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.00002**	**0.00005**					
Copper (Cu)-Total	mg/L	0.0004	0.0002	<0.0001	0.0003	<0.0001	0.0002	<0.00010	0.0002	0.00042	<0.00070	<0.00050	<0.00010	0.0001	**0.0001**	**0.00042**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.039	0.052	0.109	0.131	0.074	0.055	0.055	0.063	0.065	0.274	0.058	0.046	0.036	**0.036**	**0.274**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.00003	<0.00002	0.00002	<0.00002	<0.00002	<0.00002	<0.000050	<0.000050	<0.000050	<0.000070	<0.000050	<0.000050	<0.000050	**0.00002**	**0.00003**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	0.0031	0.0029	0.0028	0.0033	0.0032	0.0028	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0028**	**0.00330**					
Magnesium (Mg)-Total	mg/L	20.7	22.2	26.2	28.0	24.7	20.6	17.0	18.7	17.7	23.2	17.9	16.5	17.6	**16.5**	**28.0**					
Manganese (Mn)-Total	mg/L	0.00276	0.00516	0.0111	0.0138	0.00773	0.00542	0.00286	0.00413	0.00322	0.0244	0.00374	0.00290	0.00289	**0.00276**	**0.0244**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000010	<0.000010	**<0.000010**	**<0.000050**		0.001			0.0001
Inorganic Mercury	mg/L																**0.000026**				
Methylmercury	mg/L																**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.00012	0.00017	0.00087	0.0001	0.00009	0.00009	0.000062	0.000072	<0.000050	0.000073	0.000058	<0.000050	0.000095	**0.000058**	**0.00087**					0.073
Nickel (Ni)-Total	mg/L	<0.0005	0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.0021	0.00066	0.00015	<0.00010	<0.00010	**0.00015**	**0.00210**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	0.006	0.01	0.004	0.006	0.004	0.003	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.003**	**0.010**	**narrative**[x]				
Potassium (K)-Total	mg/L	0.705	0.241	0.366	0.614	0.921	1.14	<2.0	<2.0	<2.0	<2.0	0.412	0.707	1.31	**0.24**	**1.31**					
Selenium (Se)-Total	mg/L	<0.0005	<0.0005	<0.01	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	0.00019	**0.00019**	**0.00019**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	2.04	3.17	5.10	5.97	5.01	4.43	3.29	2.60	1.55	5.37	4.45	3.89	2.8	**1.55**	**5.97**					
Silver (Ag)-Total	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**<0.000010**	**<0.000010**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	2.05	2.11	2.24	2.58	2.6	2.47	<2.0	<2.0	<2.0	<2.0	1.53	1.68	1.6	**1.5**	**2.6**				≤200	
Strontium (Sr)-Total	mg/L	0.0389	0.0517	0.0554	0.0608	0.0461	0.0361	0.0309	0.0451	0.0341	0.0496	0.0356	0.0319	0.0335	**0.0309**	**0.0608**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00005	0.00015	0.00007	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0006	**0.00007**	**0.00060**					
Titanium (Ti)-Total	mg/L	0.0006	<0.0005	<0.01	<0.0005	<0.0005	<0.0005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**0.00060**	**0.00060**					
Uranium (U)-Total	mg/L	0.00034	0.00020	0.00021	0.00015	0.00014	0.00016	0.00004	0.00003	0.00002	0.00003	0.00003	0.00003	0.000071	**0.00002**	**0.00034**			0.02		
Vanadium (V)-Total	mg/L	0.00009	0.00008	0.00045	0.00008	0.00011	<0.00005	<0.0010	<0.0010	<0.0010	<0.0010	0.00007	<0.000050	0.000058	**0.00006**	**0.00045**					
Zinc (Zn)-Total	mg/L	<0.0005	<0.0005	<0.01	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0020	<0.0040	<0.0010	<0.0010	<0.0010	**<0.0010**	**<0.0040**	**0.03**[d]			≤5	

Table 7.5-D-9 Total Metals in William River and at Sampling Station WRW2x

Sample ID		WR	William River	WILLIAM RIVER AT ROAD	WRW1	WRW1	WRW1	WRW1	WRW2x (formerly WRW1)	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		03-May-06	11-MAR-08	10-May-08	16-May-07	13-Jun-07	16-Jul-07	14-Aug-07	14-Sep-07	WRW2x	WRW2x	Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007) (see Footness for details)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines Drinking			
UTM (NAD 83) Easting			485141	485078	495419	495419	495419	495419	495416							
UTM (NAD 83) Northing			5973774	5973791	5987166	5987166	5987166	5987166	5987162							
Lab Sample ID			L610409-3		L507178-8	L518885-8	L532666-3	L544316-19	L555597-2							
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water	Water				**MAC**	**IMAC**	**AO**	**Freshwater**
Physical Tests																
Hardness (as CaCO3)	mg/L	200	288		167	192	190	199	130	**130.0**	**199.0**					
Conductivity (in laboratory)	uS/cm°C		469		282	277	291	336	251	**251.0**	**336.0**					
pH	pH Units		8.25		8.18	8.25	8.18	8.33	8.25	**8.18**	**8.33**	**6.5-9**			6.5-8.5	
Total Elements																
Aluminum (Al)-Total	mg/L	0.0937	0.0139		**0.732**	**0.968**	**0.543**	**0.277**	**0.198**	**0.198**	**0.968**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	0.00012	0.00085		0.00044	<0.00010	<0.00010	<0.00010	<0.000050	**0.00044**	**0.00044**			0.006		
Arsenic (As)-Total	mg/L	0.0006	0.00067		0.00065	0.00065	0.00071	0.00074	0.000716	**0.00065**	**0.00074**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.0288	0.0408		0.0272	0.0295	0.0242	0.0251	0.0138	**0.0138**	**0.02950**		1			
Beryllium (Be)-Total	mg/L	<0.00005	<0.00020		<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	0.00017	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	0.016	0.0191		0.012	0.014	0.013	0.015	0.0064	**0.0064**	**0.015**			5		
Cadmium (Cd)-Total	mg/L	<0.00001	<0.000017		0.00006	<0.000050	<0.000050	<0.000050	<0.000017	**0.00006**	**0.00006**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	30.3	37.6		26.4	29.9	32.2	26.2	27.3	**26.2**	**32.2**					
Chromium (Cr)-Total	mg/L	0.0006	0.00018		0.00149	0.00163	0.00119	0.00062	0.00019	**0.00019**	**0.00163**		0.05			
Trivalent Chromium (Cr-III)	mg/L											**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L											**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.0001	<0.00010		0.00041	0.00047	0.00039	0.00021	0.00014	**0.00014**	**0.00047**					
Copper (Cu)-Total	mg/L	0.0003	0.00046		0.00105	0.00131	0.00138	0.00075	0.00051	**0.00051**	**0.00138**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.125	0.036		**0.748**	**0.833**	**0.657**	**0.373**	0.274	**0.274**	**0.833**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.00012	0.00014		0.000437	0.000561	0.000407	0.000261	0.00012	**0.00012**	**0.000561**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	0.0023	<0.0050		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Total	mg/L	30.4	46.6		23.6	26.7	24.9	33.6	17.0	**17.0**	**33.6**					
Manganese (Mn)-Total	mg/L	0.00918	0.00864		0.022	0.029	0.0247	0.0184	0.0201	**0.0184**	**0.029**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.00005	<0.000010		<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	**<0.000050**	**<0.00010**		0.001			0.0001
Inorganic Mercury	mg/L											**0.000026**				
Methylmercury	mg/L											**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.00013	0.00013		0.000124	0.000131	0.00009	0.000094	0.00006	**0.00006**	**0.00013**					0.073
Nickel (Ni)-Total	mg/L	<0.0005	0.00052		0.00124	0.00138	0.00215	0.00069	0.00061	**0.00061**	**0.00215**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	0.012	<0.30		<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**	**narrative**[x]				
Potassium (K)-Total	mg/L	1.07	1.43		<2.0	<2.0	<2.0	<2.0	0.716	**0.72**	**0.72**					
Selenium (Se)-Total	mg/L	<0.0005	<0.00010		0.00081	0.00063	<0.00050	<0.00050	<0.00010	**0.00063**	**0.00081**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	3.23	4.44		3.95	3.78	3.29	3.86	5.04	**3.29**	**5.04**					
Silver (Ag)-Total	mg/L	0.00001	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	**<0.000010**	**<0.000010**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	2.13	2.4		<2.0	2.5	<2.0	2.1	3.09	**2.1**	**3.1**				≤200	
Strontium (Sr)-Total	mg/L	0.0312	0.0457		0.0310	0.0357	0.0329	0.0297	0.0389	**0.0297**	**0.0389**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.00005	<0.000050		<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[l]				0.0008
Tin (Sn)-Total	mg/L	<0.00005	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.00010**					
Titanium (Ti)-Total	mg/L	0.0049	<0.010		0.035	0.034	0.026	0.02	0.013	**0.01300**	**0.03500**					
Uranium (U)-Total	mg/L	0.00028	0.00033		0.00025	0.00029	0.00021	0.00029	0.00016	**0.00016**	**0.00029**			0.02		
Vanadium (V)-Total	mg/L	0.00038	0.00017		0.00170	0.00190	0.00150	<0.0010	0.00059	**0.00059**	**0.00190**					
Zinc (Zn)-Total	mg/L	<0.0005	<0.0010		0.0036	<0.0060	<0.0040	0.0022	0.0014	**0.0014**	**0.00360**	**0.03**[d]			≤5	

Note: **0.748** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-10 Total Metals at Sampling Stations WRAOC and WRW1x

Sample ID		WRAOC	WRAOC	WRW2	WRW2	WRW2	WRW2	WRW1x (formerly WRW2)	WRW1X	WRW1X	MINIMUM	MAXIMUM	REGULATIONS			
Date Sampled		16-Oct-07	08-May-08	16-May-07	13-Jun-07	16-Jul-07	14-Aug-07	14-Sep-07	15-Oct-07	08-May-08	WRW1x	WRW1x	Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)	Manitoba Water Quality Standards, Objectives (Williamson, 2002) TIER III - Water Quality Guidelines		
UTM (NAD 83) Easting		498452	498452	498578	498578	498578	498578	498523	498523	498523				Drinking		
UTM (NAD 83) Northing		5986647	5986647	5986330	5986330	5986330	5986330	5986554	5986554	5986554						
Lab Sample ID		L569390-2	L632454-6	L507178-9	L518885-9	L532666-4	L544316-7	L555597-3	L569390-1	L632454-8						
Matrix	**Units**	Water	Water	Water	Water	Water	Water	Water	Water	Water			(see Footness for details)	MAC	IMAC	AO	Freshwater
Physical Tests																	
Hardness (as CaCO3)	mg/L	168	198	132	154	123	161	173	102	88.7	**88.7**	**173.0**					
Conductivity (in laboratory)	uS/cm	324	355	218	225	199	272	323	202	177	**177.0**	**323.0**					
pH	pH Units	8.21	8.24	8.07	8.11	8	8.16	8.32	7.71	8.05	**7.71**	**8.32**	**6.5-9**			6.5-8.5	
Total Elements																	
Aluminum (Al)-Total	mg/L	**0.154**	**0.804**	**0.813**	**1.94**	**0.383**	**0.645**	**0.126**	**0.231**	**0.632**	**0.126**	**1.940**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.000050	<0.000050	0.00043	<0.00010	<0.00010	<0.00010	<0.000050	0.00005	<0.000050	**0.000051**	**0.00043**			0.006		
Arsenic (As)-Total	mg/L	0.00056	0.00056	0.0007	0.00075	0.0008	0.00107	0.000572	0.0006	0.000487	**0.000487**	**0.00107**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.02320	0.0341	0.0232	0.0300	0.0160	0.0194	0.0190	0.0126	0.0185	**0.0126**	**0.03000**		1			
Beryllium (Be)-Total	mg/L	<0.00020	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	0.0122	0.0134	0.01	0.012	<0.010	0.011	0.0111	0.0054	0.0069	**0.0054**	**0.012**			5		
Cadmium (Cd)-Total	mg/L	<0.000017	<0.000017	0.000364	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**0.000364**	**0.00036**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	25.1	28.4	23.6	29.6	24.8	29.8	24.0	21.0	17.8	**17.8**	**29.8**					
Chromium (Cr)-Total	mg/L	0.00034	0.00154	0.00167	0.00298	0.00078	0.00086	<0.00010	0.00044	0.00139	**0.00044**	**0.00298**		0.05			
Trivalent Chromium (Cr-III)	mg/L												**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L												**0.001**[k]				
Cobalt (Co)-Total	mg/L	<0.00010	0.00041	0.00045	0.00072	0.00028	0.00031	<0.00010	0.00012	0.00047	**0.00012**	**0.00072**					
Copper (Cu)-Total	mg/L	0.00036	0.00108	0.00131	0.00183	0.00166	0.00091	<0.00050	0.00046	0.00133	**0.00046**	**0.00183**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.213	**0.81**	**0.895**	**1.450**	**0.492**	**0.588**	0.157	0.268	**0.783**	**0.157**	**1.450**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.00095	0.0004	0.000509	0.000707	0.00031	0.000293	0.000082	0.00013	0.000496	**0.000082**	**0.000707**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Total	mg/L	26.2	28.1	17.6	22.4	15.1	21.0	27.0	12.6	10.9	**10.9**	**27.0**					
Manganese (Mn)-Total	mg/L	0.00787	0.0215	0.0302	0.0437	0.0328	0.0355	0.00779	0.0145	0.0451	**0.00779**	**0.0451**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000010	<0.000010	**<0.000010**	**<0.00010**		0.001			0.0001
Inorganic Mercury	mg/L												**0.000026**				
Methylmercury	mg/L												**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.00011	0.000107	0.000091	0.000116	0.000062	0.000076	0.000102	<0.000050	<0.000050	**0.000062**	**0.00012**					0.073
Nickel (Ni)-Total	mg/L	0.00030	0.00121	0.00135	0.00223	0.00641	0.00091	0.00041	0.00045	0.00133	**0.00041**	**0.00641**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**	**narrative**[x]				
Potassium (K)-Total	mg/L	0.955	1.32	<2.0	<2.0	<2.0	<2.0	0.903	0.757	1.1	**0.76**	**1.10**					
Selenium (Se)-Total	mg/L	<0.00010	<0.00010	**0.00135**	0.00094	<0.00050	0.0006	<0.00010	<0.00010	<0.00010	**0.0006**	**0.00135**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	3.87	4.51	4.41	5.67	3.70	5.51	3.32	4.79	3.3	**3.30**	**5.67**					
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	<0.000010	0.000012	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**0.000012**	**0.00001**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	2.17	2.02	<2.0	3.1	2.1	2.6	2.18	3.01	1.93	**1.9**	**3.1**				≤200	
Strontium (Sr)-Total	mg/L	0.0309	0.0337	0.0305	0.0401	0.0344	0.0385	0.0290	0.0304	0.0235	**0.0235**	**0.0401**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.000050	<0.000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00010	0.00033	<0.00010	<0.00030	0.00012	<0.00010	<0.00010	<0.00010	0.00049	**0.00012**	**0.00049**					
Titanium (Ti)-Total	mg/L	0.016	0.04	0.04	0.065	0.02	0.028	0.01	0.013	0.029	**0.01000**	**0.06500**					
Uranium (U)-Total	mg/L	0.00027	0.000312	0.00018	0.00026	0.00010	0.00020	0.00024	0.00012	0.000202	**0.00010**	**0.00026**			0.02		
Vanadium (V)-Total	mg/L	0.00055	0.00175	0.00180	0.00320	0.00110	0.00110	0.00063	0.00061	0.00165	**0.00061**	**0.00320**					
Zinc (Zn)-Total	mg/L	<0.0010	<0.0050	0.0060	<0.0070	<0.0050	0.0028	<0.0010	0.0015	<0.0060	**0.0015**	**0.00600**	**0.03**[d]			≤5	

Note: **0.895** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-11 Total Metals at Stations WRALSB, LSBBWR, Russell Lk, Little Limestone Lk, William Lk

Sample ID		WRALSB	LSBBWR	RUSSELL LK	LITTLE LLK	WILLIAM LAKE	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		13-Oct-07	13-Oct-07	12-Sep-07	12-Sep-07	07-May-08	All stations	All stations	Canadian Water Quality Guidelines for the Protection	Manitoba Water Quality Standards, Objectives (Williamson, 2002)			
UTM (NAD 83) Easting		503935	504092	482571	478725	479083	(listed on	(listed on		TIER III - Water Quality Guidelines			
UTM (NAD 83) Northing		5969206	5968889	5967117	5954922	5973831	this	this	of Aquatic Life				
Lab Sample ID		L569390-5	L569390-4	L557029-1	L557031-1	L632454-5	sheet)	sheet)	(CCME, 2007)	Drinking			
Matrix	Units	Water	Water	Water	Water	Water			(see Footness for details)	MAC	IMAC	AO	Freshwater
Physical Tests													
Hardness (as CaCO3)	mg/L	120	128	198	216	61.5	**61.5**	**216.0**					
Conductivity (in laboratory)	uS/cm	236	247	326	364	109	**109.0**	**364.0**					
pH	pH Units	8.12	7.9	8.56	8.4	8.18	**7.90**	**8.56**	**6.5-9**			6.5-8.5	
Total Elements													
Aluminum (Al)-Total	mg/L	**0.133**	**0.175**	0.0713	0.0492	0.0036	**0.004**	**0.175**	**0.005 - 0.1**				0.005 - 0.1
Antimony (Sb)-Total	mg/L	<0.000050	<0.000050	0.000051	0.000065	<0.000050	**0.000051**	**0.00007**			0.006		
Arsenic (As)-Total	mg/L	0.00063	0.00063	0.000697	0.000913	0.000136	**0.00014**	**0.00091**	**0.005**[k]		0.025		0.15 mg/L (4-Day, 3-Year)[A]
Barium (Ba)-Total	mg/L	0.0149	0.0158	0.0245	0.0307	0.0109	**0.0109**	**0.03070**		1			
Beryllium (Be)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00020**					
Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Total	mg/L	0.0078	0.0082	0.0142	0.015	0.0035	**0.0035**	**0.015**			5		
Cadmium (Cd)-Total	mg/L	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	**<0.000017**	**<0.000017**	**0.000017**[c,l]	0.005			
Calcium (Ca)-Total	mg/L	20.8	22.1	22.7	27.0	10.8	**10.8**	**27.0**					
Chromium (Cr)-Total	mg/L	0.00040	0.00046	0.00031	0.00038	0.00019	**0.00019**	**0.00046**		0.05			
Trivalent Chromium (Cr-III)	mg/L								**0.0089**[c,k]				
Hexavalent Chromium (Cr-VI)	mg/L								**0.001**[k]				
Cobalt (Co)-Total	mg/L	0.00012	0.00011	<0.00010	<0.00010	<0.00010	**0.00011**	**0.00012**					
Copper (Cu)-Total	mg/L	0.00048	0.00045	<0.00050	<0.00050	0.00026	**0.00026**	**0.00048**	**0.002-0.004**[m]			≤1.0	
Iron (Fe)-Total	mg/L	0.287	0.232	0.079	0.025	<0.010	**0.025**	**0.287**	**0.3**[d]			≤0.3	0.3
Lead (Pb)-Total	mg/L	0.00014	0.00012	0.00009	0.000079	0.000069	**0.00007**	**0.00014**	**0.001-0.007**[o]	0.01			
Lithium (Li)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Total	mg/L	16.6	18.1	35.9	37.7	8.32	**8.3**	**37.7**					
Manganese (Mn)-Total	mg/L	0.0158	0.013	0.00748	0.00206	0.000681	**0.000681**	**0.0158**				≤0.05	
Mercury (Hg)-Total	mg/L	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	**<0.000010**	**<0.000020**		0.001			0.0001
Inorganic Mercury	mg/L								**0.000026**				
Methylmercury	mg/L								**0.000004**[c,w]				
Molybdenum (Mo)-Total	mg/L	0.00007	0.000063	0.000146	0.000223	<0.000050	**0.00006**	**0.00022**					0.073
Nickel (Ni)-Total	mg/L	0.00040	0.00044	0.00039	0.0004	<0.00010	**0.00039**	**0.00044**	**0.025-0.15**[p]				
Phosphorus (P)-Total	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**	**narrative**[x]				
Potassium (K)-Total	mg/L	0.751	0.829	0.833	0.901	0.411	**0.41**	**0.90**					
Selenium (Se)-Total	mg/L	<0.00010	<0.00010	0.00028	0.00016	0.00011	**0.00011**	**0.00028**	**0.001**[d]	0.01			0.001
Silicon (Si)-Total	mg/L	4.31	4.28	2.96	3.38	0.92	**0.92**	**4.31**					
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	<0.00010	<0.00010	<0.000010	**<0.00010**	**<0.00010**	**0.0001**[d]				0.0001
Sodium (Na)-Total	mg/L	2.49	2.54	1.47	1.31	0.507	**0.51**	**2.54**				≤200	
Strontium (Sr)-Total	mg/L	0.0276	0.0290	0.0268	0.0294	0.0113	**0.0113**	**0.0294**		5 Bq/L			
Thallium (Tl)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**	**0.0008**[j]				0.0008
Tin (Sn)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00054	**0.00054**	**0.00054**					
Titanium (Ti)-Total	mg/L	0.012	0.012	<0.010	<0.010	<0.010	**0.01200**	**0.01200**					
Uranium (U)-Total	mg/L	0.00016	0.00017	0.00037	0.00050	0.000058	**0.00006**	**0.00050**			0.02		
Vanadium (V)-Total	mg/L	0.00048	0.00055	0.00057	0.00065	0.000059	**0.00006**	**0.00065**					
Zinc (Zn)-Total	mg/L	0.0015	0.0019	<0.0010	<0.0010	<0.0010	**0.0015**	**0.00190**	**0.03**[d]			≤5	

Note: **0.175** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-D-12 Detection Limits for Dissolved Metal Analyses for Minago

	Units	DETECTION LIMITS					
		2006	May-Aug. 2007	Sep-Oct. 2007	Mar-2008 for HRW1	Mar-2008, except for HRW1	May-2008
Physical Tests							
Hardness (as CaCO3)	mg/L	0.5	0.5	0.5	0.5	0.5	0.5
Conductivity (in laboratory)	uS/cm°C	1	2	2	2	2	2
pH	pH Units	0.01	0.01	0.01	0.01	0.01	0.01
Total Elements							
Aluminum (Al)-Total	mg/L	0.0002	0.001	0.001	0.002	0.001	0.001
Antimony (Sb)-Total	mg/L	0.00005	0.0001	0.00005	0.0001	0.00005	0.00005
Arsenic (As)-Total	mg/L	0.0001	0.0001	0.00003	0.00006	0.00003	0.00003
Barium (Ba)-Total	mg/L	0.00002	0.00005	0.00005	0.0001	0.00005	0.00005
Beryllium (Be)-Total	mg/L	0.00005	0.0005	0.0002	0.0004	0.0002	0.0002
Bismuth (Bi)-Total	mg/L	0.00005	0.0005	0.0005	0.001	0.0005	0.0005
Boron (B)-Total	mg/L	0.008	0.01	0.001	0.002	0.001	0.001
Cadmium (Cd)-Total	mg/L	0.00001	0.00005	0.000017	0.000034	0.000017	0.000017
Calcium (Ca)-Total	mg/L	0.1	0.05	0.02	0.04	0.02	0.02
Chromium (Cr)-Total	mg/L	0.0002	0.0005	0.0001	0.0002	0.0001	0.0001
Trivalent Chromium (Cr-III)	mg/L						
Hexavalent Chromium (Cr-VI)	mg/L						
Cobalt (Co)-Total	mg/L	0.00002	0.0001	0.0001	0.0002	0.0001	0.0001
Copper (Cu)-Total	mg/L	0.0001	0.0003	0.0005	0.0002	0.0001	0.0001
Iron (Fe)-Total	mg/L	0.005	0.03	0.01	0.01	0.01	0.01
Lead (Pb)-Total	mg/L	0.00002	0.00005	0.00005	0.0001	0.00005	0.00005
Lithium (Li)-Total	mg/L	0.0002	0.005	0.005	0.01	0.005	0.005
Magnesium (Mg)-Total	mg/L	0.1	0.1	0.01	0.01	0.005	0.005
Manganese (Mn)-Total	mg/L	0.00002	0.00005	0.00005	0.0001	0.00005	0.00005
Mercury (Hg)-Total	mg/L	0.00005	0.00005	0.00002	0.00001	0.00001	0.00001
Inorganic Mercury	mg/L						
Methylmercury	mg/L						
Molybdenum (Mo)-Total	mg/L	0.00002	0.00005	0.00005	0.0001	0.00005	0.00005
Nickel (Ni)-Total	mg/L	0.0005	0.0005	0.0001	0.0002	0.0001	0.0001
Phosphorus (P)-Total	mg/L	0.002	0.3	0.3	0.3	0.3	0.3
Potassium (K)-Total	mg/L	0.05	2	0.05	0.1	0.05	0.05
Selenium (Se)-Total	mg/L	0.0005	0.0005	0.0001	0.0002	0.0001	0.0001
Silicon (Si)-Total	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Silver (Ag)-Total	mg/L	0.00001	0.00001	0.0001	0.00002	0.00001	0.00001
Sodium (Na)-Total	mg/L	0.05	2	0.01	0.02	0.01	0.01
Strontium (Sr)-Total	mg/L	0.00001	0.0001	0.0001	0.0002	0.0001	0.0001
Thallium (Tl)-Total	mg/L	0.00005	0.0001	0.00005	0.0001	0.00005	0.00005
Tin (Sn)-Total	mg/L	0.00005	0.0001	0.0001	0.0002	0.0001	0.0001
Titanium (Ti)-Total	mg/L	0.0005	0.01	0.01	0.01	0.01	0.01
Uranium (U)-Total	mg/L	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001
Vanadium (V)-Total	mg/L	0.00005	0.001	0.00005	0.0001	0.00005	0.00005
Zinc (Zn)-Total	mg/L	0.0005	0.001	0.001	0.002	0.001	0.004-0.006

Notes:

MAC - Maximum Acceptable Concentration
IMAC Interim Maximum Acceptable Concentration
AO - Aesthetic Objectives

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

Footnotes for the CCME Aquatic Guidelines (Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life). Environment, Winnipeg.

c Interim guideline.

d No fact sheet created.

g Aluminium guideline= 5 $\mu g \cdot L^{-1}$ at pH <6.5
= 100 $\mu g \cdot L^{-1}$ at pH $\geq$6.5

h Ammonia guideline: Expressed as µg unionized ammonia$\cdot L^{-1}$. This would be equivalent to 15.2 µg ammonia-nitrogen$\cdot L^{-1}$. Guideline for total ammonia is temperature and pH dependent, please consult factsheet for more information.

j The technical document for the guideline is available from the Ontario Ministry of the Environment.

k Substance has been re-evaluated since CCREM 1987 + Appendixes. Either a new guideline has been derived or insufficient data existed to derive a new guideline.

l Cadmium guideline = 10{0.86[log(hardness)] - 3.2}.

m Copper guideline = 2 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–120 $mg \cdot L^{-1}$
= 3 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 4 $\mu g \cdot L^{-1}$ at [CaCO3] >180 $mg \cdot L^{-1}$

n Dissolved oxygen for warm-water biota: early life stages = 6000 $\mu g \cdot L^{-1}$
other life stages = 5500 $\mu g \cdot L^{-1}$
for cold-water biota: early life stages = 9500 $\mu g \cdot L^{-1}$
other life stages = 6500 $\mu g \cdot L^{-1}$

o Lead guideline = 1 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–60 $mg \cdot L^{-1}$
= 2 $\mu g \cdot L^{-1}$ at [CaCO3] = 60–120 $mg \cdot L^{-1}$
= 4 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 7 $\mu g \cdot L^{-1}$ at [CaCO3] = >180 $mg \cdot L^{-1}$

p Nickel guideline = 25 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–60 $mg \cdot L^{-1}$
= 65 $\mu g \cdot L^{-1}$ at [CaCO3] = 60–120 $mg \cdot L^{-1}$
= 110 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 150 $\mu g \cdot L^{-1}$ at [CaCO3] = >180 $mg \cdot L^{-1}$

s Temperature: (for more information, see CCREM 1987)
Thermal Stratification: Thermal additions to receiving waters should be such that thermal stratification and subsequent turnover dates are not altered from those existing prior to the addition of heat from artificial origins.
Maximum Weekly Average Temperature: Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded.
Short-term Exposure to Extreme Temperature: Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

u For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.

w May not protect fully higher trophic level fish; see factsheet for details.

x Canadian Trigger Ranges (for further narrative see factsheet), Total Phosphorus (ug·.L^{-1}):
ultra-oligotrophic <4
oligotrophic 4-10
mesotrophic 10-20
meso-eutrophic 20-35
eutrophic 35-100
hyper-eutrophic >100

y Guidelines are expressed in µg nitrate$\cdot L^{-1}$. These values are equivalent to 2900 µg nitrate-nitrogen$\cdot L^{-1}$, and 3600 µg nitrate-nitrogen$\cdot L^{-1}$, for freshwater and marine respectively.

z Guideline is expressed as µg nitrite-nitrogen$\cdot L^{-1}$. This value is equivalent to 197 µg nitrite$\cdot L^{-1}$.

APPENDIX 7.5-E

Detailed Water Quality Results – All Stations – Diss. Metals

Table 7.5-E-1 Dissolved Metals at Minago Sampling Station MRW1

Sample ID		MRW-1	MRW-1	MRW-1	MRW-1	MRW-1	MRW-1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MINIMUM	MAXIMUM
Date Sampled		16-May-06	20-Jun-06	18-20 Jul-06	22-24 Aug-06	19-21 Sep-06	12-Oct-06	15-May-07	13-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	11-Mar-08	09-May-08		
UTM (NAD 83) Easting		488684	488684	488684	488684	488684	488684	488694	488694	488694	488694	488671	488671	488671	488671		
UTM (NAD 83) Northing		6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005277	6005277	6005277	6005277		
Lab Sample ID								L507178-1	L518885-5	L532666-9	L544316-4	L557287-1	L569390-6	L610409-2	L632454-11		
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water		
Physical Tests																	
Hardness (as CaCO3)	mg/L	110	130	160	170	160	140	107	139	141	161	172	153	256	87.2	**87.2**	**256.0**
pH	pH Units							7.84	8.05	7.93	8.15	7.91	8.18	7.92	7.87	**7.84**	**8.18**
Dissolved Elements																	
Aluminum (Al)-Dissolved	mg/L	0.0134	0.0058	0.0022	0.0026	0.0034	0.0061	0.0957	0.0109	0.0116	0.0278	0.0064	0.0052	0.0044	0.0346	**0.00220**	**0.09570**
Antimony (Sb)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00062	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	0.00114	<0.000050	**0.00062**	**0.00114**
Arsenic (As)-Dissolved	mg/L	0.0006	0.0008	0.001	0.001	0.001	0.0009	0.00065	0.00078	0.00101	0.00095	0.00102	0.000691	0.00135	0.000538	**0.00054**	**0.00135**
Barium (Ba)-Dissolved	mg/L	0.0092	0.0101	0.0101	0.0106	0.0110	0.0099	0.0151	0.0112	0.0099	0.0103	0.00797	0.0144	0.0278	0.00852	**0.00797**	**0.02780**
Beryllium (Be)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**
Bismuth (Bi)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**
Boron (B)-Dissolved	mg/L	0.011	0.012	0.019	0.018	0.016	0.01	0.01	0.012	0.011	0.015	0.0094	0.0124	0.0284	0.0086	**0.00860**	**0.02840**
Cadmium (Cd)-Dissolved	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00218	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	<0.000017	**0.00218**	**0.00218**
Calcium (Ca)-Dissolved	mg/L	24.4	29.6	37.7	38.5	37.1	32.4	23.6	31.5	33	36.8	36.5	34.5	54.2	20.2	**20.2**	**54.2**
Chromium (Cr)-Dissolved	mg/L	<0.0002	0.0003	<0.0002	<0.0001	<0.0001	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	0.00061	0.00035	0.00049	0.00035	**0.00030**	**0.00049**
Cobalt (Co)-Dissolved	mg/L	0.00003	0.00006	0.00004	0.00002	0.00002	<0.00002	0.00013	<0.00010	<0.00010	<0.00010	0.00016	<0.00010	0.00084	<0.00010	**0.00002**	**0.00084**
Copper (Cu)-Dissolved	mg/L	0.0004	0.0004	0.0004	0.0003	0.0003	0.0005	0.00088	0.00064	0.00034	0.00081	<0.00050	0.00049	0.00021	0.00065	**0.00021**	**0.00088**
Iron (Fe)-Dissolved	mg/L	0.056	0.051	0.036	0.045	0.029	0.038	0.152	0.041	0.128	0.100	0.143	0.032	**1.190**	0.062	**0.02900**	**1.19000**
Lead (Pb)-Dissolved	mg/L	<0.00002	<0.00002	0.00013	0.00002	<0.00002	<0.00002	0.00019	<0.000050	<0.000050	0.000123	<0.000050	<0.000050	0.000138	<0.000050	**0.00002**	**0.00019**
Lithium (Li)-Dissolved	mg/L	0.0025	0.0033	0.0041	0.0042	0.0037	0.0034	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0061	<0.0050	**0.00250**	**0.00610**
Magnesium (Mg)-Dissolved	mg/L	11.7	13.2	17	16.9	16.2	14.4	11.7	14.8	14.3	16.8	19.6	16.1	29.3	8.95	**8.95**	**29.30**
Manganese (Mn)-Dissolved	mg/L	0.00078	0.00086	0.00057	0.00524	0.00036	0.00187	0.00916	0.00658	0.01060	0.00691	**0.16400**	0.00318	**0.90600**	0.01320	**0.00036**	**0.90600**
Mercury (Hg)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000010	<0.000010	<0.000010	**<0.000010**	**<0.000050**
Molybdenum (Mo)-Dissolved	mg/L	0.00008	0.0001	0.00007	0.00007	0.0001	0.00008	0.00031	0.000071	0.000056	0.000068	0.00023	0.000086	<0.000050	0.000084	**0.00006**	**0.00031**
Nickel (Ni)-Dissolved	mg/L	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	0.00053	0.00106	0.00039	0.00041	0.00114	**0.00039**	**0.00114**
Phosphorus (P)-Dissolved	mg/L	0.013	0.008	0.007	0.015	0.013	0.013	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.007**	**0.015**
Potassium (K)-Dissolved	mg/L	0.636	0.54	0.442	0.431	0.653	0.967	<2.0	<2.0	<2.0	<2.0	1.01	1.28	1.97	1.24	**0.43**	**1.97**
Selenium (Se)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.00025	<0.00010	<0.00010	0.00014	**0.00014**	**0.00025**
Silicon (Si)-Dissolved	mg/L	2.28	2.00	3.00	3.41	4.61	4.52	3.47	2.27	4.06	4.50	6.12	4.76	7.80	1.7	**1.70**	**7.80**
Silver (Ag)-Dissolved	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	<0.000010	**<0.000010**	**<0.000010**
Sodium (Na)-Dissolved	mg/L	3.33	4.11	5.08	5.35	5.24	5.11	2.7	4.5	2.6	3.8	4.11	5.64	10.3	2.52	**2.52**	**10.30**
Strontium (Sr)-Dissolved	mg/L	0.0336	0.0456	0.0553	0.0575	0.0557	0.0496	0.0338	0.0519	0.0415	0.0520	0.0652	0.0583	0.0949	0.0296	**0.0296**	**0.0949**
Thallium (Tl)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**
Tin (Sn)-Dissolved	mg/L	<0.00005	0.00011	<0.00005	<0.00005	<0.00005	<0.00005	0.0002	<0.00010	<0.00010	0.00019	<0.00010	0.00011	<0.00010	<0.00010	**0.00011**	**0.00020**
Titanium (Ti)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.0005**	**<0.010**
Uranium (U)-Dissolved	mg/L	0.00012	0.00012	0.00014	0.00010	0.00012	0.00014	0.00009	0.00013	0.00005	0.00008	0.00012	0.00016	0.00011	0.000065	**0.00005**	**0.00016**
Vanadium (V)-Dissolved	mg/L	0.00029	0.00024	0.00014	0.00010	0.00027	0.00025	<0.0010	<0.0010	<0.0010	<0.0010	0.00027	0.00027	0.00026	0.000305	**0.00010**	**0.00031**
Zinc (Zn)-Dissolved	mg/L	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	0.0032	<0.0010	<0.0010	0.0017	<0.0010	<0.0010	<0.0010	0.0019	**0.00060**	**0.00320**

REGULATIONS					
Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)					
TIER II Water Quality Objectives	TIER III - Water Quality Guidelines				
	DRINKING			Freshwater	
	MAC	IMAC	AO	Aquatic Life	
			6.5-8.5		
				0.005 - 0.1	
		0.006			
0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II	
	1				
		5			
Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II	
Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II	
Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II	
			≤0.3	0.3	
Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II	
			≤0.05		
	0.001			0.0001	
				0.073	
Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II	
	0.01			0.001	
				0.0001	
			≤200		
	5 Bq/L				
				0.0008	
		0.02			
Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II	

Note: 0.164 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-E-2 Dissolved Metals at Minago Sampling Station MRW2

Sample ID		MRW2	MRW2	MRW2	MRW2	MRW2	MRW2X	MRW2X	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-May-07	13-Jun-07	17-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08							
UTM (NAD 83) Easting		472484	472484	472484	472484	472476	472571	472571			Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
UTM (NAD 83) Northing		6001209	6001209	6001209	6001209	6001212	6001166	6001166			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID		L507178-2	L518885-6	L532666-5	L544316-5	L555597-1	L569390-20	L632454-4				DRINKING			Freshwater
	Units	Water	Water	Water	Water	Water	Water	Water				MAC	IMAC	AO	Aquatic Life
Physical Tests															
Hardness (as CaCO3)	mg/L	184	205	192	213	205	176	169	**169.0**	**213.0**					
pH	pH Units	8.12	8.16	7.94	8.17	8.23	8.24	8.07	**7.94**	**8.24**				6.5-8.5	
Dissolved Elements															
Aluminum (Al)-Dissolved	mg/L	0.0119	0.0135	0.0053	0.026	0.0037	0.0046	0.0194	**0.00370**	**0.02600**					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	<0.00010	<0.00010	0.00012	<0.00010	<0.000050	<0.000050	<0.000050	**0.00012**	**0.00012**			0.006		
Arsenic (As)-Dissolved	mg/L	0.00048	0.00063	0.00086	0.00072	0.000582	0.000497	0.000461	**0.00046**	**0.00086**	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.0211	0.0260	0.0210	0.0250	0.0242	0.0205	0.0248	**0.02050**	**0.02600**		1			
Beryllium (Be)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Dissolved	mg/L	0.014	0.02	0.015	0.017	0.0155	0.0109	0.0134	**0.01090**	**0.02000**			5		
Cadmium (Cd)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**<0.000017**	**<0.000050**	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	41.5	45.2	45	47.5	43	37.8	37.3	**37.3**	**47.5**					
Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.00035	0.0002	**0.00020**	**0.00035**	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.00010**					
Copper (Cu)-Dissolved	mg/L	0.00043	0.00049	0.00084	0.00033	0.00118	0.00028	0.00045	**0.00028**	**0.00118**	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.055	0.071	0.102	0.117	0.052	0.047	0.041	**0.04100**	**0.11700**				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	<0.000050	<0.000050	0.000224	0.000052	<0.000050	<0.000050	<0.000050	**0.00005**	**0.00022**	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Dissolved	mg/L	19.5	22.3	19.3	22.8	23.8	19.8	18.4	**18.40**	**23.80**					
Manganese (Mn)-Dissolved	mg/L	0.01180	0.03680	0.01220	0.01050	0.01020	0.00550	0.01780	**0.00550**	**0.03680**				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	-	<0.000010	**<0.000010**	**<0.00010**		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.000145	0.000156	0.000111	0.000126	0.000119	0.00010	0.000132	**0.00010**	**0.00016**					0.073
Nickel (Ni)-Dissolved	mg/L	<0.00050	<0.00050	0.00585	<0.00050	0.00032	0.00019	0.00029	**0.00019**	**0.00585**	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**					
Potassium (K)-Dissolved	mg/L	<2.0	<2.0	11.7	<2.0	1.16	1.16	1.36	**1.16**	**11.70**					
Selenium (Se)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	0.00081	<0.00010	<0.00010	<0.00010	**0.00081**	**0.00081**		0.01			0.001
Silicon (Si)-Dissolved	mg/L	3.44	2.48	3.58	4.54	4.66	4.55	3.33	**2.48**	**4.66**					
Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	0.000575	<0.000010	<0.00010	<0.000010	<0.000010	**0.00058**	**0.00058**					0.0001
Sodium (Na)-Dissolved	mg/L	3.1	5.4	2.5	4.3	4.52	3.56	3.87	**2.50**	**5.40**				≤200	
Strontium (Sr)-Dissolved	mg/L	0.0476	0.0722	0.0482	0.0616	0.0683	0.0520	0.0515	**0.0476**	**0.0722**		5 Bq/L			
Thallium (Tl)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**					0.0008
Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	0.00134	<0.00010	<0.00010	<0.00010	**0.00134**	**0.00134**					
Titanium (Ti)-Dissolved	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.010**	**<0.010**					
Uranium (U)-Dissolved	mg/L	0.00018	0.00021	0.00009	0.00014	0.00018	0.00016	0.000246	**0.00009**	**0.00025**			0.02		
Vanadium (V)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.00029	0.00026	0.00039	**0.00026**	**0.00039**					
Zinc (Zn)-Dissolved	mg/L	<0.0010	<0.0010	0.0026	<0.0010	<0.0010	<0.0010	0.0019	**0.00190**	**0.00260**	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Table 7.5-E-3 Dissolved Metals at Minago Sampling Station MRW3

Sample ID		MRW3	MRW3	MRW3	MRW3	MRW3	MRW3	MRW3	MINIMUM	MAXIMUM
Date Sampled		15-May-07	14-Jun-07	17-Jul-07	16-Aug-07	12-Sep-07	16-Oct-07	06-May-08		
UTM (NAD 83) Easting		494327	494327	494327	494327	494274	494274	494274		
UTM (NAD 83) Northing		6007867	6007867	6007867	6007867	6007895	6007895	6007895		
Lab Sample ID		L507178-3	L518885-7	L532666-6	L544316-6	L557035-1	L569390-21	L632454-1		
	Units	Water	Water	Water	Water	Water	Water	Water		
Physical Tests										
Hardness (as CaCO3)	mg/L	106	139	135	163	177	154	89.5	**89.5**	**177.0**
pH	pH Units	7.95	7.94	7.81	8.12	7.78	8.23	7.77	**7.77**	**8.23**
Dissolved Elements										
Aluminum (Al)-Dissolved	mg/L	0.0339	0.0058	0.006	0.027	0.0043	0.0044	0.0438	**0.00430**	**0.04380**
Antimony (Sb)-Dissolved	mg/L	0.0005	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**0.00050**	**0.00050**
Arsenic (As)-Dissolved	mg/L	0.00064	0.00077	0.00099	0.00095	0.000919	0.000691	0.000558	**0.00056**	**0.00099**
Barium (Ba)-Dissolved	mg/L	0.0101	0.0099	0.0093	0.0099	0.0108	0.0127	0.00962	**0.00929**	**0.01270**
Beryllium (Be)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**
Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**
Boron (B)-Dissolved	mg/L	0.01	0.013	0.012	0.015	0.0166	0.0125	0.0099	**0.00990**	**0.01660**
Cadmium (Cd)-Dissolved	mg/L	0.000351	<0.000050	<0.000050	0.000051	<0.000017	<0.000017	<0.000017	**0.00005**	**0.00035**
Calcium (Ca)-Dissolved	mg/L	23.7	31.9	31.7	37.7	37.3	34.8	21.1	**21.1**	**37.7**
Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00094	0.00039	0.00023	**0.00023**	**0.00094**
Cobalt (Co)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.00010**
Copper (Cu)-Dissolved	mg/L	0.00096	0.00064	0.00031	0.00066	<0.00050	0.00042	0.00084	**0.00031**	**0.00096**
Iron (Fe)-Dissolved	mg/L	0.111	0.041	0.123	0.105	0.035	0.030	0.078	**0.03000**	**0.12300**
Lead (Pb)-Dissolved	mg/L	0.000148	<0.000050	0.000063	0.000128	<0.000050	<0.000050	0.000106	**0.00006**	**0.00015**
Lithium (Li)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**
Magnesium (Mg)-Dissolved	mg/L	11.5	14.3	13.5	16.8	20.3	16.3	8.96	**8.96**	**20.30**
Manganese (Mn)-Dissolved	mg/L	0.01350	0.01090	0.01620	0.02110	0.01540	0.00370	0.00706	**0.00370**	**0.02110**
Mercury (Hg)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000010	<0.000010	**<0.000010**	**<0.000050**
Molybdenum (Mo)-Dissolved	mg/L	0.000134	0.000073	0.000051	0.000069	0.000082	0.00009	0.000085	**0.00005**	**0.00013**
Nickel (Ni)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.0007	0.00036	0.00034	**0.00034**	**0.00070**
Phosphorus (P)-Dissolved	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**
Potassium (K)-Dissolved	mg/L	<2.0	<2.0	<2.0	<2.0	0.897	1.28	1.7	**0.90**	**1.70**
Selenium (Se)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	0.00053	0.00015	<0.00010	0.0002	**0.00015**	**0.00053**
Silicon (Si)-Dissolved	mg/L	3.26	2.29	4.09	4.36	3.64	4.74	1.97	**1.97**	**4.74**
Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**<0.00010**	**<0.00010**
Sodium (Na)-Dissolved	mg/L	2.8	4.6	2.6	3.8	5.25	5.6	2.54	**2.54**	**5.60**
Strontium (Sr)-Dissolved	mg/L	0.0359	0.0603	0.0422	0.0575	0.0813	0.0619	0.0337	**0.0337**	**0.0813**
Thallium (Tl)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**
Tin (Sn)-Dissolved	mg/L	0.00039	<0.00010	<0.00010	0.0007	<0.00010	<0.00010	0.00023	**0.00023**	**0.00070**
Titanium (Ti)-Dissolved	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.010**	**<0.010**
Uranium (U)-Dissolved	mg/L	0.00008	0.00013	0.00004	0.00007	0.00014	0.00015	0.000069	**0.00004**	**0.00015**
Vanadium (V)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.00028	0.00025	0.000307	**0.00025**	**0.00031**
Zinc (Zn)-Dissolved	mg/L	0.0024	0.0012	<0.0010	0.0023	<0.0010	<0.0010	0.0014	**0.00120**	**0.00240**

REGULATIONS				
Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
	DRINKING			Freshwater
	MAC	IMAC	AO	Aquatic Life
			6.5-8.5	
				0.005 - 0.1
		0.006		
0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
	1			
		5		
Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
			≤0.3	0.3
Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
			≤0.05	
	0.001			0.0001
				0.073
Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
				0.001
				0.0001
			≤200	
	5 Bq/L			
				0.0008
		0.02		
Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Table 7.5-E-4 Dissolved Metals at Minago Sampling Station HRW1

Sample ID		HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-May-07	13-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	11-Mar-08	09-May-08			Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
UTM (NAD 83) Easting		495457	495457	495457	495457	495606	495606	495606	495606			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
UTM (NAD 83) Northing		5027815	5027815	5027815	5027815	5028072	5028072	5028072	5028072				DRINKING			Freshwater
Lab Sample ID		L507178-4	L518885-4	L532666-8	L544316-8	L557285-1	L569390-8	L610409-1	L632454-10				MAC	IMAC	AO	Aquatic Life
	Units	Water	Water	Water	Water	Water	Water	Water	Water							
Physical Tests																
Hardness (as CaCO3)	mg/L	74.5	103	105	118	108	79	715	91.3	**74.5**	**715.0**					
pH	pH Units	7.9	7.99	8.05	8.07	8.11	8.04	8.15	8.05	**7.90**	**8.15**				6.5-8.5	
Dissolved Elements																
Aluminum (Al)-Dissolved	mg/L	0.0462	0.0755	0.0412	0.0625	0.092	0.0488	0.0447	0.319	**0.04120**	**0.31900**					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	0.00101	<0.000050	**0.00101**	**0.00101**			0.006		
Arsenic (As)-Dissolved	mg/L	0.00064	0.00087	0.00118	0.00137	0.00105	0.00071	0.00456	0.000754	**0.00064**	**0.00456**	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.0073	0.0104	0.0098	0.0109	0.0109	0.0072	0.0630	0.0142	**0.00721**	**0.06300**		1			
Beryllium (Be)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00040	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	**<0.00050**	**<0.0010**					
Boron (B)-Dissolved	mg/L	<0.010	<0.010	0.011	0.011	0.0179	0.0063	0.0692	0.0095	**0.00630**	**0.06920**			5		
Cadmium (Cd)-Dissolved	mg/L	0.000053	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000034	<0.000017	**0.00005**	**0.00005**	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	18	24.1	24.4	28.6	26.3	19	151	21.8	**18.0**	**151.0**					
Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.00029	0.00091	0.0012	**0.00029**	**0.00120**	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	0.00031	**<0.00010**	**<0.00020**					
Copper (Cu)-Dissolved	mg/L	0.00082	0.00111	0.00092	0.001	0.00099	0.00057	0.0063	0.00125	**0.00057**	**0.00630**	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.103	0.100	0.130	0.221	0.214	0.150	0.027	**0.425**	**0.02700**	**0.42500**				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	0.000113	0.000081	0.000097	0.000115	0.000106	0.000051	0.00212	0.000279	**0.00005**	**0.00212**	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.018	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Dissolved	mg/L	7.17	10.4	10.7	11.4	10.2	7.66	32.1	8.99	**7.17**	**32.10**					
Manganese (Mn)-Dissolved	mg/L	0.01460	0.02720	0.02550	0.03620	0.02870	0.01350	**0.08130**	0.03390	**0.01350**	**0.08130**				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	-	<0.000010	<0.000010	**<0.000010**	**<0.000050**		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.000057	0.000075	0.000051	0.000061	0.000056	<0.000050	0.00067	0.00005	**0.00005**	**0.00067**					0.073
Nickel (Ni)-Dissolved	mg/L	0.00056	0.00067	0.00066	0.00063	0.00058	0.00041	0.00204	0.00093	**0.00041**	**0.00204**	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**					
Potassium (K)-Dissolved	mg/L	<2.0	<2.0	<2.0	<2.0	0.759	0.788	5.51	1.39	**0.76**	**5.51**					
Selenium (Se)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	0.00056	<0.00010	<0.00010	0.00048	<0.00010	**0.00048**	**0.00056**		0.01			0.001
Silicon (Si)-Dissolved	mg/L	2.52	3.07	3.34	4.70	4.43	4.14	18.30	2.98	**2.52**	**18.30**					
Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000020	<0.000010	**<0.00010**	**<0.00010**					0.0001
Sodium (Na)-Dissolved	mg/L	<2.0	3.1	2.5	3.2	3.51	3.04	21.3	2.53	**2.50**	**21.30**				≤200	
Strontium (Sr)-Dissolved	mg/L	0.0270	0.0450	0.0392	0.0456	0.0491	0.0334	0.2680	0.0354	**0.0270**	**0.2680**		5 Bq/L			
Thallium (Tl)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.00010	<0.000050	**<0.000050**	**<0.00010**					0.0008
Tin (Sn)-Dissolved	mg/L	0.00014	<0.00010	0.00011	0.0001	0.00024	<0.00010	0.00031	0.00011	**0.00010**	**0.00031**					
Titanium (Ti)-Dissolved	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.019	**0.0190**	**0.0190**					
Uranium (U)-Dissolved	mg/L	0.00006	0.00011	0.00006	0.00008	0.00010	0.00005	0.00102	0.000143	**0.00005**	**0.00102**			0.02		
Vanadium (V)-Dissolved	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.00067	0.00035	0.00428	0.00155	**0.00035**	**0.00428**					
Zinc (Zn)-Dissolved	mg/L	0.0018	0.0014	0.0011	0.0014	<0.0010	<0.0010	0.0036	0.0023	**0.00110**	**0.00360**	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Note: **0.425** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-E-5 Dissolved Metals at Minago Sampling Station OCW1

Sample ID		OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW1	OCW1	OCW1	OCW1	OCW1	OCW1	OCW1	MINIMUM	MAXIMUM
Date Sampled		May 3, 2006	May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	15-May-07	12-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	09-May-08		
UTM (NAD 83) Easting		489238	489238	489238	489238	489238	489238	489238	489238	489238	489238	489238	489322	489322	489322		
UTM (NAD 83) Northing		5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990510	5990510	5990510		
Lab Sample ID									L507178-5	L518885-1	L532666-7	L544316-18	L557283-1	L569390-7	L632454-9		
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water		
Physical Tests																	
Hardness (as CaCO3)	mg/L	140.0	160.0	180.0	240.0	250.0	220.0	170.0	158.0	191.0	183.0	244.0	224.0	156.0	150	**140.0**	**250.0**
pH	pH Units								8.0	8.1	8.0	8.2	8.1	8.2	8.1	**8.01**	**8.20**
Dissolved Elements																	
Aluminum (Al)-Dissolved	mg/L	0.00410	0.00240	0.00410	0.00400	0.00370	0.00250	0.00160	0.00890	0.00650	0.00700	0.01460	0.00490	0.00200	0.0034	**0.00160**	**0.01460**
Antimony (Sb)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00057	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**0.00057**	**0.00057**
Arsenic (As)-Dissolved	mg/L	0.00030	0.00030	0.00040	0.00060	0.00060	0.00060	0.00050	0.00036	0.00042	0.00061	0.00052	0.00038	0.00034	0.000323	**0.00030**	**0.00061**
Barium (Ba)-Dissolved	mg/L	0.01820	0.01930	0.02460	0.02930	0.02900	0.02380	0.01510	0.01770	0.02270	0.02180	0.02960	0.02550	0.01740	0.0181	**0.01510**	**0.02960**
Beryllium (Be)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**
Bismuth (Bi)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**
Boron (B)-Dissolved	mg/L	0.01100	<0.008	0.00900	0.01300	0.00900	<0.008	<0.008	<0.010	0.01000	0.01200	<0.010	0.00670	0.00500	0.0061	**0.00500**	**0.01300**
Cadmium (Cd)-Dissolved	mg/L	0.00004	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00009	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**0.00001**	**0.00009**
Calcium (Ca)-Dissolved	mg/L	31.3	34.6	41.5	54.6	57.2	48.4	36.8	35.2	41.9	42.3	54.4	48.4	33.4	32	**31.3**	**57.2**
Chromium (Cr)-Dissolved	mg/L	<0.0002	0.0	<0.0001	<0.0002	<0.0001	<0.0001	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.00037	0.00047	**0.00037**	**0.00070**
Cobalt (Co)-Dissolved	mg/L	0.0	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.00002**	**0.00002**
Copper (Cu)-Dissolved	mg/L	0.0	<0.0001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.00050	0.00015	0.00018	**0.00015**	**0.00106**
Iron (Fe)-Dissolved	mg/L	0.026	0.033	0.038	0.063	0.064	0.032	0.030	0.039	0.043	0.081	0.100	0.059	0.034	0.026	**0.02600**	**0.10000**
Lead (Pb)-Dissolved	mg/L	<0.00002	0.0	<0.00002	0.0	<0.00002	<0.00002	<0.00002	0.0	0.0	<0.000050	0.0	0.0	<0.000050	<0.000050	**0.00004**	**0.00011**
Lithium (Li)-Dissolved	mg/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.00210**	**0.00330**
Magnesium (Mg)-Dissolved	mg/L	15.6	17.3	19.0	24.6	26.6	23.6	19.0	17.0	20.9	18.7	26.3	25.0	17.8	17.1	**15.60**	**26.60**
Manganese (Mn)-Dissolved	mg/L	0.00278	0.00339	0.00186	0.00784	0.00963	0.00175	0.00401	0.00824	0.01260	0.01400	0.01370	0.01060	0.00433	0.00697	**0.00175**	**0.01400**
Mercury (Hg)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000010	<0.000010	**<0.000010**	**<0.000050**
Molybdenum (Mo)-Dissolved	mg/L	0.00010	0.00008	0.00010	0.00010	0.00009	0.00008	0.00009	0.00013	0.00012	0.00007	0.00010	0.00006	0.00007	0.000154	**0.00006**	**0.00015**
Nickel (Ni)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00063	<0.00050	<0.00050	<0.00050	0.00032	0.00015	0.00012	**0.00012**	**0.00063**
Phosphorus (P)-Dissolved	mg/L	0.0	0.0	0.0	0.0	0.0	0.0070	0.0030	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**
Potassium (K)-Dissolved	mg/L	0.5	0.5	0.2	0.2	0.6	0.9	1.1	<2.0	<2.0	<2.0	<2.0	0.8	0.7	1.14	**0.20**	**1.14**
Selenium (Se)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	**0.00050**	**0.00050**
Silicon (Si)-Dissolved	mg/L	2.2	1.9	2.8	5.2	5.6	5.2	4.4	3.1	3.0	2.7	4.8	4.2	4.0	2.36	**1.87**	**5.63**
Silver (Ag)-Dissolved	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**<0.00010**	**<0.00010**
Sodium (Na)-Dissolved	mg/L	1.8	2.0	2.1	2.4	2.6	2.7	2.4	<2.0	2.4	<2.0	2.1	2.3	2.1	1.88	**1.77**	**2.69**
Strontium (Sr)-Dissolved	mg/L	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0322	**0.0322**	**0.0561**
Thallium (Tl)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**
Tin (Sn)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0004	<0.00010	0.0002	0.0011	<0.00010	0.00011	0.00021	**0.00011**	**0.00107**
Titanium (Ti)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.010**	**<0.010**
Uranium (U)-Dissolved	mg/L	0.0	0.0	0.0	0.0	0.0	0.0002	0.0001	0.0001	0.0002	0.0001	0.0002	0.0002	0.00001	0.000316	**0.00001**	**0.00032**
Vanadium (V)-Dissolved	mg/L	0.0	0.0	0.0	<0.00005	<0.00005	0.0002	0.0001	<0.0010	<0.0010	<0.0010	<0.0010	0.0001	0.00007	0.000119	**0.00006**	**0.00017**
Zinc (Zn)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0031	0.0015	0.0010	0.0011	0.0058	<0.0010	<0.0010	**0.00100**	**0.00580**

REGULATIONS				
Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
	DRINKING			Freshwater
	MAC	IMAC	AO	Aquatic Life
			6.5-8.5	
				0.005 - 0.1
		0.006		
0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
	1			
		5		
Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
			≤0.3	0.3
Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
			≤0.05	
	0.001			0.0001
				0.073
Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
	0.01			0.001
				0.0001
			≤200	
5 Bq/L				0.0008
		0.02		
Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Table 7.5-E-6 Dissolved Metals at Minago Sampling Station OCAWR

Sample ID		OCAWR	OCAWR	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-Oct-07	08-May-08			Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
UTM (NAD 83) Easting		498457	498457			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
UTM (NAD 83) Northing		5986744	5986744				DRINKING			Freshwater
Lab Sample ID	Units	L569390-3 Water	L632454-7 Water				MAC	IMAC	AO	Aquatic Life
Physical Tests										
Hardness (as CaCO3)	mg/L	89.6	73.8	**73.8**	**89.6**					
pH	pH Units	8.0	7.99	**7.99**	**8.02**				6.5-8.5	
Dissolved Elements										
Aluminum (Al)-Dissolved	mg/L	0.032600	0.0991	**0.03260**	**0.09910**					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	<0.000050	<0.000050	**<0.000050**	**<0.000050**			0.006		
Arsenic (As)-Dissolved	mg/L	0.000593	0.000534	**0.00053**	**0.00059**	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.008900	0.0102	**0.00890**	**0.01020**		1			
Beryllium (Be)-Dissolved	mg/L	<0.00020	<0.00020	**<0.00020**	**<0.00020**					
Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Dissolved	mg/L	0.004400	0.0056	**0.00440**	**0.00560**			5		
Cadmium (Cd)-Dissolved	mg/L	<0.000017	<0.000017	**<0.000017**	**<0.000017**	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	19.5	17.3	**17.3**	**19.5**					
Chromium (Cr)-Dissolved	mg/L	0.000250	0.00035	**0.00025**	**0.00035**	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	<0.00010	0.00011	**0.00011**	**0.00011**					
Copper (Cu)-Dissolved	mg/L	0.000370	0.00096	**0.00037**	**0.00096**	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.083	0.099	**0.08300**	**0.09900**				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	<0.000050	0.000089	**0.00009**	**0.00009**	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Dissolved	mg/L	9.910000	7.43	**7.43**	**9.91**					
Manganese (Mn)-Dissolved	mg/L	0.00872	0.03240	**0.00872**	**0.03240**				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.000010	<0.000010	**<0.000010**	**<0.000050**		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	<0.000050	<0.000050	**<0.000050**	**<0.000050**					0.073
Nickel (Ni)-Dissolved	mg/L	0.000260	0.00069	**0.00026**	**0.00069**	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	<0.30	<0.30	**<0.30**	**<0.30**					
Potassium (K)-Dissolved	mg/L	0.67	1.1	**0.67**	**1.10**					
Selenium (Se)-Dissolved	mg/L	<0.00010	<0.00010	**<0.00010**	**<0.00010**		0.01			0.001
Silicon (Si)-Dissolved	mg/L	4.6	2.26	**2.26**	**4.64**					
Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	**<0.00010**	**<0.00010**					0.0001
Sodium (Na)-Dissolved	mg/L	3.2	2.03	**2.03**	**3.17**				≤200	
Strontium (Sr)-Dissolved	mg/L	0.029800	0.0237	**0.0237**	**0.0298**		5 Bq/L			
Thallium (Tl)-Dissolved	mg/L	<0.000050	<0.000050	**<0.000050**	**<0.00010**					0.0008
Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	**<0.00010**	**<0.00010**					
Titanium (Ti)-Dissolved	mg/L	<0.010	<0.010	**<0.010**	**<0.010**					
Uranium (U)-Dissolved	mg/L	0.000083	0.000158	**0.00008**	**0.00016**			0.02		
Vanadium (V)-Dissolved	mg/L	0.000214	0.000513	**0.00021**	**0.00051**					
Zinc (Zn)-Dissolved	mg/L	<0.0010	0.0013	**0.00130**	**0.00130**	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Table 7.5-E-7 Dissolved Metals at Minago Sampling Station OCW2

Sample ID		OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW2	Duplicate OCW2	OCW2	OCW2	OCW2	OCW2	OCW2	OCW2	MINIMUM	MAXIMUM
Date Sampled		May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	16-May-07	16-May-07	12-Jun-07	15-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08		
UTM (NAD 83) Easting		487559	487559	487559	487559	487559	487559	487344	487344	487344	487344	487344	487463	487463	487463		
UTM (NAD 83) Northing		5990974	5990974	5990974	5990974	5990974	5990974	5990878	5990878	5990878	5990878	5990878	5990961	5990961	5990961		
Lab Sample ID								L507178-6		L518885-2	L532666-1	L544316-1	L555597-6	L569390-19	L632454-2		
	Units	Water	Water	Water	Water	Water	Water	Water		Water	Water	Water	Water	Water	Water		
Physical Tests																	
Hardness (as CaCO3)	mg/L	170.0	190.0	250.0	260.0	230.0	180.0	179.0		209.0	195.0	265.0	195.0	169.0	171	**169.0**	**265.0**
pH	pH Units							8.0		8.1	7.9	8.0	8.2	8.2	8.03	**7.94**	**8.17**
Dissolved Elements																	
Aluminum (Al)-Dissolved	mg/L	0.001800	0.002100	0.003600	0.003500	0.001800	0.001100	0.002400	0.00220	0.002800	0.002500	0.008700	0.001700	0.001200	0.0019	**0.00110**	**0.00870**
Antimony (Sb)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.00005**	**<0.00010**
Arsenic (As)-Dissolved	mg/L	0.000300	0.000300	0.000500	0.000600	0.000500	0.000400	0.000280	0.00029	0.000340	0.000580	0.000420	0.000303	0.000191	0.000259	**0.00019**	**0.00060**
Barium (Ba)-Dissolved	mg/L	0.022000	0.026400	0.031800	0.032400	0.024000	0.015700	0.021000	0.02110	0.028000	0.023900	0.030600	0.022400	0.018600	0.0209	**0.01570**	**0.03240**
Beryllium (Be)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**
Bismuth (Bi)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**
Boron (B)-Dissolved	mg/L	<0.008	<0.008	0.011000	0.008000	<0.008	<0.008	<0.010	<0.010	0.013000	0.012000	<0.010	0.006500	0.005300	0.0065	**0.00530**	**0.01300**
Cadmium (Cd)-Dissolved	mg/L	0.000010	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**<0.00001**	**<0.000050**
Calcium (Ca)-Dissolved	mg/L	38.1	42.6	56.4	58.8	50.5	38.8	40.2	39.8	47.0	45.2	58.1	40.8	36.0	37.2	**36.0**	**58.8**
Chromium (Cr)-Dissolved	mg/L	0.000800	<0.0001	<0.0002	<0.0001	<0.0001	<0.001	<0.00050	<0.00050	<0.00050	<0.0020	<0.00050	<0.00010	0.000350	0.00015	**0.00015**	**0.00080**
Cobalt (Co)-Dissolved	mg/L	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00002**	**<0.00010**
Copper (Cu)-Dissolved	mg/L	<0.0001	0.000100	0.000200	<0.0001	0.000400	<0.0001	0.000220	0.00018	0.000180	0.000130	0.000170	<0.00050	<0.00010	0.00014	**0.00010**	**0.00040**
Iron (Fe)-Dissolved	mg/L	0.021	0.032	0.091	0.122	0.042	0.026	<0.030	<0.030	0.032	0.055	0.152	0.031	0.038	0.035	**0.021**	**0.152**
Lead (Pb)-Dissolved	mg/L	0.000030	<0.00002	0.000020	<0.00002	<0.00002	<0.00002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**<0.00002**	**<0.000050**
Lithium (Li)-Dissolved	mg/L	0.002400	0.002900	0.003200	0.003600	0.003500	0.003000	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.00240**	**0.00360**
Magnesium (Mg)-Dissolved	mg/L	18.900000	19.600000	25.500000	27.500000	25.100000	20.300000	19.200000	18.9	22.300000	20.000000	29.100000	22.800000	19.200000	19	**18.90**	**29.10**
Manganese (Mn)-Dissolved	mg/L	0.00083	0.00064	0.00296	0.01020	0.00282	0.00271	0.00300	0.00026	0.00402	0.00143	0.01760	0.00424	0.00519	0.00322	**0.00026**	**0.01760**
Mercury (Hg)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.00010	<0.00010	**<0.000050**	**<0.00010**
Molybdenum (Mo)-Dissolved	mg/L	0.000090	0.000090	0.000110	0.000090	0.000090	0.000080	0.000102	0.00010	0.000102	0.000110	0.000096	0.000095	0.000092	0.000195	**0.00008**	**0.00020**
Nickel (Ni)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.000240	0.000100	<0.00010	**0.00010**	**0.00024**
Phosphorus (P)-Dissolved	mg/L	0.003000	<0.002	0.005	0.005	0.004	0.002	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.002**	**0.005**
Potassium (K)-Dissolved	mg/L	0.57	0.18	0.27	0.54	0.89	1.20	<2.0	<2.0	<2.0	<2.0	<2.0	0.99	0.76	1.16	**0.18**	**1.20**
Selenium (Se)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.000600	<0.00010	<0.00010	<0.00010	**0.00060**	**0.00060**
Silicon (Si)-Dissolved	mg/L	1.8	2.8	5.4	6.0	5.1	4.4	3.0	2.98	2.9	2.4	4.7	3.9	3.9	2.6	**1.75**	**5.95**
Silver (Ag)-Dissolved	mg/L	<0.00001	<0.00001	<0.00001	0.000020	0.000010	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**0.00001**	**0.00002**
Sodium (Na)-Dissolved	mg/L	2.1	2.0	2.3	2.6	2.7	2.3	<2.0	<2.0	2.3	<2.0	2.1	2.0	2.1	1.85	**1.85**	**2.68**
Strontium (Sr)-Dissolved	mg/L	0.037000	0.046300	0.055800	0.055000	0.046800	0.036300	0.036100	0.03630	0.053200	0.042000	0.051400	0.042000	0.036900	0.037	**0.0361**	**0.0558**
Thallium (Tl)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**
Tin (Sn)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.00010**
Titanium (Ti)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.0005**	**<0.010**
Uranium (U)-Dissolved	mg/L	0.000220	0.000150	0.000180	0.000140	0.000150	0.000160	0.000184	0.00019	0.000213	0.000081	0.000181	0.000204	0.000189	0.000444	**0.00008**	**0.00044**
Vanadium (V)-Dissolved	mg/L	0.000050	<0.00005	<0.00005	<0.00005	0.000060	<0.00005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.000056	<0.000050	0.000112	**0.00005**	**0.00011**
Zinc (Zn)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.001200	0.00110	<0.0010	<0.0010	0.001500	0.001200	<0.0010	<0.0010	**0.00110**	**0.00150**

REGULATIONS				
Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
	DRINKING			Freshwater
	MAC	IMAC	AO	Aquatic Life
			6.5-8.5	
				0.005 - 0.1
		0.006		
0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
	1			
		5		
Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
			≤0.3	0.3
Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
			≤0.05	
	0.001			0.0001
				0.073
Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
	0.01			0.001
				0.0001
			≤200	
	5 Bq/L			
				0.0008
		0.02		
Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Table 7.5-E-8 Dissolved Metals at Minago Sampling Station OCW3

Sample ID		OCW-3A	OCW-3A	OCW-3A-1	OCW-3A	OCW-3A	OCW-3A	OCW3	OCW3	OCW3	OCW3	OCW3	OCW3	OCW3	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	16-May-07	12-Jun-07	15-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08			Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
UTM (NAD 83) Easting		487048	487048	487048	487048	487048	487048	487230	487230	487230	487230	487230	487230	487230			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
UTM (NAD 83) Northing		5990931	5990931	5990931	5990931	5990931	5990931	5990892	5990892	5990892	5990892	5990892	5990892	5990892				DRINKING			Freshwater
Lab Sample ID								L507178-7	L518885-3	L532666-2	L544316-2	L555597-5	L569390-18	L632454-3				MAC	IMAC	AO	Aquatic Life
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water							
Physical Tests																					
Hardness (as CaCO3)	mg/L	190	210	260	270	230	180	163	179	173	226	163	146	157	**146.0**	**270.0**					
pH	pH Units							7.97	8.03	7.89	8	8.11	8.11	7.97	**7.89**	**8.11**				6.5-8.5	
Dissolved Elements																					
Aluminum (Al)-Dissolved	mg/L	0.0015	0.0019	0.0021	0.0024	0.0015	0.0011	0.0026	0.0027	0.0033	0.036	0.0017	0.0015	0.0011	**0.00110**	**0.03600**					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.00005**	**<0.00010**			0.006		
Arsenic (As)-Dissolved	mg/L	0.0003	0.0003	0.0005	0.0005	0.0005	0.0004	0.00027	0.00032	0.00041	0.00049	0.000341	0.00025	0.000367	**0.00025**	**0.00050**	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.0253	0.0304	0.0343	0.0318	0.0236	0.0158	0.0163	0.0204	0.0187	0.0223	0.0159	0.0134	0.0168	**0.01340**	**0.03430**		1			
Beryllium (Be)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Dissolved	mg/L	0.009	0.014	0.012	<0.008	<0.008	<0.008	<0.010	0.011	0.01	<0.010	0.0061	0.0043	0.0057	**0.00430**	**0.01400**			5		
Cadmium (Cd)-Dissolved	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000017	**<0.00001**	**<0.000050**	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	42.9	46.9	59.7	50.3	50.8	38.5	37	40.2	40.4	51.4	34.8	31.3	33.8	**31.3**	**50.3**					
Chromium (Cr)-Dissolved	mg/L	0.0008	<0.0001	<0.0002	<0.0001	<0.0001	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	0.00024	<0.0010	**0.00024**	**0.00080**	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00002**	**<0.00010**					
Copper (Cu)-Dissolved	mg/L	<0.0001	0.0002	0.0001	<0.0001	0.0001	0.0003	0.00012	0.00018	0.00015	0.00026	<0.00050	<0.00010	0.00011	**0.00010**	**0.00030**	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.019	0.032	0.074	0.100	0.037	0.025	<0.030	0.030	0.059	0.201	0.043	0.033	0.021	**0.019**	**0.201**				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	<0.00002	<0.00002	<0.00002	0.00003	<0.00002	<0.00002	<0.000050	<0.000050	<0.000050	0.000051	<0.000050	<0.000050	<0.000050	**0.00003**	**0.00005**	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	0.0026	0.003	0.0032	0.0033	0.0034	0.0029	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.00260**	**0.00340**					
Magnesium (Mg)-Dissolved	mg/L	21.2	21.5	27.2	28.5	25.4	20.1	17.3	19.1	17.4	23.7	18.4	16.5	17.5	**16.50**	**28.50**					
Manganese (Mn)-Dissolved	mg/L	0.00113	0.00114	0.00294	0.00697	0.00297	0.00249	0.00166	0.00296	0.00313	0.02190	0.00331	0.00025	0.00122	**0.00025**	**0.02190**				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000010	<0.000010	**<0.000050**	**<0.00010**		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.0001	0.00012	0.00011	0.00008	0.00008	0.00009	0.000059	0.000062	<0.000050	<0.000050	0.000062	<0.000050	0.000271	**0.00006**	**0.00027**					0.073
Nickel (Ni)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.00018	<0.00010	<0.00010	**0.00018**	**0.00018**	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	0.003	0.003	0.004	0.004	0.004	0.002	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.002**	**0.004**					
Potassium (K)-Dissolved	mg/L	0.631	0.248	0.339	0.59	0.929	1.24	<2.0	<2.0	<2.0	<2.0	0.431	0.7	1.27	**0.25**	**1.27**					
Selenium (Se)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	0.00022	**0.00022**	**0.00022**		0.01			0.001
Silicon (Si)-Dissolved	mg/L	1.96	2.97	5.55	5.05	5.08	4.31	3.28	2.65	1.54	5.31	4.51	3.84	2.84	**1.54**	**5.05**					
Silver (Ag)-Dissolved	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**<0.000010**	**<0.000010**					0.0001
Sodium (Na)-Dissolved	mg/L	2.04	2.07	2.35	2.53	2.62	2.29	<2.0	<2.0	<2.0	<2.0	1.55	1.66	1.61	**1.55**	**2.62**				≤200	
Strontium (Sr)-Dissolved	mg/L	0.0386	0.0502	0.0562	0.0554	0.0469	0.0375	0.0304	0.0454	0.0344	0.0469	0.0363	0.0314	0.0328	**0.0304**	**0.0562**		5 Bq/L			
Thallium (Tl)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**					0.0008
Tin (Sn)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00011	<0.00010	<0.00010	0.00033	<0.00010	<0.00010	0.00018	**0.00011**	**0.00033**					
Titanium (Ti)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.0005**	**<0.010**					
Uranium (U)-Dissolved	mg/L	0.00031	0.00020	0.00021	0.00014	0.00015	0.00016	0.00003	0.00003	0.00002	0.00004	0.00003	0.00030	0.000074	**0.00002**	**0.00031**			0.02		
Vanadium (V)-Dissolved	mg/L	0.00006	<0.00005	<0.00005	<0.00005	0.00006	<0.00005	<0.0010	<0.0010	<0.0010	<0.0010	0.00006	<0.000050	0.00005	**0.00005**	**0.00006**					
Zinc (Zn)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	**0.00120**	**0.00120**	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Table 7.5-E-9 Dissolved Metals in William River and at Minago Sampling Station WRW2x

Sample ID		WR	William River	WRW1	WRW1	WRW1	WRW1	WRW2x (formerly WRW1)	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		03-May-06	11-MAR-08	16-May-07	13-Jun-07	16-Jul-07	14-Aug-07	14-Sep-07	WRW2x	WRW2x					
UTM (NAD 83) Easting			485141	495419	495419	495419	495419	495416			Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
UTM (NAD 83) Northing			5973774	5987166	5987166	5987166	5987166	5987162			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID			L610409-3	L507178-8	L518885-8	L532666-3	L544316-19	L555597-2				DRINKING			Freshwater
	Units	Water	Water	Water	Water	Water	Water	Water				MAC	IMAC	AO	Aquatic Life
Physical Tests															
Hardness (as CaCO3)	mg/L	200	288	167	192	190	199	130	**130.0**	**199.0**					
pH	pH Units		8.25	8.18	8.25	8.18	8.33	8.25	**8.18**	**8.33**				6.5-8.5	
Dissolved Elements															
Aluminum (Al)-Dissolved	mg/L	0.0047	<0.0010	0.229	0.211	0.012	0.052	0.019	**0.012**	**0.229**					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	<0.00005	0.00096	0.00042	<0.00010	<0.00010	<0.00010	<0.000050	**0.00042**	**0.00042**			0.006		
Arsenic (As)-Dissolved	mg/L	0.0005	0.00066	0.0006	0.00066	0.00071	0.00072	0.00071	**0.00060**	**0.00072**	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.0275	0.0394	0.0227	0.0250	0.0190	0.0222	0.0119	**0.01190**	**0.02500**		1			
Beryllium (Be)-Dissolved	mg/L	<0.00005	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Dissolved	mg/L	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Dissolved	mg/L	0.014	0.197	0.012	0.014	0.013	0.015	0.0062	**0.00620**	**0.01500**			5		
Cadmium (Cd)-Dissolved	mg/L	<0.00001	<0.000017	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	**<0.00001**	**<0.000050**	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	29.5	37.4	26.7	30	32.9	25.8	25.6	**25.6**	**32.9**					
Chromium (Cr)-Dissolved	mg/L	0.0002	0.00018	0.00066	<0.00050	<0.00050	<0.00050	<0.00010	**0.00066**	**0.00066**	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	<0.00002	<0.00010	0.00021	0.00013	<0.00010	<0.00010	<0.00010	**0.00013**	**0.00021**					
Copper (Cu)-Dissolved	mg/L	0.0016	0.00018	0.00068	0.00074	0.0005	0.0006	<0.00050	**0.00050**	**0.00074**	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.010	<0.010	0.273	0.166	0.036	0.074	0.067	**0.036**	**0.273**				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	0.00012	<0.000050	0.00021	0.000149	<0.000050	0.000141	<0.000050	**0.00014**	**0.00021**	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	0.0024	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Dissolved	mg/L	30.5	47.3	24.4	28.5	26.2	32.6	16	**16.00**	**32.60**					
Manganese (Mn)-Dissolved	mg/L	0.00185	0.00223	0.01220	0.01120	0.00670	0.00677	0.01150	**0.00670**	**0.01220**				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.00005	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	**<0.000050**	**<0.00010**		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.00012	0.00012	0.000088	0.000126	0.000082	0.0001	0.000073	**0.00007**	**0.00013**					0.073
Nickel (Ni)-Dissolved	mg/L	<0.0005	0.00013	0.00061	0.00054	<0.00050	<0.00050	0.00031	**0.00031**	**0.00061**	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	0.009	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.000**	**0.000**					
Potassium (K)-Dissolved	mg/L	0.744	1.41	<2.0	<2.0	<2.0	<2.0	0.634	**0.63**	**0.63**					
Selenium (Se)-Dissolved	mg/L	<0.0005	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	**<0.00010**	**<0.00050**		0.01			0.001
Silicon (Si)-Dissolved	mg/L	3.01	4.35	3.01	2.77	2.64	3.09	4.66	**2.64**	**4.66**					
Silver (Ag)-Dissolved	mg/L	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	**<0.000010**	**<0.000010**					0.0001
Sodium (Na)-Dissolved	mg/L	1.98	2.41	<2.0	2.6	<2.0	2	2.85	**2.00**	**2.85**				≤200	
Strontium (Sr)-Dissolved	mg/L	0.0292	0.0446	0.0285	0.0312	0.0298	0.0287	0.0370	**0.0285**	**0.0370**		5 Bq/L			
Thallium (Tl)-Dissolved	mg/L	<0.00005	<0.000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	**<0.000050**	**<0.00010**					0.0008
Tin (Sn)-Dissolved	mg/L	<0.00005	<0.00010	0.00011	<0.00010	0.00012	0.00038	<0.00010	**0.00011**	**0.00038**					
Titanium (Ti)-Dissolved	mg/L	<0.0005	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	**0.012**	**0.012**					
Uranium (U)-Dissolved	mg/L	0.00029	0.00034	0.00022	0.00030	0.00018	0.00027	0.00015	**0.00015**	**0.00030**			0.02		
Vanadium (V)-Dissolved	mg/L	0.00021	0.00012	<0.0010	<0.0010	<0.0010	<0.0010	0.00027	**0.00027**	**0.00027**					
Zinc (Zn)-Dissolved	mg/L	0.0006	<0.0010	0.0020	0.0014	<0.0010	<0.0010	<0.0010	**0.00140**	**0.00200**	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Note: 0.229 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-E-10 Dissolved Metals at Minago Sampling Stations WRAOC, WRW1x

Sample ID		WRAOC	WRAOC	WRW2	WRW2	WRW2	WRW2	WRW1x (formerly WRW2)	WRW1X	WRW1X	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-Oct-07	08-May-08	16-May-07	13-Jun-07	16-Jul-07	14-Aug-07	14-Sep-07	15-Oct-07	08-May-08	WRW1x	WRW1x					
UTM (NAD 83) Easting		498452	498452	498578	498578	498578	498578	498523	498523	498523			Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
UTM (NAD 83) Northing		5986647	5986647	5986330	5986330	5986330	5986330	5986554	5986554	5986554			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID		L569390-2	L632454-6	L507178-9	L518885-9	L532666-4	L544316-7	L555597-3	L569390-1	L632454-8				DRINKING			Freshwater
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water				MAC	IMAC	AO	Aquatic Life
Physical Tests																	
Hardness (as CaCO3)	mg/L	168	198	132	154	123	161	173	102	88.7	**88.7**	**173.0**					
pH	pH Units	8.21	8.24	8.07	8.11	8	8.16	8.32	7.71	8.05	**7.71**	**8.32**				6.5-8.5	
Dissolved Elements																	
Aluminum (Al)-Dissolved	mg/L	0.0029	.	0.306	0.0446	0.0338	0.0588	0.0063	0.038	0.0852	**0.006**	**0.306**					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	<0.000050	<0.000050	0.00035	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**0.00035**	**0.00035**			0.006		
Arsenic (As)-Dissolved	mg/L	0.00057	0.000697	0.0006	0.00067	0.00081	0.001	0.000591	0.00060	0.000494	**0.00049**	**0.00100**	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.0217	0.0379	0.0185	0.0187	0.0139	0.0160	0.0185	0.0108	0.0118	**0.01080**	**0.01870**		1			
Beryllium (Be)-Dissolved	mg/L	<0.00020	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00050**					
Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Dissolved	mg/L	0.0124	0.0143	<0.010	0.011	<0.010	0.011	0.0112	0.0058	0.0068	**0.00580**	**0.01120**			5		
Cadmium (Cd)-Dissolved	mg/L	<0.000017	<0.000017	<0.000050	<0.000050	<0.000050	<0.000050	<0.000017	0.00002	<0.000017	**0.00002**	**0.00002**	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	24.7	30.8	23.5	25.9	24.6	29.6	24	20.4	18.1	**18.1**	**29.6**					
Chromium (Cr)-Dissolved	mg/L	0.00043	0.00199	0.00077	<0.00050	<0.00050	<0.00050	<0.00010	0.0003	0.00038	**0.00030**	**0.00077**	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	<0.00010	0.00035	0.0003	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**0.00030**	**0.00030**					
Copper (Cu)-Dissolved	mg/L	0.00028	0.00103	0.00093	0.00061	0.00053	0.00064	<0.00050	0.0003	0.00061	**0.00030**	**0.00093**	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.026	0.391	0.395	0.042	0.088	0.105	0.030	0.086	0.083	**0.030**	**0.395**				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	<0.000050	0.000396	0.000303	<0.000050	0.00009	0.0001	<0.000050	<0.000050	0.00009	**0.00009**	**0.00030**	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Dissolved	mg/L	25.8	29.4	17.7	21.6	14.9	21	27.4	12.4	10.6	**10.60**	**27.40**					
Manganese (Mn)-Dissolved	mg/L	0.004	0.019	0.021	0.007	0.017	0.017	0.004	0.008	0.027	**0.004**	**0.027**				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000010	<0.000010	**<0.000050**	**<0.00010**		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.00010	0.000106	0.00006	0.00011	<0.000050	0.000073	0.0001	<0.000050	0.000063	**0.00006**	**0.00011**					0.073
Nickel (Ni)-Dissolved	mg/L	0.00013	0.00098	0.00085	<0.00050	0.00076	<0.00050	0.00026	0.00022	0.00045	**0.00022**	**0.00085**	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	**0.000**	**0.000**					
Potassium (K)-Dissolved	mg/L	0.901	1.63	<2.0	<2.0	<2.0	<2.0	0.877	705.000	1.04	**0.88**	**705.00**					
Selenium (Se)-Dissolved	mg/L	<0.00010	0.00014	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.00050**		0.01			0.001
Silicon (Si)-Dissolved	mg/L	3.02	3.77	3.27	2.68	3.17	4.46	2.87	4.52	2.3	**2.30**	**4.52**					
Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010	<0.000010	<0.000010	**<0.000010**	**<0.000010**					0.0001
Sodium (Na)-Dissolved	mg/L	2.17	2.16	<2.0	3	2.2	2.7	2.2	2.96	1.91	**1.91**	**3.00**				≤200	
Strontium (Sr)-Dissolved	mg/L	0.0304	0.0375	0.0281	0.0309	0.0323	0.0371	0.0296	0.0295	0.0239	**0.0239**	**0.0371**		5 Bq/L			
Thallium (Tl)-Dissolved	mg/L	<0.000050	<0.000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.00010**					0.0008
Tin (Sn)-Dissolved	mg/L	<0.00010	0.00019	0.00024	0.00017	0.00013	0.00029	<0.00010	<0.00010	<0.00010	**0.00013**	**0.00029**					
Titanium (Ti)-Dissolved	mg/L	<0.010	0.026	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**0.016**	**0.016**					
Uranium (U)-Dissolved	mg/L	0.00025	0.00031	0.00015	0.00024	0.00009	0.00018	0.00023	0.00011	0.00018	**0.00009**	**0.00024**			0.02		
Vanadium (V)-Dissolved	mg/L	0.00025	0.00207	<0.0010	<0.0010	<0.0010	<0.0010	0.00029	0.00024	0.000461	**0.00024**	**0.00046**					
Zinc (Zn)-Dissolved	mg/L	<0.0010	0.0043	0.0027	<0.0010	0.0018	0.0020	<0.0010	<0.0010	0.0011	**0.00110**	**0.00270**	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Note: 0.306 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-E-11 Dissolved Metals at WRALSB, LSBBWR, Russel Lk, Little Limestone Lk, William Lk

Sample ID		WRALSB	LSBBWR	RUSSELL LK	LITTLE LLK	WILLIAM LAKE	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		13-Oct-07	13-Oct-07	12-Sep-07	12-Sep-07	07-May-08	All stations	All stations	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
UTM (NAD 83) Easting		503935	504092	482571	478725	479083	(listed	(listed	TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
UTM (NAD 83) Northing		5969206	5968889	5967117	5954922	5973831	on this	on this		DRINKING			Freshwater
Lab Sample ID	Units	L569390-5 Water	L569390-4 Water	L557029-1 Water	L557031-1 Water	L632454-5 Water	sheet)	sheet)		MAC	IMAC	AO	Aquatic Life
Physical Tests													
Hardness (as CaCO3)	mg/L	120	128	198	216	61.5	**61.5**	**216.0**					
pH	pH Units	8.12	7.9	8.56	8.4	8.18	**7.90**	**8.56**				6.5-8.5	
Dissolved Elements													
Aluminum (Al)-Dissolved	mg/L	0.0196	0.0083	0.0188	0.002	0.0021	**0.002**	**0.020**					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	<0.000050	<0.000050	0.000054	0.000067	<0.000050	**0.00005**	**0.00007**			0.006		
Arsenic (As)-Dissolved	mg/L	0.00060	0.00060	0.00074	0.00089	0.000142	**0.00014**	**0.00089**	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.0136	0.0142	0.0223	0.0293	0.0108	**0.01080**	**0.02930**		1			
Beryllium (Be)-Dissolved	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	**<0.00020**	**<0.00020**					
Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	**<0.00050**	**<0.00050**					
Boron (B)-Dissolved	mg/L	0.0077	0.0081	0.0134	0.0145	0.0034	**0.00340**	**0.01450**			5		
Cadmium (Cd)-Dissolved	mg/L	<0.000017	0.000035	<0.000017	<0.000017	<0.000017	**0.00004**	**0.00004**	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	20.7	21.9	21.8	25.1	10.9	**10.9**	**25.1**					
Chromium (Cr)-Dissolved	mg/L	0.00034	0.00031	0.00041	0.00027	0.00025	**0.00025**	**0.00041**	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.00010**					
Copper (Cu)-Dissolved	mg/L	0.00036	0.00036	<0.00050	0.00051	0.00026	**0.00026**	**0.00051**	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.129	0.054	0.010	<0.010	<0.010	**0.010**	**0.129**				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.000050**	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**					
Magnesium (Mg)-Dissolved	mg/L	16.5	17.9	34.9	37.3	8.35	**8.35**	**37.30**					
Manganese (Mn)-Dissolved	mg/L	0.01200	0.00851	0.00143	0.00027	0.00066	**0.00027**	**0.01200**				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	**<0.000010**	**<0.000020**		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.00007	0.00007	0.00015	0.00023	<0.000050	**0.00007**	**0.00023**					0.073
Nickel (Ni)-Dissolved	mg/L	0.00022	0.00018	0.00027	0.00037	<0.00010	**0.00018**	**0.00037**	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	**<0.30**	**<0.30**					
Potassium (K)-Dissolved	mg/L	0.712	0.776	0.819	0.931	0.416	**0.42**	**0.93**					
Selenium (Se)-Dissolved	mg/L	<0.00010	<0.00010	0.00015	0.00014	<0.00010	**0.00014**	**0.00015**		0.01			0.001
Silicon (Si)-Dissolved	mg/L	3.84	3.79	2.87	3.25	0.756	**0.76**	**3.84**					
Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	<0.00010	<0.00010	<0.000010	**<0.000010**	**<0.000010**					0.0001
Sodium (Na)-Dissolved	mg/L	2.49	2.54	1.46	1.37	0.52	**0.52**	**2.54**				≤200	
Strontium (Sr)-Dissolved	mg/L	0.0274	0.0286	0.0263	0.0290	0.0112	**0.0112**	**0.0290**		5 Bq/L			
Thallium (Tl)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	**<0.000050**	**<0.000050**					0.0008
Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	**<0.00010**	**<0.00010**					
Titanium (Ti)-Dissolved	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	**<0.010**	**<0.010**					
Uranium (U)-Dissolved	mg/L	0.00016	0.00017	0.00035	0.00050	0.000063	**0.00006**	**0.00050**			0.02		
Vanadium (V)-Dissolved	mg/L	0.00025	0.00022	0.00048	0.00063	<0.000050	**0.00022**	**0.00063**					
Zinc (Zn)-Dissolved	mg/L	<0.0010	0.0011	0.0014	<0.0010	<0.0010	**0.00110**	**0.00140**	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II

Note: 8.56 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-E-12 Detection Limits for Dissolved Metal Analyses for Minago

		DETECTION LIMITS					
	Units	2006 Water	May-Aug. 2007 Water	Sep-Oct. 2007 Water	Mar-2008 for HRW1 Water	Mar-2008, except for HRW1 Water	May-2008 Water
Physical Tests							
Hardness (as CaCO3)	mg/L		0.5	0.5	0.5	0.5	0.5
pH	pH Units	1	0.01	0.01	0.01	0.01	0.01
Dissolved Elements							
Aluminum (Al)-Dissolved	mg/L	0.0002	0.001	0.001	0.002	0.001	0.001
Antimony (Sb)-Dissolved	mg/L	0.00005	0.0001	0.00005	0.0001	0.00005	0.00005
Arsenic (As)-Dissolved	mg/L	0.0001	0.0001	0.00003	0.00006	0.00003	0.00003
Barium (Ba)-Dissolved	mg/L	0.00002	0.00005	0.00005	0.0001	0.00005	0.00005
Beryllium (Be)-Dissolved	mg/L	0.00005	0.0005	0.0002	0.0004	0.0002	0.0002
Bismuth (Bi)-Dissolved	mg/L	0.00005	0.0005	0.0005	0.001	0.0005	0.0005
Boron (B)-Dissolved	mg/L	0.008	0.01	0.001	0.002	0.001	0.001
Cadmium (Cd)-Dissolved	mg/L	0.00001	0.00005	0.000017	0.000034	0.000017	0.000017
Calcium (Ca)-Dissolved	mg/L	0.05	0.05	0.02	0.04	0.02	0.02
Chromium (Cr)-Dissolved	mg/L	0.0002	0.0005	0.0001	0.0002	0.0001	0.0001
Cobalt (Co)-Dissolved	mg/L	0.00002	0.0001	0.0001	0.0002	0.0001	0.0001
Copper (Cu)-Dissolved	mg/L	0.0001	0.0001	0.0005	0.0002	0.0001	0.0001
Iron (Fe)-Dissolved	mg/L	0.005	0.030	0.010	0.010	0.010	0.010
Lead (Pb)-Dissolved	mg/L	0.00002	0.00005	0.00005	0.0001	0.00005	0.00005
Lithium (Li)-Dissolved	mg/L	0.0002	0.005	0.005	0.01	0.005	0.005
Magnesium (Mg)-Dissolved	mg/L	0.05	0.1	0.01	0.01	0.005	0.005
Manganese (Mn)-Dissolved	mg/L	0.00002	0.00005	0.00005	0.00010	0.00005	0.00005
Mercury (Hg)-Dissolved	mg/L	0.00005	0.00005	0.0001-0.00005	0.00001	0.00001	0.00001
Molybdenum (Mo)-Dissolved	mg/L	0.00002	0.00005	0.00005	0.0001	0.00005	0.00005
Nickel (Ni)-Dissolved	mg/L	0.0005	0.0005	0.0001	0.0002	0.0001	0.0001
Phosphorus (P)-Dissolved	mg/L	0.002	0.3	0.3	0.3	0.3	0.3
Potassium (K)-Dissolved	mg/L	0.05	2	0.05	0.1	0.05	0.05
Selenium (Se)-Dissolved	mg/L	0.0005	0.0005	0.0001	0.0002	0.0001	0.0001
Silicon (Si)-Dissolved	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Silver (Ag)-Dissolved	mg/L	0.00001	0.00001	0.0001-0.00001	0.00002	0.00001	0.00001
Sodium (Na)-Dissolved	mg/L	0.05	2	0.01	0.02	0.01	0.01
Strontium (Sr)-Dissolved	mg/L	0.00001	0.0001	0.0001	0.0002	0.0001	0.0001
Thallium (Tl)-Dissolved	mg/L	0.00005	0.0001	0.00005	0.0001	0.00005	0.00005
Tin (Sn)-Dissolved	mg/L	0.00005	0.0001	0.0001	0.0002	0.0001	0.0001
Titanium (Ti)-Dissolved	mg/L	0.0005	0.01	0.01	0.01	0.01	0.01
Uranium (U)-Dissolved	mg/L	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001
Vanadium (V)-Dissolved	mg/L	0.00005	0.001	0.00005	0.0001	0.00005	0.00005
Zinc (Zn)-Dissolved	mg/L	0.0005	0.001	0.001	0.002	0.001	0.001

Notes:

MAC - Maximum Acceptable Concentration
IMAC Interim Maximum Acceptable Concentration
AO - Aesthetic Objectives

A Arsenic limits: 0.15 mg/L for averaging duration 4 days (4-Day, 3-Year or 7Q10 Design Flow); 0.34 mg/L for averaging duration 1 hr (1-Day, 3-Year or 1Q10 Design Flow)

B Cadmium limits: [e{0.7852[ln(Hardness)]-2.715}]×[1.101672-{ln(Hardness)(0.041838)}] for 4 days averaging duration.
[e{1.128[ln(Hardness)]-3.6867}]×[1.136672-{ln(Hardness)(0.041838)}] for 1 hour averaging duration.

C Chromium limits: Chromium III: [e{0.8190[ln(Hardness)]+0.6848}]×[0.860] for 4 days averaging duration.
Chromium III: [e{0.8190[ln(Hardness)]+3.7256}]×[0.316] for 1 hour averaging duration.
Chromium VI: 0.011 mg/L for averaging duration 4 days (4-Day, 3-Year or 7Q10 Design Flow); 0.016 mg/L for averaging duration 1 hr (1-Day, 3-Year or 1Q10 Design Flow)

D Copper limits: [e{0.8545[ln(Hardness)]-1.702}]×[0.960] for 4 Days hour averaging duration.
[e{0.9422[ln(Hardness)]-1.700}]×[0.960] for 1 hour averaging duration.

E Lead limits: [e{1.273[ln(Hardness)]-4,705}]×[1.46203 -{ln(Hardness)(0.145712)}] for 4 Days averaging duration.
[e{1.273[ln(Hardness)]-1.460}]×[1.46203 -{ln(Hardness)(0.145712)}] for 1 hour averaging duration.

F Nickel limits: [e{0.8460[ln(Hardness)]+0.0584}]×[0.997] for 4 Days averaging duration.
[e{0.8460[ln(Hardness)]+2.255}]×[0.998] for 1 hour averaging duration.

G Zinc limits: [e{0.8473[ln(Hardness)]+0.884}]×[0.976] for 4 Days averaging duration.
[e{0.8473[ln(Hardness)]+0.884}]×[0.978] for 1 hour averaging duration.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

APPENDIX 7.5-F

Detailed Water Quality Results – All Stations – Other Parameters

Table 7.5-F-1 Other Water Quality Parameters Measured at Minago Sampling Station MRW1

Sample ID		MRW-1	MRW-1	MRW-1	MRW-1	MRW-1	MRW-1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MRW1	MINIMUM	MAXIMUM	REGULATIONS			
Date Sampled		16-May-06	20-Jun-06	18-20 Jul-06	22-24 Aug-06	19-21 Sep-06	12-Oct-06	15-May-07	13-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	11-Mar-08	09-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		488684	488684	488684	488684	488684	488684	488694	488694	488694	488694	488671	488671	488671	488671			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines		
UTM (NAD 83) Northing		6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005275	6005277	6005277	6005277	6005277				DRINKING		Freshwater Aquatic Life
Lab Sample ID								L507178-1	L518885-5	L532666-9	L544316-4	L557287-1	L569390-6	L610409-2	L632454-11				MAC	AO	
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water						
Field Properties																					
Temperature	°C	***15.41***	***21.98***	***22.17***	***18.87***	11.62	3.00	11.30	***22.70***	***23.20***	***20.10***	11.36	6.69		6.8	**3.0**	**23.2**			≤ 15	Tier II	**narrative** [5]
Specific Conductance	uS/cm at 25°C	186.0	n/a	243.0	271.0	273.0	255.0	199.8	269.0	318.0	338.0	313.8	308.3		153.0	**153.0**	**338.0**	1000			
Conductance	uS/cm	153.0	226.0	232.0	239.0	203.0	149/262*					232.0	200.0		99.5	**99.5**	**239.0**				
Total dissolved solids	g/L	0.12	0.16	0.16	0.18	0.18	0.17					0.20	0.20		0.100	**0.100**	**0.204**				
Dissolved oxygen (% saturation)	sat %	103.4	100.8	98.7	120.8?	106.3	88.9					92.4	101.1		91.7	**88.9**	**106.3**				
Dissolved oxygen	mg/L	10.33	8.83	8.60	11.23	11.59	11.94	8.00	5.66	-	6.66	10.10	12.36		11.18	**5.7**	**12.4**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)			
Depth												0.01	0.05		0.031	**0.009**	**0.054**				
pH	pH Units	8.04	7.83	7.99	7.33	7.46	7.99/8.2*	-	8.54	7.67	8.08	7.87	7.83		7.76	**7.33**	**8.54**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	164.7	130.4	157.1	189.0	225.4	180.9	229.0	200.0	204.0	239.0	235.5	309.0		291.0	**130.4**	**309.0**				
Barometric pressure	kN/m^2	98.65	97.97	n/a		98.88	98.11					99.50	99.34		14.36	**14.4**	**99.5**				
Salinity	ppt	n/a	0.11	0.11	0.13	0.13	0.12									**0.11**	**0.13**				
Physical Tests																					
Hardness (as CaCO3)	mg/L	110	130	160	170	160	140	107	139	141	161	172	153	256	87.2	**87.2**	**256.0**				
Conductivity (in laboratory)	uS/cm°C							184	211	219	280	314	317	467	153	**153.0**	**467.0**	1000			
pH	pH Units							7.84	8.05	7.93	8.15	7.91	8.18	7.92	7.87	**7.8**	**8.2**			6.5-8.5	**6.5-9**
Total Dissolved Solids	mg/L	120	143	183	180	180	190	126	159	163	183	211	198	281	99	**99.0**	**281.0**	700		≤500	
Total Suspended Solids	mg/L	2	3	4	1	1	3	<3.0	<3.0	<3.0	<3.0	1.5	3	5	5	**1.0**	**5.0**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	2.4	0.8	1.9	1	1.1	2.5	2.87	1.46	1.33	0.76	1.14	2.71	7.32	2.77	**0.76**	**7.32**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit	40	50	40	40	50	50									**40.0**	**50.0**			≤ 15 TCU	
Anions and Nutrients																					
Ammonia (NH4)	mg/L	<0.005	<0.005	<0.005	0.012	0.012	0.020	0.031	<0.020	0.021	<0.020	0.080	<0.020	0.087	0.021	**0.012**	**0.087**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L							2.9	2.4	2.4	1	4.7	1.6	10.7	2.7	**1.0**	**10.7**				
Alkalinity, Total (as CaCO3)	mg/L	104.0	133.0	149.0	172.0	150.0	141.0	92.8	121.0	120.0	161.0	182.0	172.0	272.0	83.9	**83.9**	**272.0**				
Alkalinity (PP as CaCO3) **	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5														
Alkalinity, Carbonate (as CaCO3)	mg/L												<2.0	<2.0	<2.0	**<2.0**	**<2.0**				
Alkalinity, Hydroxide (as CaCO3)	mg/L												<2.0	<2.0	<2.0	**<2.0**	**<2.0**				
Alkalinity, Bicarbonate (as CaCO3)														272.0	83.9	**83.9**	**272.0**				
Bromide (Br)	mg/L							<0.050	<0.050	<0.050	<0.050	<0.05	<0.050	<0.050	<0.050	**<0.050**	**<0.050**				
Chloride (Cl)	mg/L	0.7	0.8	1.1	1.2	1.6	1.3	0.57	<0.50	<0.50	0.7	0.93	1.97	4.27	0.69	**0.57**	**4.27**			≤250		
Fluoride (F)	mg/L	n/a	n/a	0.11	0.10	0.09	0.59	0.06	<0.020	0.06	0.07	0.06	0.08	0.11	0.04	**0.04**	**0.59**		1.5			
Sulphate (SO4)	mg/L	0.9	<0.5	<5 (1)	<0.5	<0.5	<0.5	0.73	<0.50	<0.50	0.62	0.55	1.33	1.83	0.52	**0.52**	**1.83**			≤500		
Nitrate (NO3-N)	mg/L							<0.0050	<0.0050	<0.0050	<0.0050	<0.005	0.89	0.83	<0.0050	**0.830**	**0.890**		10			2.93 [c,u]
Nitrate (NO3)	mg/L	<0.02	<0.02	<0.02	0.02	<0.02	<0.02												45			13 [c,u,y]
Nitrite (NO2-N)	mg/L							<0.0010	<0.0010	<0.0010	<0.0010	0.044	0.13	0.29	<0.0010	**0.044**	**0.290**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005									**<0.005**	**<0.005**		3.2		CCME	0.197
Nitrate-N plus Nitrite-N																		10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.49	0.61	0.69	0.7	0.64	0.69	0.507	0.614	0.582	0.674	0.803	0.592	0.665	0.48	**0.48**	**0.80**				
Total Nitrogen	mg/L							0.507	0.614	0.582	0.674	1.05	0.592	1.79	0.48	**0.48**	**1.79**				
Dissolved Organic Carbon	mg/L	13.9	16	13.7	16.7	16.5	17.1					18.4	-	17.1	9.95	**10.0**	**18.4**				
Dissolved Inorganic Carbon (C)	mg/L	n/a	31.9	34.5	37.2	32.9	31.9									**31.9**	**37.2**				
Total Organic Carbon	mg/L	14.2	16	13.6	17.2	18.3	17					19.3	-	17.9	8.96	**9.0**	**19.3**				
Total Inorganic Carbon (C)	mg/L	25.3	31.9	35.7	36.6	34.9	33.3									**25.3**	**36.6**				
Cyanides																					
Cyanide, **Total**	mg/L							0.0104	0.0092	0.0068	0.0108					**0.0068**	**0.0108**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L											<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters																					
Radium-226	Bq/L	<0.01	<0.01	<0.01	< 0.01	< 0.01	<0.01	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.006	<0.005	**0.006**	**0.006**		0.6			

Note: 2.4 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-2 Other Water Quality Parameters Measured at Minago Sampling Station MRW2

Sample ID		MRW2	MRW2	MRW2	MRW2	MRW2	MRW2X	MRW2X	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-May-07	13-Jun-07	17-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		472484	472484	472484	472484	472476	472571	472571							
UTM (NAD 83) Northing		6001209	6001209	6001209	6001209	6001212	6001166	6001166			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID	Units	L507178-2 Water	L518885-6 Water	L532666-5 Water	L544316-5 Water	L555597-1 Water	L569390-20 Water	L632454-4 Water				DRINKING MAC	DRINKING AO	Freshwater Aquatic Life	
Field Properties															
Temperature	°C	12.80	*20.10*	*25.60*	*17.30*	10.08	5.97	7.4	**6.0**	**25.6**			≤ 15	Tier II	narrative [5]
Specific Conductance	uS/cm at 25°C	303.0	367.0	318.0	364.0	377.8	337.2	316.8	**303.0**	**377.8**	1000				
Conductance	uS/cm					270.0	215.0	210.5	**210.5**	**270.0**					
Total dissolved solids	g/L					0.25	0.22	0.206	**0.206**	**0.245**					
Dissolved oxygen (% saturation)	sat %					92.6	99.7	92.3	**92.3**	**99.7**					
Dissolved oxygen	mg/L	7.70	7.06	-	7.40	10.41	12.41	11.09	**7.1**	**12.4**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth						0.09	0.09	0.066	**0.066**	**0.092**					
pH	pH Units	-	8.00	7.74	7.01	7.81	7.90	7.62	**7.01**	**8.00**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	177.0	219.0	206.0	220.0	185.6	115.8	252.0	**115.8**	**252.0**					
Barometric pressure	kN/m^2					97.96	98.58	98.66	**98.0**	**98.7**					
Salinity	ppt														
Physical Tests															
Hardness (as CaCO3)	mg/L	184	205	192	213	205	176	169	**169.0**	**213.0**					
Conductivity (in laboratory)	uS/cm°C	306	305	302	366	386	344	326	**302.0**	**386.0**	1000				
pH	pH Units	8.12	8.16	7.94	8.17	8.23	8.24	8.07	**7.9**	**8.2**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	192	200	206	232	240	205	193	**192.0**	**240.0**	700		≤500		
Total Suspended Solids	mg/L	6.7	<3.0	4.9	3.3	3.3	4	12.5	**3.3**	**12.5**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	**5.36**	**2.42**	**2.18**	**2.16**	**3.38**	**3.11**	**7.97**	**2.16**	**7.97**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit												≤ 15 TCU		
Anions and Nutrients															
Ammonia (NH4)	mg/L	0.030	<0.020	0.022	<0.020	0.024	<0.020	0.025	**0.022**	**0.030**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L	2.1	2.1	3.1	1.2	2.4	<1.0	2.7	**1.2**	**3.1**					
Alkalinity, Total (as CaCO3)	mg/L	157.0	176.0	167.0	210.0	212.0	195.0	181	**157.0**	**212.0**					
Alkalinity (PP as CaCO3) **	mg/L														
Alkalinity, Carbonate (as CaCO3)	mg/L						<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Hydroxide (as CaCO3)	mg/L						<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Bicarbonate (as CaCO3)								181	**181.0**	**181.0**					
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	1.19	0.65	0.56	1.31	1.41	1.5	1.61	**0.56**	**1.61**			≤250		
Fluoride (F)	mg/L	0.08	0.05	0.08	0.10	0.09	0.08	0.075	**0.05**	**0.10**		1.5			
Sulphate (SO4)	mg/L	1.5	1.15	0.65	1.26	1.36	1.28	1.82	**0.65**	**1.82**			≤500		
Nitrate (NO3-N)	mg/L	<0.0050	0.0055	<0.0050	<0.0050	<0.50	1.35	0.0065	**0.006**	**1.350**		10			2.93 [c,u]
Nitrate (NO3)	mg/L											45			13 [c,u,y]
Nitrite (NO2-N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	**0.12**	**0.25**	0.0026	**0.003**	**0.250**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L											3.2		CCME	0.197
Nitrate-N plus Nitrite-N											10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.409	0.522	0.546	0.542	0.459	0.462	0.462	**0.41**	**0.55**					
Total Nitrogen	mg/L	0.409	0.527	0.546	0.542	<0.70	0.462	0.471	**0.41**	**0.55**					
Dissolved Organic Carbon	mg/L					-	-	10.7	**10.7**	**10.7**					
Dissolved Inorganic Carbon (C)	mg/L														
Total Organic Carbon	mg/L					-	-	10.1	**10.1**	**10.1**					
Total Inorganic Carbon (C)	mg/L														
Cyanides															
Cyanide, **Total**	mg/L	0.0094	0.0067	0.0140	0.0070				**0.0067**	**0.0140**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L					<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters															
Radium-226	Bq/L	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	**0.007**	**0.007**		0.6			

Note: **2.42** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-3 Other Water Quality Parameters Measured at Minago Sampling Station MRW3

Sample ID		MRW3	MRW3	MRW3	MRW3	MRW3	MRW3	MRW3	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		15-May-07	14-Jun-07	17-Jul-07	16-Aug-07	12-Sep-07	16-Oct-07	06-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		494327	494327	494327	494327	494274	494274	494274							
UTM (NAD 83) Northing		6007867	6007867	6007867	6007867	6007895	6007895	6007895			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID	Units	L507178-3 Water	L518885-7 Water	L532666-6 Water	L544316-6 Water	L557035-1 Water	L569390-21 Water	L632454-1 Water				DRINKING MAC	DRINKING AO	Freshwater Aquatic Life	
Field Properties															
Temperature	°C	10.20	***19.80***	***20.10***	***17.30***	9.82	8.12		**8.1**	**20.1**			≤ 15	Tier II	**narrative** [5]
Specific Conductance	uS/cm at 25°C	182.4	236.0	245.0	283.0	306.8	313.0		**182.4**	**313.0**	1000				
Conductance	uS/cm					217.8	211.7		**211.7**	**217.8**					
Total dissolved solids	g/L					0.20	0.20		**0.200**	**0.203**					
Dissolved oxygen (% saturation)	sat %					90.4	109.2		**90.4**	**109.2**					
Dissolved oxygen	mg/L	-	7.20	-	8.10	10.23	12.88		**7.2**	**12.9**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth						0.021	0.014		**0.014**	**0.021**					
pH	pH Units	-	8.18	7.55	7.83	7.88	7.88		**7.55**	**8.18**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	230.0	217.0	256.0	260.0	120.5	223.0		**120.5**	**260.0**					
Barometric pressure	kN/m^2					98.58	98.61		**98.6**	**98.6**					
Salinity	ppt														
Physical Tests															
Hardness (as CaCO3)	mg/L	106	139	135	163	177	154	89.5	**89.5**	**177.0**					
Conductivity (in laboratory)	uS/cm°C	188	213	212	282	304	315	155	**155.0**	**315.0**	1000				
pH	pH Units	7.95	7.94	7.81	8.12	7.78	8.23	7.77	**7.8**	**8.2**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	123	159	156	193	196	207	97	**97.0**	**207.0**	700		≤500		
Total Suspended Solids	mg/L	5.7	<3.0	<3.0	<3.0	4.7	3	4.5	**3.0**	**5.7**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	~~3.9~~	~~1.12~~	~~1.25~~	~~1.74~~	~~1.05~~	~~2.33~~	~~2.01~~	**1.05**	**3.90**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit												≤ 15 TCU		
Anions and Nutrients															
Ammonia (NH4)	mg/L	<0.020	0.021	0.026	<0.020	0.155	0.025	<0.020	**0.021**	**0.155**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L	2.5	3.1	3	1.1	5.5	1.2	2.9	**1.1**	**5.5**					
Alkalinity, Total (as CaCO3)	mg/L	96.5	124.0	115.0	160.0	178.0	176.0	88	**88.0**	**178.0**					
Alkalinity (PP as CaCO3) **	mg/L														
Alkalinity, Carbonate (as CaCO3)	mg/L						<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Hydroxide (as CaCO3)	mg/L						<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Bicarbonate (as CaCO3)								88	**88.0**	**88.0**					
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.05	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	0.71	<0.50	<0.50	0.9	1.37	2.07	0.97	**0.71**	**2.07**			≤250		
Fluoride (F)	mg/L	0.06	0.04	0.06	0.07	0.07	0.07	0.042	**0.04**	**0.07**		1.5			
Sulphate (SO4)	mg/L	0.6	0.52	<0.50	0.66	1.14	1.41	0.89	**0.52**	**1.41**			≤500		
Nitrate (NO3-N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	1.28	<0.0050	**1.280**	**1.280**		10			2.93 [c,u]
Nitrate (NO3)	mg/L											45			13 [c,u,y]
Nitrite (NO2-N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.001	~~0.25~~	0.0016	**0.002**	**0.250**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L											3.2		CCME	0.197
Nitrate-N plus Nitrite-N											10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.52	0.645	0.603	0.748	0.98	0.662	0.501	**0.50**	**0.98**					
Total Nitrogen	mg/L	0.52	0.645	0.603	0.748	1.2	0.662	0.503	**0.50**	**1.20**					
Dissolved Organic Carbon	mg/L					19.1	18.1	10.6	**10.6**	**19.1**					
Dissolved Inorganic Carbon (C)	mg/L														
Total Organic Carbon	mg/L					17.2	18.1	9.81	**9.8**	**18.1**					
Total Inorganic Carbon (C)	mg/L														
Cyanides															
Cyanide, **Total**	mg/L	0.0118	0.0090	0.0069	0.0089				**0.0069**	**0.0118**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L					<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters															
Radium-226	Bq/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**<0.005**	**<0.005**		0.6			

Note: ~~0.25~~ BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-4 Other Water Quality Parameters Measured at Minago Sampling Station HRW1

Sample ID		HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	HRW1	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-May-07	13-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	11-Mar-08	09-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		495457	495457	495457	495457	495606	495606	495606	495606							
UTM (NAD 83) Northing		6027815	6027815	6027815	6027815	6028072	6028072	6028072	6028072			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID	Units	L507178-4 Water	L518885-4 Water	L532666-8 Water	L544316-8 Water	L557285-1 Water	L569390-8 Water	L610409-1 Water	L632454-10 Water				DRINKING MAC	DRINKING AO	Freshwater Aquatic Life	
Field Properties																
Temperature	°C	14.50	***19.60***	***22.40***	***18.30***	9.12	5.02		5.3	**5.0**	**22.4**			≤ 15	Tier II	**narrative** [5]
Specific Conductance	uS/cm at 25°C	127.0	180.8	230.0	263.0	211.3	152.0		162.6	**127.0**	**263.0**	1000				
Conductance	uS/cm					147.0	94.0		101.6	**94.0**	**147.0**					
Total dissolved solids	g/L					0.14	0.10		0.106	**0.099**	**0.137**					
Dissolved oxygen (% saturation)	sat %					104.3	104.5		94.5	**94.5**	**104.5**					
Dissolved oxygen	mg/L	7.50	6.29	-	6.97	12.02	13.33		11.95	**6.3**	**13.3**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth						0.04	0.13		0.122	**0.036**	**0.126**					
pH	pH Units	-	8.12	8.04	7.97	8.16	7.82		7.88	**7.82**	**8.16**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	210.0	267.0	188.0	228.0	184.3	295.3		289.2	**184.3**	**295.3**					
Barometric pressure	kN/m^2					99.57	99.34		99.01	**99.0**	**99.6**					
Salinity	ppt															
Physical Tests																
Hardness (as CaCO3)	mg/L	74.5	103	105	118	108	79	715	91.3	**74.5**	**715.0**					
Conductivity (in laboratory)	uS/cm°C	129	155	177	203	210	156	1170	171	**129.0**	**1170.0**	1000				
pH	pH Units	7.9	7.99	8.05	8.07	8.11	8.04	8.15	8.05	**7.9**	**8.2**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	111	141	153	167	165	121	739	118	**111.0**	**739.0**	700		≤500		
Total Suspended Solids	mg/L	33.2	38.5	39.4	23.8	11.2	13.5	8	42	**8.0**	**42.0**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	28.9	33.8	32	37.4	26.3	15.8	3.94	16.6	**3.94**	**37.40**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit													≤ 15 TCU		
Anions and Nutrients																
Ammonia (NH4)	mg/L	0.025	<0.020	0.029	<0.020	0.109	0.021	0.119	0.027	**0.021**	**0.119**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L	2.1	2.6	1.4	2.9	2	1.7	<1.0	2	**1.4**	**2.9**					
Alkalinity, Total (as CaCO3)	mg/L	66.2	90.3	97.1	111.0	117.0	81.2	703.0	91.3	**66.2**	**703.0**					
Alkalinity (PP as CaCO3) **	mg/L															
Alkalinity, Carbonate (as CaCO3)	mg/L						<2.0	<1.0	<2.0	**<1.0**	**<2.0**					
Alkalinity, Hydroxide (as CaCO3)	mg/L						<2.0	<1.0	<2.0	**<1.0**	**<2.0**					
Alkalinity, Bicarbonate (as CaCO3)								703.0	91.3	**91.3**	**703.0**					
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	0.52	0.72	1.12	11.1	0.63	**0.52**	**11.10**			≤250		
Fluoride (F)	mg/L	0.05	0.05	0.06	0.07	0.07	0.05	0.25	0.05	**0.05**	**0.25**		1.5			
Sulphate (SO4)	mg/L	<0.50	<0.50	<0.50	0.59	0.56	<0.50	10.9	0.69	**0.56**	**10.90**			≤500		
Nitrate (NO3-N)	mg/L	<0.0050	0.01	<0.0050	0.0057	<0.0050	1.07	0.92	0.0109	**0.006**	**1.070**		10			2.93 [c,u]
Nitrate (NO3)	mg/L												45			13 [c,u,y]
Nitrite (NO2-N)	mg/L	<0.0010	<0.0010	<0.0010	0.0022	<0.0010	<0.10	0.23	0.0033	**0.002**	**0.230**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L												3.2		CCME	0.197
Nitrate-N plus Nitrite-N												10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.492	0.629	0.594	0.819	0.687	0.633	1.44	0.511	**0.49**	**1.44**					
Total Nitrogen	mg/L	0.492	0.639	0.594	0.827	0.687	0.633	2.59	0.525	**0.49**	**2.59**					
Dissolved Organic Carbon	mg/L					18.8	22.2	35.1	11.2	**11.2**	**35.1**					
Dissolved Inorganic Carbon (C)	mg/L															
Total Organic Carbon	mg/L					20.3	22.8	35.8	10.6	**10.6**	**35.8**					
Total Inorganic Carbon (C)	mg/L															
Cyanides																
Cyanide, **Total**	mg/L	0.0140	0.0092	0.0131	0.0118					**0.0092**	**0.0140**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L					<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters																
Radium-226	Bq/L	<0.005	0.005	<0.005	0.01	<0.005	<0.005	0.009	<0.005	**0.0050**	**0.0100**		0.6			

Note: 28.9 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-5 Other Water Quality Parameters Measured at Minago Sampling Station OCW1

Sample ID		OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW-1	OCW1	OCW1	OCW1	OCW1	OCW1	OCW1	OCW1	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		May 3, 2006	May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	15-May-07	12-Jun-07	18-Jul-07	13-Aug-07	11-Sep-07	14-Oct-07	09-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		489238	489238	489238	489238	489238	489238	489238	489238	489238	489238	489238	489322	489322	489322							
UTM (NAD 83) Northing		5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990528	5990510	5990510	5990510			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID									L507178-5	L518885-1	L532666-7	L544316-18	L557283-1	L569390-7	L632454-9				DRINKING		Freshwater Aquatic Life	
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water				MAC	AO		
Field Properties																						
Temperature	°C	8.3	11.2	***19.3***	***18.3***	***15.9***	10.8	2.7	9.0	***17.7***	***24.1***	***18.4***	10.4	5.8	3.6	**2.7**	**24.1**			≤ 15	Tier II	**narrative** [$]
Specific Conductance	uS/cm at 25°C	244.0	284.0	n/a	350.0	384.0	357.0	305.0	277.0	306.0	197.0	440.0	403.0	298.7	247.8	**197.0**	**440.0**	1000				
Conductance	uS/cm	165.0	208.0	301.0	305.0	317.0	260.0	177/303*					290.5	189.0	146.8	**146.8**	**317.0**					
Total dissolved solids	g/L	0.2	0.2	0.2	0.2	0.3	0.2	0.2					0.3	0.2	0.161	**0.158**	**0.262**					
Dissolved oxygen (% saturation)	sat %	67.1	81.0	78.6	78.0	79.0	85.8	92.8					92.3	96.9	87.3	**67.1**	**96.9**					
Dissolved oxygen	mg/L	7.9	8.9	7.3	7.3	7.8	9.5	12.6	9.1	7.9	-	6.0	10.3	12.1	11.56	**6.0**	**12.6**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth													0.0	0.0	0.056	**0.002**	**0.056**					
pH	pH Units	7.4	7.8	7.7	7.7	7.2	7.6	8.07/8.2*	-	7.7	7.9	8.1	7.8	7.8	7.61	**7.19**	**8.05**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	143.6	171.0	128.4	175.7	189.4	208.6	188.4	187.0	196.0	195.0	258.0	255.5	299.7	279.8	**128.4**	**299.7**					
Barometric pressure	kN/m^2	98.0	98.7	97.9	99.0	98.1	98.6	97.7					99.2	99.1	98.80	**97.7**	**99.2**					
Salinity	ppt	0.1	n/a	0.2	0.2	0.2	0.2	0.2								**0.1**	**0.2**					
Physical Tests																						
Hardness (as CaCO3)	mg/L	140.0	160.0	180.0	240.0	250.0	220.0	170.0	158.0	191.0	183.0	244.0	224.0	156.0	150	**140.0**	**250.0**					
Conductivity (in laboratory)	uS/cm°C								253.0	260.0	290.0	404.0	402.0	307.0	258	**253.0**	**404.0**	1000				
pH	pH Units								8.0	8.1	8.0	8.2	8.1	8.2	8.1	**8.0**	**8.2**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	168.0	170.0	188.0	231.0	230.0	220.0	200.0	159.0	184.0	213.0	257.0	258.0	186.0	149	**149.0**	**258.0**	700		≤500		
Total Suspended Solids	mg/L	3.0	<1	2.0	<1	1.0	23.0	<1	<3.0	<3.0	<3.0	<3.0	<1.0	<3.0	<3.0	**1.0**	**23.0**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	0.3	0.4	0.7	0.4	0.5	**6.8**	0.4	**1.5**	0.8	**1.1**	0.7	0.5	0.5	0.5	**0.30**	**6.80**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit	**40.0**	**30.0**	**60.0**	**60.0**	**60.0**	**50.0**	**40.0**								**30.0**	**60.0**			≤ 15 TCU		
Anions and Nutrients																						
Ammonia (NH4)	mg/L	<0.005	0.008	<0.005	<0.005	0.005	0.023	0.007	0.022	<0.020	<0.020	0.020	0.031	<0.020	0.025	**0.005**	**0.031**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L								2.7	2.3	2.4	<1.0	3.6	1.6	1.9	**1.6**	**3.6**					
Alkalinity, Total (as CaCO3)	mg/L	134.0	146.0	175.0	212.0	233.0	199.0	166.0	134.0	151.0	162.0	237.0	238.0	168.0	138	**134.0**	**238.0**					
Alkalinity (PP as CaCO3) **	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								**<0.5**	**<0.5**					
Alkalinity, Carbonate (as CaCO3)	mg/L													<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Hydroxide (as CaCO3)	mg/L													<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Bicarbonate (as CaCO3)															138	**138.0**	**138.0**					
Bromide (Br)	mg/L								<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	<0.5	1.6	<0.5	0.7	0.8	1.2	0.9	<0.50	<0.50	<0.50	<0.50	<0.50	1.1	0.56	**0.56**	**1.60**			≤250		
Fluoride (F)	mg/L	n/a	n/a	n/a	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.058	**0.06**	**0.18**		1.5			
Sulphate (SO4)	mg/L	1.0	1.5	<0.5	<5 (1)	<0.5	<0.5	<0.5	0.8	<0.50	<0.50	0.7	1.2	1.6	1.57	**0.66**	**1.57**			≤500		
Nitrate (NO3-N)	mg/L								<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.9	0.0092	**0.009**	**0.850**		10			2.93 [c,u]
Nitrate (NO3)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02											45			13 [c,u,y]
Nitrite (NO2-N)	mg/L								<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.130**	<0.0010	**0.130**	**0.130**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005								**<0.005**	**<0.005**		3.2		CCME	0.197
Nitrate-N plus Nitrite-N																		10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.4	0.4	0.5	0.6	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.325	**0.33**	**0.55**					
Total Nitrogen	mg/L								0.4	0.5	0.5	0.5	0.4	0.4	0.335	**0.34**	**0.51**					
Dissolved Organic Carbon	mg/L	12.8	14.5	15.9	14.6	16.8	14.5	14.3					12.7	13.8	9.34	**9.3**	**16.8**					
Dissolved Inorganic Carbon (C)	mg/L	31.8	n/a	41.9	46.9	43.6	45.6	35.2								**31.8**	**46.9**					
Total Organic Carbon	mg/L	12.8	12.7	17.0	14.3	16.2	16.2	14.5					12.8	13.7	9.15	**9.2**	**17.0**					
Total Inorganic Carbon (C)	mg/L	33.1	35.7	41.3	49.4	49.5	45.5	39.6								**33.1**	**49.5**					
Cyanides																						
Cyanide, **Total**	mg/L								0.0117	0.0109	0.0107	0.0107				**0.0107**	**0.0117**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L												<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters																						
Radium-226	Bq/L	<0.01	<0.01	<0.01	<0.01	< 0.01	< 0.01	0.020	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	**0.006**	**0.020**		0.6			

Note: **30** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-6 Other Water Quality Parameters Measured at Minago Sampling Station OCAWR

Sample ID		OCAWR	OCAWR	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		16-Oct-07	08-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		498457	498457							
UTM (NAD 83) Northing		5986744	5986744			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID	Units	L569390-3 Water	L632454-7 Water				DRINKING		Freshwater Aquatic Life	
							MAC	AO		
Field Properties										
Temperature	°C	5.9	5.7	**5.7**	**5.9**			≤ 15	Tier II	**narrative** [s]
Specific Conductance	uS/cm at 25°C	176.8	128.8	**128.8**	**176.8**	1000				
Conductance	uS/cm	112.0	81.2	**81.2**	**112.0**					
Total dissolved solids	g/L	0.1	0.084	**0.084**	**0.115**					
Dissolved oxygen (% saturation)	sat %	102.1	90.7	**90.7**	**102.1**					
Dissolved oxygen	mg/L	12.7	11.39	**11.4**	**12.7**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth		0.1	0.242	**0.105**	**0.242**					
pH	pH Units	7.7	7.81	**7.74**	**7.81**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	275.0	229.2	**229.2**	**275.0**					
Barometric pressure	kN/m^2	99.1	98.57	**98.6**	**99.1**					
Salinity	ppt									
Physical Tests										
Hardness (as CaCO3)	mg/L	89.6	73.8	**73.8**	**89.6**					
Conductivity (in laboratory)	uS/cm°C	181.0	137	**137.0**	**181.0**	1000				
pH	pH Units	8.02	7.99	**7.99**	**8.02**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	139.0	99	**99.0**	**139.0**	700		≤500		
Total Suspended Solids	mg/L	3.5	50	**3.5**	**50.0**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	7.2	24.1	**7.2**	**24.1**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit							≤ 15 TCU		
Anions and Nutrients										
Ammonia (NH4)	mg/L	<0.020	0.043	**0.043**	**0.043**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L	2.3	1.5	**1.5**	**2.3**					
Alkalinity, Total (as CaCO3)	mg/L	98.3	73.9	**73.9**	**98.3**					
Alkalinity (PP as CaCO3) **	mg/L									
Alkalinity, Carbonate (as CaCO3)	mg/L	<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Hydroxide (as CaCO3)	mg/L	<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Bicarbonate (as CaCO3)			73.9	**73.9**	**73.9**					
Bromide (Br)	mg/L	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	1.55	0.57	**0.57**	**1.55**			≤250		
Fluoride (F)	mg/L	0.053	0.042	**0.042**	**0.053**		1.5			
Sulphate (SO4)	mg/L	0.6	0.53	**0.53**	**0.55**			≤500		
Nitrate (NO3-N)	mg/L	0.9000	0.0141	**0.014**	**0.900**		10			2.93 [c,u]
Nitrate (NO3)	mg/L						45			13 [c,u,y]
Nitrite (NO2-N)	mg/L	<0.10	0.0048	**0.005**	**0.005**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L			**<0.005**	**<0.005**		3.2		CCME	0.197
Nitrate-N plus Nitrite-N						10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.5	0.53	**0.53**	**0.55**					
Total Nitrogen	mg/L	0.5	0.549	**0.55**	**0.55**					
Dissolved Organic Carbon	mg/L	-	12.3	**12.3**	**12.3**					
Dissolved Inorganic Carbon (C)	mg/L			**0.0**	**0.0**					
Total Organic Carbon	mg/L	-	12.2	**12.2**	**12.2**					
Total Inorganic Carbon (C)	mg/L									
Cyanides										
Cyanide, **Total**	mg/L						0.2			
Cyanide, **Weak Associable Cyanide**	mg/L	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters										
Radium-226	Bq/L	0.005	0.006	**0.005**	**0.005**		0.6			

Note: 24.1 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-7 Other Water Quality Parameters Measured at Minago Sampling Station OCW2

Sample ID		OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW-2A	OCW2	Duplicate OCW2	OCW2	OCW2	OCW2	OCW2	OCW2	OCW2	MINIMUM	MAXIMUM	REGULATIONS			
Date Sampled		May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	16-May-07	16-May-07	12-Jun-07	15-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		487559	487559	487559	487559	487559	487559	487344	487344	487344	487344	487344	487463	487463	487463			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines		
UTM (NAD 83) Northing		5990974	5990974	5990974	5990974	5990974	5990974	5990878	5990878	5990878	5990878	5990878	5990961	5990961	5990961				DRINKING		Freshwater Aquatic Life
Lab Sample ID	Units	Water	Water	Water	Water	Water	Water	L507178-6 Water		L518885-2 Water	L532666-1 Water	L544316-1 Water	L555597-6 Water	L569390-19 Water	L632454-2 Water				MAC	AO	
Field Properties																					
Temperature	°C	12.3	***20.2***	***17.9***	***15.6***	7.4	n/a	12.3		***19.6***	***23.6***	***16.8***	9.6	4.6	2.4	**2.4**	**23.6**			≤ 15	Tier II	**narrative** [5]
Specific Conductance	uS/cm at 25°C	311.0	n/a	363.0	399.0	370.0	n/a	288.0		351.0	212.0	580.0	357.2	323.7	293.5	**212.0**	**580.0**	1000			
Conductance	uS/cm	236.0	323.0	314.0	328.0	246.0	320*						252.0	197.0	167.0	**167.0**	**328.0**				
Total dissolved solids	g/L	0.2	0.2	0.2	0.3	0.2	n/a						0.2	0.2	0.191	**0.191**	**0.260**				
Dissolved oxygen (% saturation)	sat %	75.2	70.0	65.0	84.0	75.5	n/a						86.5	95.8	85.5	**65.0**	**95.8**				
Dissolved oxygen	mg/L	8.1	6.4	6.2	8.4	9.0	n/a	7.9		-	-	5.8	9.8	12.4	11.69	**5.8**	**12.4**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)			
Depth													0.1	0.1	0.118	**0.051**	**0.118**				
pH	pH Units	7.8	7.6	7.6	7.1	7.4	8.2*	-		7.9	7.8	7.7	7.8	7.8	7.67	**7.07**	**7.92**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	149.9	132.5	182.7	199.0	233.8	n/a	183.0		189.0	201.0	217.0	193.4	274.0	239.8	**132.5**	**274.0**				
Barometric pressure	kN/m^2	98.8	97.7	n/a	98.8	98.2	n/a						97.8	98.6	98.39	**97.7**	**98.8**				
Salinity	ppt	n/a	0.2	0.2	0.2	0.2	n/a									**0.2**	**0.2**				
Physical Tests																					
Hardness (as CaCO3)	mg/L	170.0	190.0	250.0	260.0	230.0	180.0	179.0		209.0	195.0	265.0	195.0	169.0	171	**169.0**	**265.0**				
Conductivity (in laboratory)	uS/cm°C							290.0		284.0	291.0	417.0	366.0	327.0	295	**284.0**	**417.0**	1000			
pH	pH Units							8.0		8.1	7.9	8.0	8.2	8.2	8.03	**7.94**	**8.17**			6.5-8.5	**6.5-9**
Total Dissolved Solids	mg/L	186.0	209.0	238.0	260.0	220.0	210.0	177.0		189.0	197.0	260.0	217.0	199.0	165	**165.0**	**260.0**	700		≤500	
Total Suspended Solids	mg/L	1.0	<1	11.0	<1	1.0	<1	<3.0		<3.0	<3.0	<3.0	<1.0	3.5	4.5	**1.0**	**11.0**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	0.3	0.2	0.5	0.4	0.2	0.2	0.6		0.3	0.4	0.6	0.5	1.1	0.5	**0.2**	**1.1**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit	30.0	60.0	60.0	70.0	50.0	40.0									**30.0**	**70.0**			≤ 15 TCU	
Anions and Nutrients																					
Ammonia (NH4)	mg/L	0.007	<0.005	<0.005	<0.005	0.058	0.005	0.021		<0.020	<0.020	0.031	0.025	<0.020	<0.020	**0.005**	**0.058**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L							3.0		2.4	2.9	3.7	4.2	1.7	2.7	**1.7**	**4.2**				
Alkalinity, Total (as CaCO3)	mg/L	162.0	187.0	222.0	242.0	206.0	176.0	152.0	148.0	163.0	164.0	250.0	206.0	186.0	168.0	**148.0**	**250.0**				
Alkalinity (PP as CaCO3) **	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									**<0.5**	**<0.5**				
Alkalinity, Carbonate (as CaCO3)	mg/L													<2.0	<2.0	**<2.0**	**<2.0**				
Alkalinity, Hydroxide (as CaCO3)	mg/L													<2.0	<2.0	**<2.0**	**<2.0**				
Alkalinity, Bicarbonate (as CaCO3)															168	**168.0**	**168.0**				
Bromide (Br)	mg/L							<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**				
Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	0.8	1.0	0.9	<0.50		<0.50	<0.50	<0.50	0.5	0.8	<0.50	**0.53**	**1.00**			≤250		
Fluoride (F)	mg/L	n/a	n/a	0.1	0.2	0.1	0.2	0.1		0.1	0.1	0.1	0.1	0.1	0.067	**0.067**	**0.150**		1.5			
Sulphate (SO4)	mg/L	1.6	<0.5	<5 (1)	<0.5	<0.5	<0.5	1.4		0.6	<0.50	1.3	2.0	2.0	2.17	**0.59**	**2.17**			≤500		
Nitrate (NO3-N)	mg/L									<0.0050	<0.0050	<0.0050	<0.50	1.06	0.0123	**0.012**	**1.060**		10			2.93 [c,u]
Nitrate (NO3)	mg/L	<0.02	0.0300	<0.02	<0.02	<0.02	<0.02	<0.0050								**0.030**	**0.030**		45			13 [c,u,y]
Nitrite (NO2-N)	mg/L									<0.0010	<0.0010	<0.0010	<0.10	0.28	<0.0010	**0.280**	**0.280**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L	<0.005	<0.005	0.0050	<0.005	<0.005	<0.005	<0.0010								**<0.0010**	**<0.005**		3.2		CCME	0.197
Nitrate-N plus Nitrite-N																		10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.3	0.4	0.5	0.5	0.4	0.4	0.3		0.4	0.5	0.5	0.3	0.3	0.325	**0.32**	**0.53**					
Total Nitrogen	mg/L							0.3		0.4	0.5	0.5	<0.70	0.3	0.337	**0.32**	**0.52**					
Dissolved Organic Carbon	mg/L	13.1	15.4	14.1	15.9	13.4	12.4						-	-	8.3	**8.3**	**15.9**					
Dissolved Inorganic Carbon (C)	mg/L	n/a	44.2	47.9	55.5	46.6	36.1									**36.1**	**55.5**					
Total Organic Carbon	mg/L	11.9	15.6	14.0	16.6	14.6	13.1						-	-	8.43	**8.4**	**16.6**					
Total Inorganic Carbon (C)	mg/L	37.8	44.1	59.0	56.0	47.0	42.4									**37.8**	**59.0**					
Cyanides																					
Cyanide, **Total**	mg/L							0.0093		0.0077	0.0072	0.0076				**0.0072**	**0.0093**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L												<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters																						
Radium-226	Bq/L	<0.01	<0.01	<0.01	< 0.01	< 0.01	0.020000	<0.005		<0.005	0.010000	<0.005	<0.005	<0.005	<0.005	**0.010**	**0.020**		0.6			

Note: 30 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-8 Other Water Quality Parameters Measured at Minago Sampling Station OCW3

Sample ID		OCW-3A	OCW-3A	OCW-3A-1	OCW-3A	OCW-3A	OCW-3A	OCW3	OCW3	OCW3	OCW3	OCW3	OCW3	OCW3	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		May 16, 2006	Jun. 20, 2006	Jul. 18-20, 2006	Aug 22-24, 2006	Sep. 19-21, 2006	Oct. 12, 2006	16-May-07	12-Jun-07	15-Jul-07	15-Aug-07	14-Sep-07	16-Oct-07	07-May-08			Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		487048	487048	487048	487048	487048	487048	487230	487230	487230	487230	487230	487230	487230							
UTM (NAD 83) Northing		5990931	5990931	5990931	5990931	5990931	5990931	5990892	5990892	5990892	5990892	5990892	5990892	5990892			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID								L507178-7	L518885-3	L532666-2	L544316-2	L555597-5	L569390-18	L632454-3				DRINKING		Freshwater Aquatic Life	
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water				MAC	AO		
Field Properties																					
Temperature	°C	13.64	***20.27***	***18.26***	***16.28***	8.56	n/a	11.50	***18.90***	***24.60***	14.40	9.35	4.07	1.6	**1.6**	**24.6**			≤ 15	Tier II	**narrative** [$]
Specific Conductance	uS/cm at 25°C	348.0	n/a	386.0	410.0	375.0	n/a	261.0	351.0	224.0	504.0	293.7	280.0	252.7	**224.0**	**504.0**	1000				
Conductance	uS/cm	271.0	346.0	337.0	341.0	257.0	319*					206.0	168.0	140.0	**140.0**	**346.0**					
Total dissolved solids	g/L	0.23	0.25	0.25	0.27	0.24	n/a					0.19	0.18	0.164	**0.164**	**0.266**					
Dissolved oxygen (% saturation)	sat %	76.3	66.7	61.4	85.3	79.6	n/a					83.6	90.3	84.6	**61.4**	**90.3**					
Dissolved oxygen	mg/L	7.94	6.03	5.78	8.41	9.21	n/a	7.40	-	-	6.80	9.57	11.80	11.83	**5.8**	**11.8**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth												0.05	0.02	0.072	**0.018**	**0.072**					
pH	pH Units	7.81	7.69	7.69	7.13	7.33	8.3*	-	7.75	7.69	7.59	7.60	7.65	7.55	**7.13**	**7.81**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	171.9	134.6	187.6	192.7	225.6	n/a	191.0	223.0	207.0	158.0	169.7	176.7	233.3	**134.6**	**233.3**					
Barometric pressure	kN/m^2	98.77	97.68	98.01	98.79	98.08	n/a					97.83	98.72	98.46	**97.7**	**98.8**					
Salinity	ppt	n/a	0.18	0.19	0.2	0.18	n/a								**0.2**	**0.2**					
Physical Tests																					
Hardness (as CaCO3)	mg/L	190	210	260	270	230	180	163	179	173	226	163	146	157	**146.0**	**270.0**					
Conductivity (in laboratory)	uS/cm°C							259	269	258	373	301	285	258	**258.0**	**373.0**	1000				
pH	pH Units							7.97	8.03	7.89	8	8.11	8.11	7.97	**7.89**	**8.11**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	214	202	240	280	230	210	164	176	175	244	193	173	141	**141.0**	**280.0**	700		≤500		
Total Suspended Solids	mg/L	1	<1	<1	<1	<1	2	<3.0	<3.0	<3.0	<3.0	<1.0	<3.0	<3.0	**1.0**	**2.0**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	0.3	0.2	0.3	0.5	0.2	0.2	1.01	0.28	0.24	0.64	0.64	0.37	0.25	**0.2**	**1.0**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit	30	60	60	60	40	40								**30.0**	**60.0**			≤ 15 TCU		
Anions and Nutrients																					
Ammonia (NH4)	mg/L	0.010	0.016	<0.005	<0.005	<0.005	<0.005	0.043	<0.020	0.021	0.020	0.023	<0.020	0.031	**0.010**	**0.043**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L							3.1	3	2.9	3.2	5.2	2	3	**2.0**	**5.2**					
Alkalinity, Total (as CaCO3)	mg/L	185.0	200.0	254.0	253.0	209.0	176.0	139.0	156.0	144.0	219.0	169.0	161.0	145	**139.0**	**254.0**					
Alkalinity (PP as CaCO3) **	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								**<0.5**	**<0.5**					
Alkalinity, Carbonate (as CaCO3)	mg/L												<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Hydroxide (as CaCO3)	mg/L												<2.0	<2.0	**<2.0**	**<2.0**					
Alkalinity, Bicarbonate (as CaCO3)														145	**145.0**	**145.0**					
Bromide (Br)	mg/L							<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	0.6	<0.5	<0.5	0.7	<0.5	0.9	<0.50	<0.50	<0.50	<0.50	<0.50	0.69	<0.50	**0.60**	**0.90**			≤250		
Fluoride (F)	mg/L	n/a	n/a	0.16	0.15	0.10	0.08	0.07	0.04	0.07	0.07	0.06	0.06	0.054	**0.043**	**0.160**		1.5			
Sulphate (SO4)	mg/L	2.6	<0.5	<5 (1)	<0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	1.05	1.19	**1.05**	**2.60**			≤500		
Nitrate (NO3-N)	mg/L							<0.0050	<0.0050	0.007	<0.0050	<0.50	1.21	<0.0050	**0.007**	**1.210**		10			2.93 [c,u]
Nitrate (NO3)	mg/L	<0.02	0.02	<0.02	<0.02	<0.02	<0.02								**0.020**	**0.020**		45			13 [c,u,y]
Nitrite (NO2-N)	mg/L							<0.0010	<0.0010	<0.0010	<0.0010	<0.10	0.23	<0.0010	**0.230**	**0.230**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005								**<0.005**	**<0.005**		3.2		CCME	0.197
Nitrate-N plus Nitrite-N																	10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.3	0.39	0.43	0.46	0.36	0.38	0.354	0.532	0.43	0.592	0.408	0.32	0.333	**0.30**	**0.59**					
Total Nitrogen	mg/L							0.354	0.532	0.437	0.592	<0.70	0.32	0.333	**0.32**	**0.59**					
Dissolved Organic Carbon	mg/L	11.6	13.6	12.5	15.5	13.1	12.5					-	-	7.8	**7.8**	**15.5**					
Dissolved Inorganic Carbon (C)	mg/L	n/a	46.9	54.0	60.0	47.9	38.4								**38.4**	**60.0**					
Total Organic Carbon	mg/L	11.1	14.3	12.7	15.3	13	12.5					-	-	7.81	**7.8**	**15.3**					
Total Inorganic Carbon (C)	mg/L	42.4	47.1	61	58	47.9	42.5								**42.4**	**61.0**					
Cyanides																					
Cyanide, **Total**	mg/L							0.0106	0.0083	0.0110	0.0091				**0.0083**	**0.0110**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L											<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters																					
Radium-226	Bq/L	<0.01	<0.01	<0.01	< 0.01	< 0.01	0.05	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	**0.006**	**0.050**		0.6			

Note: 30 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-9 Other Water Quality Parameters Measured in William River and at WRW2x

Sample ID		WR	William River	WILLIAM RIVER AT ROAD	WRW1	WRW1	WRW1	WRW1	WRW2x (formerly WRW1)	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		03-May-06	11-MAR-08	10-May-08	16-May-07	13-Jun-07	16-Jul-07	14-Aug-07	14-Sep-07	WRW2x	WRW2x	Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting			485141	485078	495419	495419	495419	495419	495416							
UTM (NAD 83) Northing			5973774	5973791	5987166	5987166	5987166	5987166	5987162			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID	Units	Water	L610409-3 Water	Water	L507178-8 Water	L518885-8 Water	L532666-3 Water	L544316-19 Water	L555597-2 Water				DRINKING		Freshwater Aquatic Life	
													MAC	AO		
Field Properties																
Temperature	°C	8.87		9.4	9.70	***18.00***	***17.40***	***18.10***	8.75	**8.8**	**18.1**			≤ 15	Tier II	**narrative** [a]
Specific Conductance	uS/cm at 25°C	337.0		391.7	271.0	308.0	323.0	327.0	313.8	**271.0**	**327.0**	1000				
Conductance	uS/cm	233.0		275.0					216.0	**216.0**	**216.0**					
Total dissolved solids	g/L	0.22		0.254					0.204	**0.204**	**0.204**					
Dissolved oxygen (% saturation)	sat %	91.2		103.1					101.6	**101.6**	**101.6**					
Dissolved oxygen	mg/L	10.56		11.77	10.60	8.30	-	6.12	11.80	**6.1**	**11.8**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth				0.084					0.057	**0.057**	**0.057**					
pH	pH Units	8.14		8.14	-	8.30	8.02	7.93	8.34	**7.93**	**8.34**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	128.6		293.7	198.0	206.0	226.0	220.0	158.8	**158.8**	**226.0**					
Barometric pressure	kN/m^2	97.83		98.37					98.03	**98.0**	**98.0**					
Salinity	ppt	0.16														
Physical Tests																
Hardness (as CaCO3)	mg/L	200	288		167	192	190	199	130	**130.0**	**199.0**					
Conductivity (in laboratory)	uS/cm°C		469		282	277	291	336	251	**251.0**	**336.0**	1000				
pH	pH Units		8.25		8.18	8.25	8.18	8.33	8.25	**8.18**	**8.33**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	226	238		170	197	181	186	173	**170.0**	**197.0**	700		≤500		
Total Suspended Solids	mg/L	7	<3.0		30.2	65	29.9	19.8	6.9	**6.9**	**65.0**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	2.9	1.69		22.6	28.3	20.6	14.2	7.82	**7.8**	**28.3**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit	10												≤ 15 TCU		
Anions and Nutrients																
Ammonia (NH4)	mg/L	0.012	0.089		0.031	0.032	0.022	0.047	0.023	**0.022**	**0.047**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L		4.5		1.4	1.3	1.1	<1.0	1.7	**1.1**	**1.7**					
Alkalinity, Total (as CaCO3)	mg/L	189.0	284.0		151.0	158.0	160.0	186.0	134.0	**134.0**	**186.0**					
Alkalinity (PP as CaCO3) **	mg/L	<0.5														
Alkalinity, Carbonate (as CaCO3)	mg/L		<2.0													
Alkalinity, Hydroxide (as CaCO3)	mg/L		<2.0													
Alkalinity, Bicarbonate (as CaCO3)			284.0													
Bromide (Br)	mg/L		<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	1.1	1.15		1.06	1	1.06	1.04	1.11	**1.00**	**1.11**			≤250		
Fluoride (F)	mg/L	n/a	0.14		0.08	0.07	0.09	0.11	0.06	**0.063**	**0.110**		1.5			
Sulphate (SO4)	mg/L	3.6	3.72		2.09	1.76	1.93	3.16	0.89	**0.89**	**3.16**			≤500		
Nitrate (NO3-N)	mg/L		<0.50		<0.0050	<0.0050	<0.0050	<0.0050	<0.50	**<0.0050**	**<0.50**		10			2.93 [c,u]
Nitrate (NO3)	mg/L	<0.02											45			13 [c,av]
Nitrite (NO2-N)	mg/L		0.27		<0.0010	<0.0010	<0.0010	<0.0010	<0.10	**<0.0010**	**<0.10**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L	0.044											3.2		CCME	0.197
Nitrate-N plus Nitrite-N												10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.45	0.465		0.412	0.66	0.404	0.628	0.573	**0.40**	**0.66**					
Total Nitrogen	mg/L		0.73		0.412	0.66	0.404	0.628	<0.70	**0.40**	**0.66**					
Dissolved Organic Carbon	mg/L	8.1	8.09						19.2	**19.2**	**19.2**					
Dissolved Inorganic Carbon (C)	mg/L	44.2														
Total Organic Carbon	mg/L	7.9	8.38						19.1	**19.1**	**19.1**					
Total Inorganic Carbon (C)	mg/L	44.7														
Cyanides																
Cyanide, **Total**	mg/L				0.0096	0.0056	0.0099	0.0067		**0.0056**	**0.0099**		0.2			
Cyanide, **Weak Associable Cyanide**	mg/L		<0.0050						<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters																
Radium-226	Bq/L	<0.01	0.01		<0.005	<0.005	<0.005	0.005	<0.005	**0.005**	**0.005**		0.6			

Note: 1.69 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-10 Other Water Quality Parameters Measured at Stations WRAOC and WRW1x

Sample ID		WRAOC	WRAOC	WRW2	WRW2	WRW2	WRW2	WRW1x (formerly WRW2)	WRW1X	WRW1X	MINIMUM	MAXIMUM	REGULATIONS			
Date Sampled		16-Oct-07	08-May-08	16-May-07	13-Jun-07	16-Jul-07	14-Aug-07	14-Sep-07	15-Oct-07	08-May-08	WRW1x	WRW1x	Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)			Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		498452	498452	498578	498578	498578	498578	498523	498523	498523						
UTM (NAD 83) Northing		5986647	5986647	5986330	5986330	5986330	5986330	5986554	5986554	5986554			TIER II Water Quality Objectives	TIER III - Water Quality Guidelines		
Lab Sample ID		L569390-2	L632454-6	L507178-9	L518885-9	L532666-4	L544316-7	L555597-3	L569390-1	L632454-8				DRINKING		
	Units	Water	Water	Water	Water	Water	Water	Water	Water	Water				MAC	AO	Freshwater Aquatic Life
Field Properties																
Temperature	°C	5.77	6.2	9.10	***18.00***	***19.40***	***17.60***	8.39	5.84	5.8	**5.8**	**19.4**			≤ 15	Tier II
Specific Conductance	uS/cm at 25°C	318.0	341.8	215.0	324.0	203.0	297.0	250.8	203.5	169.6	**169.6**	**324.0**	1000			
Conductance	uS/cm	201.0	218.8					171.0	129.0	107.4	**107.4**	**171.0**				
Total dissolved solids	g/L	0.21	0.222					0.16	0.13	0.110	**0.110**	**0.163**				
Dissolved oxygen (% saturation)	sat %	107.3	98.3					99.9	107.3	92.8	**92.8**	**107.3**				
Dissolved oxygen	mg/L	13.42	12.16	8.20	8.50	-	6.00	11.71	13.40	11.62	**6.0**	**13.4**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)			
Depth		0.09	0.007					0.09	0.12	0.189	**0.087**	**0.189**				
pH	pH Units	8.26	8.00	-	8.28	7.68	7.71	8.01	7.87	7.81	**7.68**	**8.28**			6.5-8.5	6.5-9
ORP	mV	267.0	211.5	202.0	192.0	218.0	232.0	146.5	243.5	237.4	**146.5**	**243.5**				
Barometric pressure	kN/m^2	99.07	98.66					98.03	99.14	98.53	**98.0**	**99.1**				
Salinity	ppt															
Physical Tests																
Hardness (as CaCO3)	mg/L	168	198	132	154	123	161	173	102	88.7	**88.7**	**173.0**				
Conductivity (in laboratory)	uS/cm°C	324	355	218	225	199	272	323	202	177	**177.0**	**323.0**	1000			
pH	pH Units	8.21	8.24	8.07	8.11	8	8.16	8.32	7.71	8.05	**7.71**	**8.32**			6.5-8.5	**6.5-9**
Total Dissolved Solids	mg/L	182	200	144	177	150	183	192	140	111	**111.0**	**192.0**	700		≤500	
Total Suspended Solids	mg/L	6.5	33.5	32.7	23.5	18.9	18.8	5.9	6	57.5	**5.9**	**57.5**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II **narrative**
Turbidity	NTU	5.21	17.7	26.3	20.8	14.1	16.2	5.73	7.16	38.1	**5.7**	**38.1**		1.0	≤5.0	Tier II **narrative**
True Colour	Col. Unit														≤ 15 TCU	
Anions and Nutrients																
Ammonia (NH4)	mg/L	<0.020	0.039	0.028	0.024	<0.020	0.080	0.021	<0.020	0.029	**0.021**	**0.080**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II **see factsheet**
Acidity (as CaCO3)	mg/L	1.2	<1.0	2	2.3	1.8	2.2	<1.0	4.8	1.6	**1.6**	**4.8**				
Alkalinity, Total (as CaCO3)	mg/L	184.0	197	113.0	131.0	108.0	152.0	172.0	111.0	93.7	**93.7**	**172.0**				
Alkalinity (PP as CaCO3) **	mg/L															
Alkalinity, Carbonate (as CaCO3)	mg/L	<2.0	<2.0						<2.0	<2.0	**<2.0**	**<2.0**				
Alkalinity, Hydroxide (as CaCO3)	mg/L	<2.0	<2.0						<2.0	<2.0	**<2.0**	**<2.0**				
Alkalinity, Bicarbonate (as CaCO3)			197							93.7	**93.7**	**93.7**				
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**				
Chloride (Cl)	mg/L	1.47	1.13	0.83	0.66	0.62	0.79	1.58	1.53	0.67	**0.62**	**1.58**			≤250	
Fluoride (F)	mg/L	0.09	0.097	0.07	0.04	0.07	0.08	0.09	0.06	0.051	**0.040**	**0.089**		1.5		
Sulphate (SO4)	mg/L	2.57	2.72	1.23	0.88	0.55	1.56	2.42	0.87	0.89	**0.55**	**2.42**			≤500	
Nitrate (NO3-N)	mg/L	0.94	0.0109	0.0053	<0.0050	<0.0050	<0.0050	<0.50	0.86	0.0164	**<0.0050**	**<0.50**		10		2.93 [c,u]
Nitrate (NO3)	mg/L													45		13 [c,u,y]
Nitrite (NO2-N)	mg/L	<0.10	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	0.13	<0.10	0.0046	**<0.0010**	**<0.10**		0.97		CCME 0.06 [z]
Nitrite (NO2)	mg/L													3.2		CCME 0.197
Nitrate-N plus Nitrite-N													10			
Total Kjeldahl Nitrogen (Calc)	mg/L	0.466	0.53	0.507	0.495	0.538	0.941	0.447	0.52	0.49	**0.45**	**0.94**				
Total Nitrogen	mg/L	0.466	0.54	0.512	0.495	0.538	0.941	<0.70	0.52	0.511	**0.50**	**0.94**				
Dissolved Organic Carbon	mg/L	-	8.88							11.6	**11.6**	**11.6**				
Dissolved Inorganic Carbon (C)	mg/L															
Total Organic Carbon	mg/L	-	8.25							11.7	**11.7**	**11.7**				
Total Inorganic Carbon (C)	mg/L															
Cyanides																
Cyanide, **Total**	mg/L			0.0120	0.0082	0.0109	0.0122				**0.0082**	**0.0122**		0.2		
Cyanide, **Weak Associable Cyanide**	mg/L	<0.0050	<0.0050					<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II 0.005 (as free CN)
Radiological Parameters																
Radium-226	Bq/L	<0.005	0.006	<0.005	<0.005	<0.005	0.01	<0.005	0.03	0.01	**0.010**	**0.030**		0.6		

Note: 26.3 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-11 Other WQ Parameters at WRALSB, LSBBWR, Russel Lk, Little Limestone Lk, William Lk

Sample ID		WRALSB	LSBBWR	RUSSELL LK	LITTLE LLK	WILLIAM LAKE	MINIMUM	MAXIMUM	REGULATIONS				
Date Sampled		13-Oct-07	13-Oct-07	12-Sep-07	12-Sep-07	07-May-08	All stations	All stations	Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2002)				Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2007)
UTM (NAD 83) Easting		503935	504092	482571	478725	479083	(listed	(listed					
UTM (NAD 83) Northing		5969206	5968889	5967117	5954922	5973831	on this	on this	TIER II Water Quality Objectives	TIER III - Water Quality Guidelines			
Lab Sample ID		L569390-5	L569390-4	L557029-1	L557031-1	L632454-5	sheet)	sheet)		DRINKING		Freshwater	
	Units	Water	Water	Water	Water	Water				MAC	AO	Aquatic Life	
Field Properties													
Temperature	°C	7.04	5.73	10.99	11.98	1.0	**1.0**	**12.0**			≤ 15	Tier II	**narrative** [x]
Specific Conductance	uS/cm at 25°C	231.3	248.0	324.0	359.3	127.3	**127.3**	**359.3**	1000				
Conductance	uS/cm	152.0	156.8	237.3	270.3	69.3	**69.3**	**270.3**					
Total dissolved solids	g/L	0.15	0.16	0.21	0.23	0.083	**0.083**	**0.234**					
Dissolved oxygen (% saturation)	sat %	104.3	106.0	100.4	98.8	67.7	**67.7**	**106.0**					
Dissolved oxygen	mg/L	12.64	13.28	11.06	10.64	9.61	**9.6**	**13.3**	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)				
Depth		0.03	0.12	0.13	0.08	0.055	**0.031**	**0.128**					
pH	pH Units	7.55	7.97	**8.84**	**8.61**	8.38	**7.55**	**8.84**			6.5-8.5	6.5-9	**6.5-9**
ORP	mV	269.3	254.5	227.7	212.5	258.5	**212.5**	**269.3**					
Barometric pressure	kN/m^2	99.07	99.07	97.89	97.79	98.60	**97.8**	**99.1**					
Salinity	ppt												
Physical Tests													
Hardness (as CaCO3)	mg/L	120	128	198	216	61.5	**61.5**	**216.0**					
Conductivity (in laboratory)	uS/cm°C	236	247	326	364	109	**109.0**	**364.0**	1000				
pH	pH Units	8.12	7.9	**8.56**	8.4	8.18	**7.90**	**8.56**			6.5-8.5		**6.5-9**
Total Dissolved Solids	mg/L	150	154	173	196	60	**60.0**	**196.0**	700		≤500		
Total Suspended Solids	mg/L	7.5	6.5	14.2	9.2	<3.0	**6.5**	**14.2**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)			Tier II	**narrative**
Turbidity	NTU	**6.46**	**6.78**	**4.48**	**6.75**	0.19	**0.2**	**6.8**		1.0	≤5.0	Tier II	**narrative**
True Colour	Col. Unit										≤ 15 TCU		
Anions and Nutrients													
Ammonia (NH4)	mg/L	<0.020	<0.020	0.033	0.042	0.024	**0.024**	**0.042**	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)			Tier II	**see factsheet**
Acidity (as CaCO3)	mg/L	2	3.1	<1.0	<1.0	<1.0	**2.0**	**3.1**					
Alkalinity, Total (as CaCO3)	mg/L	130.0	140.0	197.0	227.0	56.6	**56.6**	**227.0**					
Alkalinity (PP as CaCO3) **	mg/L												
Alkalinity, Carbonate (as CaCO3)	mg/L	<2.0	<2.0			<2.0	**<2.0**	**<2.0**					
Alkalinity, Hydroxide (as CaCO3)	mg/L	<2.0	<2.0			<2.0	**<2.0**	**<2.0**					
Alkalinity, Bicarbonate (as CaCO3)						56.6	**56.6**	**56.6**					
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	**<0.050**	**<0.050**					
Chloride (Cl)	mg/L	1.34	1.44	0.93	0.8	<0.50	**0.80**	**1.44**			≤250		
Fluoride (F)	mg/L	0.07	0.07	0.099	0.104	0.039	**0.039**	**0.104**		1.5			
Sulphate (SO4)	mg/L	1.41	1.57	5.11	6.5	0.72	**0.72**	**6.50**			≤500		
Nitrate (NO3-N)	mg/L	0.8	0.92	<0.0050	<0.0050	0.0297	**0.03**	**0.92**		10			2.93 [c,u]
Nitrate (NO3)	mg/L									45			13 [c,u,y]
Nitrite (NO2-N)	mg/L	**0.13**	**0.14**	<0.0010	<0.0010	0.0015	**<0.0010**	**0.14**		0.97		CCME	0.06 [z]
Nitrite (NO2)	mg/L									3.2		CCME	0.197
Nitrate-N plus Nitrite-N									10				
Total Kjeldahl Nitrogen (Calc)	mg/L	0.543	0.534	0.461	0.277	0.153	**0.153**	**0.543**					
Total Nitrogen	mg/L	0.543	0.534	0.461	0.277	0.184	**0.184**	**0.543**					
Dissolved Organic Carbon	mg/L			6.10	3.09	1.86	**1.86**	**6.10**					
Dissolved Inorganic Carbon (C)	mg/L												
Total Organic Carbon	mg/L			6.62	2.84	2.41	**2.41**	**6.62**					
Total Inorganic Carbon (C)	mg/L												
Cyanides													
Cyanide, **Total**	mg/L									0.2			
Cyanide, **Weak Associable Cyanide**	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**<0.0050**	**<0.0050**	0.0052 mg/L (4-Day, 3-Year)			Tier II	0.005 (as free CN)
Radiological Parameters													
Radium-226	Bq/L	<0.005	<0.005	<0.005	0.008	<0.005	**0.008**	**0.008**		0.6			

Note: **8.56** BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

Table 7.5-F-12 Detection Limits for Other Water Quality Parameters measured at Minago

		DETECTION LIMITS					
	Units	**2006** Water	**May-Aug. 2007** Water	**Sep-Oct. 2007** Water	**Mar-2008 for HRW1** Water	**Mar-2008, except for HRW1** Water	**May-2008** Water
Physical Tests							
Hardness (as CaCO3)	mg/L	0.5	0.5	0.5	0.5	0.5	0.5
Conductivity (in laboratory)	uS/cm	1	2	2	2	2	2
pH	pH Units	0.01	0.01	0.01	0.01	0.01	0.01
Total Dissolved Solids	mg/L	1	10	1.2 - 10	13	10	10
Total Suspended Solids	mg/L	1	3	1-3	3	3	3
Turbidity	NTU	0.1	0.1	0.1	0.1	0.1	0.1
True Colour	Col. Unit	5					
Anions and Nutrients							
Ammonia (NH4)	mg/L	0.005	0.02	0.02	0.02	0.02	0.02
Acidity (as CaCO3)	mg/L		1	1	1	1	1
Alkalinity, Total (as CaCO3)	mg/L	0.5	2	2	1	2	2
Alkalinity (PP as CaCO3) **	mg/L	0.5					
Alkalinity, Carbonate (as CaCO3)	mg/L				1	2	2
Alkalinity, Hydroxide (as CaCO3)	mg/L				1	2	2
Alkalinity, Bicarbonate (as CaCO3)					1	2	2
Bromide (Br)	mg/L		0.05	0.05	0.05	0.05	0.05
Chloride (Cl)	mg/L	0.5	0.5	0.5	0.5	0.5	0.5
Fluoride (F)	mg/L	0.01	0.02	0.02	0.02	0.02	0.02
Sulphate (SO4)	mg/L	0.5	0.5	0.5	0.5	0.5	0.5
Nitrate (NO3-N)	mg/L	0.02	0.005	0.005 - 0.5	0.5	0.5	0.005
Nitrate (NO3)	mg/L						
Nitrite (NO2-N)	mg/L	0.005	0.001	0.001 - 0.1	0.1	0.1	0.001
Nitrite (NO2)	mg/L						
Nitrate-N plus Nitrite-N							
Total Kjeldahl Nitrogen (Calc)	mg/L	0.02	0.05	0.05	0.05	0.05	0.05-0.125
Total Nitrogen	mg/L		0.06	0.06-0.7	0.7	0.7	0.06
Dissolved Organic Carbon	mg/L	0.5			0.5	0.5	0.5
Dissolved Inorganic Carbon (C)	mg/L	0.5					
Total Organic Carbon	mg/L	0.5			0.5	0.5	0.5
Total Inorganic Carbon (C)	mg/L	0.5					
Cyanides							
Cyanide, **Total**	mg/L		0.005				
Cyanide, **Weak Associable**	mg/L			0.005	0.005	0.005	0.005
Radiological Parameters							
Radium-226	Bq/L	0.01	0.005	0.005	0.006	0.006	0.005

Notes:

* calculated from conductivity according to algorithms in Standard Methods for the Examination of Water and Wastewater (1989)
** PP refers to phenolphthalein
MAC - Maximum Acceptable Concentration
AO - Aesthetic Objectives

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

Footnotes for the CCME (Canadian Council of Ministers of the Environment) Aquatic Guidelines. 2007. (= Canadian water quality guidelines for the protection of aquatic life).

c Interim guideline.

d No fact sheet created.

g Aluminium guideline= 5 $\mu g \cdot L^{-1}$ at pH <6.5
= 100 $\mu g \cdot L^{-1}$ at pH = 6.5 or greater

h Ammonia guideline: Expressed as µg unionized ammonia·L^{-1}. This would be equivalent to 15.2 µg ammonia-nitrogen·L^{-1}. Guideline for total ammonia is temperature and pH dependent, please consult factsheet for more information.

j The technical document for the guideline is available from the Ontario Ministry of the Environment.

k Substance has been re-evaluated since CCREM 1987 + Appendixes. Either a new guideline has been derived or insufficient data existed to derive a new guideline.

l Cadmium guideline = 10{0.86[log(hardness)] - 3.2}.

m Copper guideline = 2 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–120 $mg \cdot L^{-1}$
= 3 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 4 $\mu g \cdot L^{-1}$ at [CaCO3] >180 $mg \cdot L^{-1}$

n Dissolved oxygen for warm-water biota: early life stages = 6000 $\mu g \cdot L^{-1}$
other life stages = 5500 $\mu g \cdot L^{-1}$
for cold-water biota: early life stages = 9500 $\mu g \cdot L^{-1}$
other life stages = 6500 $\mu g \cdot L^{-1}$

o Lead guideline = 1 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–60 $mg \cdot L^{-1}$
= 2 $\mu g \cdot L^{-1}$ at [CaCO3] = 60–120 $mg \cdot^{L-1}$
= 4 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 7 $\mu g \cdot L^{-1}$ at [CaCO3] = >180 $mg \cdot L^{-1}$

p Nickel guideline = 25 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–60 $mg \cdot L^{-1}$
= 65 $\mu g \cdot L^{-1}$ at [CaCO3] = 60–120 $mg \cdot L^{-1}$
= 110 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 150 $\mu g \cdot L^{-1}$ at [CaCO3] = >180 $mg \cdot L^{-1}$

s Temperature: (for more information, see CCREM 1987)
Thermal Stratification: Thermal additions to receiving waters should be such that thermal stratification and subsequent turnover dates are not altered from those existing prior to the addition of heat from artificial origins.
Maximum Weekly Average Temperature: Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded.
Short-term Exposure to Extreme Temperature: Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

u For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.

w May not protect fully higher trophic level fish; see factsheet for details.

x Canadian Trigger Ranges (for further narrative see factsheet), Total Phosphorus (ug··L^{-1}):
ultra-oligotrophic <4
oligotrophic 4-10
mesotrophic 10-20
meso-eutrophic 20-35
eutrophic 35-100
hyper-eutrophic >100

y Guidelines are expressed in µg nitrate·L^{-1}. These values are equivalent to 2900 µg nitrate-nitrogen·L^{-1}, and 3600 µg nitrate-nitrogen·L^{-1}, for freshwater and marine respectively.

z Guideline is expressed as µg nitrite-nitrogen·L^{-1}. This value is equivalent to 197 µg nitrite·L^{-1}.

APPENDIX 7.6

Supplemental Material for Groundwater and Hydrogeology

APPENDIX 7.6-A

Detailed Pumping Well Log Information

Driller's Report – HG #3 Carbonate Bedrock

Well Location QTR SEC 10 TWP 59 RGE 12 E W [X] GPS Reading
Feet below ground level
R. Lot Parish Lat.
Remarks Long.

Well Owner Name Victory Nickel Inc. Location Sketch of Well
Address
Phone

Well Identification HG # 3 - Dewatering wells - Carbonate Bedrock

Well Use Production Test Well [X] Recharge Observation

Water Use Domestic Livestock Industrial Irrigation
Air-condition Other [X] Specify Dewatering

Date well completed February 10 2008

Depth Below Ground in Feet		DESCRIPTION WELL LOG	Water Record
0	10	Peat Moss & Vegetation	
10	18	Clay	
18	190	Limestone	
		Fractures @ 20-40 ft, 50 ft, 60-80 ft, 117 ft.	

WELL CONSTRUCTION

Depth Below Ground Level		Casing	Open Hole	Perfor-ations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE	
0	20	X					12			Steel	Black Welded		
20	190		X				11						

Top of Casing 2 Feet above [X] Below

REMARKS:
Well must be vented

PUMPING TEST

Date of Test: February 10 2008
Pumping [X] Flowing Rate 205 U.S.G.P.M.
Water level before pumping 7'12" Above Below [X]
Pumping level at end of test 36'5" Above Below [X]
Duration of test 1 HRS Minutes
Recommended pumping rate I.G.P.M.
With pump intake at Feet below ground level

CONTRACTOR

License Number 603 7
Name Friesen Drillers Ltd.
Address 307 PTH 12 N
Steinbach, MB. R5G 1T8
Drill Operator Peter Friesen

Driller's Report – HG #3 Sandstone Aquifer

Well Location	QTR		SEC	10	TWP	59	RGE	12	E	W [X]
	R. Lot		Parish							
	Remarks									
Well Owner	Name	Victory Nickel Inc.								
	Address									
							Phone			
Well Identification	HG # 3 - Dewatering wells - Sandstone Aquifer									
Well Use	Production		Test Well [X]		Recharge		Observation			
Water Use	Domestic		Livestock		Industrial		Irrigation			
	Air-condition		Other [X]		Specify	Dewatering				
Date well completed	February	16	2008							

GPS Reading: Lat. / Long.

Location Sketch of Well

Depth Below Ground in Feet		DESCRIPTION WELL LOG	Water Record
0	2	Gravel	
2	10	Peat & Vegetation	
10	18	Dense Grey Clay	
18	195	Limestone Fractures @ 114 ft.	
195	197	Sandstone Layer	
197	200	Limestone	
200	230	Sandstone Hard-Fine Fracture	
230	235	White Shale	
235	237	Granite	

WELL CONSTRUCTION

Depth Below Ground Level		Casing	Open Hole	Perfor-ations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size		TYPE	MATERIAL	MAKE	
0	37	X					16	16¾			Steel	Black Welded		
37	196	X					10	10¾			Steel	Black Welded		
196	236			X			10		15		Wire wound	Stainless steel		
188	236				X						10-20 Sand	Silica		
178	188					X					Enviroplug	Bentonite		

Top of Casing 2 Feet above [X] Below

REMARKS:

Well must be vented

PUMPING TEST

Date of Test: February 16 2008

Pumping [X] Flowing Rate 125 I.G.P.M.

Water level before pumping 8 Above Below [X]

Pumping level at end of test 100 Above Below [X]

Duration of test 1 HRS Minutes

Recommended pumping rate I.G.P.M.

With pump intake at Feet below ground level

CONTRACTOR

License Number 603 7

Name Friesen Drillers Ltd.

Address 307 PTH 12 N
Steinbach, MB. R5G 1T8

Drill Operator James Friesen

Driller's Report – HG #7 Carbonate Bedrock

Well Location — QTR — SEC 10 TWP 59 RGE 12 E W [X] — GPS Reading

R. Lot — Parish — Lat.

Remarks — Long.

Well Owner — Name: Victory Nickel Inc. — Location Sketch of Well

Address

Phone

Well Identification: HG # 7 - Dewatering wells - Carbonate Bedrock

Well Use: Production — Test Well [X] — Recharge — Observation

Water Use: Domestic — Livestock — Industrial — Irrigation

Air-condition — Other [X] — Specify: Dewatering

Date well completed: February 12 2008

Depth Below Ground in Feet		DESCRIPTION WELL LOG	Water Record
0	10	Peat Moss & Vegetation	
10	23	Grey Clay	
23	190	Limestone	

Fractures @ 39,79,82,120 ft.
Dirty fractures @ $135 ft.
60-115ft. Grey Limestone stringers

WELL CONSTRUCTION

Depth Below Ground Level		Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	25	X					12			Steel	Black Welded	
25	190		X				11					

Top of Casing: 2 Feet above [X] Below

REMARKS:

Well must be vented

PUMPING TEST

Date of Test: February 12 2008

Pumping [X] — Flowing — Rate 454 U.S.G.P.M.

Water level before pumping: 9' 10" — Above — Below [X]

Pumping level at end of test: 26 — Above — Below [X]

Duration of test: 1 HRS — Minutes

Recommended pumping rate — I.G.P.M.

With pump intake at — Feet below ground level

CONTRACTOR

License Number 603 7

Name: Friesen Drillers Ltd.

Address: 307 PTH 12 N
Steinbach, MB. R5G 1T8

Drill Operator: Peter Friesen

Driller's Report – HG #7 Sandstone Aquifer

Well Location QTR SEC 10 TWP 59 RGE 12 E W [X] GPS Reading

R. Lot Parish Lat.

Remarks Long.

Well Owner Name Victory Nickel Inc. Location Sketch of Well

Address

Phone

Well Identification HG # 7 - Dewatering wells - Sandstone Aquifer

Well Use Production Test Well [X] Recharge Observation

Water Use Domestic Livestock Industrial Irrigation

Air-condition Other [X] Specify Dewatering

Date well completed February 19 2008

Depth Below Ground in Feet		DESCRIPTION WELL LOG	Water Record
0	2	Pad - Gravel	
2	10	Peat & Vegetation	
10	25	Clay	
25	196	Limestone Fractures @ 135 ft.	
196	198	Sandstone Layer	
198	201	Limestone	
201	230	Sandstone - Hard & Soft layers - Fine Fractures	
230	235	White Shale	
235	237	Granite	

WELL CONSTRUCTION

Depth Below Ground Level		Casing	Open Hole	Perfor-ations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size		TYPE	MATERIAL	MAKE
0	48	X					16	17			Steel	Black Welded	
0	195.5	X					10	10¾			Steel	Black Welded	
195.5	325.5			X					15		Wire wound	Stainless steel	
188	235.5				X						10-20 Sand	Silica	
170	188					X					Enviroplug	Bentonite	

Top of Casing 2 Feet above X Below

REMARKS:

Well must be vented

PUMPING TEST

Date of Test: February 19 2008

Pumping [X] Flowing Rate 125 I.G.P.M.

Water level before pumping 12 Above Below [X]

Pumping level at end of test 104'4" Above Below [X]

Duration of test 1 HRS Minutes

Recommended pumping rate I.G.P.M.

With pump intake at Feet below ground level

CONTRACTOR

License Number 603 7

Name Friesen Drillers Ltd.

Address 307 PTH 12 N
Steinbach, MB. R5G 1T8

Drill Operator James Friesen

APPENDIX 7.6-B

Detailed Groundwater Quality Results – Total Metals

Table 7.6-B-1 Total Metals Groundwater Water Quality Parameters Measured in Limestone

										REGULATIONS						
	SAMPLE ID	LM	LM2	LM2 Duplicate	HG-3 LS	HG-7 LS	HG-7 LS	LIMESTONE AVERAGE [1]	LIMESTONE MAXIMUM [1]	LIMESTONE MINIMUM [1]	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)					Canadian Water Quality Guidelines for the Protection of Aquatic Life	Metal Mining Liquid Effluents (2002)	
	Date Sampled	3-Mar-07	3-Mar-07	3-Mar-07	15-AUG-08	15-AUG-08	15-AUG-08	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008		TIER III - Water Quality Guidelines						
PARAMETER	Lab Sample ID				L672682-1	L672682-3	L672682-6				TIER II Water Quality Objectives	Drinking			Freshwater			
	Units				Water	Water	Water					MAC	IMAC	AO		(CCME, 2007)	Monthly Mean	Grab Sample
Physical Tests																		
Dissolved Hardness (CaCO3)	mg/L	285	290	297				291	297	285								
Hardness (as CaCO3)	mg/L	287	307	304	242	287	271	283	307	242								
Conductivity	µS/cm	682	675	672	606	610	611	643	682	606	1000							
pH	pH Units	8.2	8.1	8.2	8.05	8.04	8.12	8.12	8.2	8.04				6.5-8.5		6.5-9	6-9.5	6-9.5
Total Metals																		
Aluminum (Al)-Total	mg/L				**0.108**	0.036	0.0349	0.060	**0.108**	0.035					0.005 - 0.1	0.005 - 0.1		
Antimony (Sb)-Total	mg/L				<0.000050	<0.000050	<0.000050	0.000025	0.000025	0.000025			0.006					
Arsenic (As)-Total	mg/L				0.00294	0.0023	0.00218	0.00247	0.00294	0.00218			0.025		0.15 mg/L (4-Day, 3-Year) [A]	0.005[k]	0.5	1
Barium (Ba)-Total	mg/L				0.0694	0.076	0.0745	0.0733	0.076	0.0694		1						
Beryllium (Be)-Total	mg/L				<0.00020	<0.00020	<0.00020	0.0001	0.0001	0.0001								
Bismuth (Bi)-Total	mg/L				<0.00050	<0.00050	<0.00050	0.00025	0.00025	0.00025								
Boron (B)-Total	mg/L				0.177	0.11	0.0958	0.128	0.177	0.096			5					
Cadmium (Cd)-Total	mg/L				<0.000017	<0.000017	<0.000017	0.0000057	0.0000057	0.0000057		0.005				0.000017[c,l]		
Calcium (Ca)-Total	mg/L				45.7	56.3	53.3	55.0	59.7	45.7								
Chromium (Cr)-Total	mg/L				<0.0020	<0.0020	<0.0020	0.001	0.001	0.001		0.05						
Trivalent Chromium (Cr-III)	mg/L															0.0089[c,k]		
Hexavalent Chromium (Cr-VI)	mg/L															0.001[k]		
Cobalt (Co)-Total	mg/L				0.00029	0.00028	0.00027	0.00028	0.00029	0.00027								
Copper (Cu)-Total	mg/L				0.00077	0.00077	0.00078	0.00077	0.00078	0.00077				≤1.0		0.002-0.004[m]	0.3	0.6
Iron (Fe)-Total	mg/L				**0.734**	**0.337**	**0.356**	**0.48**	**0.73**	**0.34**				≤0.3	0.3	0.3[d]		
Lead (Pb)-Total	mg/L				0.000389	0.000438	0.000493	0.00044	0.000493	0.000389		0.01				0.001-0.007[o]	0.2	0.4
Lithium (Li)-Total	mg/L				0.0279	0.0176	0.0156	0.0204	0.0279	0.0156								
Magnesium (Mg)- Total	mg/L				31.1	35.5	33.5	35.4	38.4	31.1								
Manganese (Mn)-Total	mg/L				0.00997	0.0091	0.00882	0.00930	0.00997	0.00882				≤0.05				
Mercury (Hg)-Total	mg/L				<0.000010	<0.000010	<0.000010	0.000005	0.000005	0.000005		0.001			0.0001			
Inorganic Mercury	mg/L															0.000026		
Methylmercury	mg/L															0.000004[c,w]		
Molybdenum (Mo)-Total	mg/L				0.000393	0.000542	0.000521	0.0005	0.0005	0.000393					0.073			
Nickel (Ni)-Total	mg/L				0.00117	0.00109	0.00094	0.0011	0.0012	0.00094						0.025-0.15[p]	0.5	1
Phosphorus (P)-Total	mg/L				<0.30	<0.30	<0.30	0.15	0.15	0.15						narrative [x]		
Potassium (K)-Total	mg/L				7.9	4.45	4.27	5.54	7.9	4.27								
Selenium (Se)-Total	mg/L				<0.0010	<0.0010	<0.0010	0.0005	0.0005	0.0005		0.01			0.001	0.001[d]		
Silicon (Si)-Total	mg/L				5.06	4.76	4.78	4.87	5.06	4.76								
Silver (Ag)-Total	mg/L				<0.000010	<0.000010	<0.000010	0.000005	0.000005	0.000005					0.0001	0.0001[d]		
Sodium (Na)-Total	mg/L				32.2	20.5	20.2	24.3	32.2	20.2				≤200				
Strontium (Sr)-Total	mg/L				0.262	0.218	0.218	0.233	0.262	0.218		5 Bq/L						
Thallium (Tl)-Total	mg/L				<0.000050	<0.000050	<0.000050	0.000025	0.000025	0.000025					0.0008	0.0008[j]		
Tin (Sn)-Total	mg/L				<0.00010	<0.00010	<0.00010	0.00005	0.00005	0.00005								
Titanium (Ti)-Total	mg/L				0.011	<0.010	<0.010	0.007	0.011	0.005								
Uranium (U)-Total	mg/L				0.000276	0.000624	0.000577	0.00049	0.000624	0.000276			0.02					
Vanadium (V)-Total	mg/L				<0.0010	<0.0010	<0.0010	0.0005	0.0005	0.0005								
Zinc (Zn)-Total	mg/L				0.0024	0.0023	0.002	0.002	0.002	0.002				≤5		0.03[d]	0.5	1

Notes:

1 If a reported concentration was below the detection limit, half the detection limit was used for the calculations.

MAC - Maximum Acceptable Concentration

IMAC - Interim Maximum Acceptable Concentration

AO - Aesthetic Objectives

FDA = field duplicate (split sample) available

FD = field duplicate

0.734 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

Table 7.6-B-2 Total Metals Groundwater Water Quality Parameters Measured in Sandstone

										REGULATIONS						
	SAMPLE ID	SS	SS-2	HG-3 SS	HG-3 SS	HG-7 SS	SANDSTONE AVERAGE [1]	SANDSTONE MAXIMUM [1]	SANDSTONE MINIIMUM [1]	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)					Canadian Water Quality Guidelines for the Protection of Aquatic Life	Metal Mining Liquid Effluents (2002)	
	Date Sampled	7-Mar-07	7-Mar-07	15-AUG-08	15-AUG-08	15-AUG-08	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008								
	Time Sampled			FDA	FD						TIER III - Water Quality Guidelines						
PARAMETER	Lab Sample ID			L672682-2	L672682-5	L672682-4				TIER II Water Quality Objectives	Drinking			Freshwater			
	Units			Water	Water	Water					MAC	IMAC	AO		(CCME, 2007)	Monthly Mean	Grab Sample
Physical Tests																	
Dissolved Hardness (CaCO3)	mg/L	287	285				286	287	285								
Hardness (as CaCO3)	mg/L	294	293	167	165	257	235	294	165								
Conductivity	µS/cm	688	677	683	684	633	673	688	633	1000							
pH	pH Units	8.1	8.1	8.17	8.18	8.05	8.12	8.18	8.05				6.5-8.5		6.5-9	6-9.5	6-9.5
Total Metals																	
Aluminum (Al)-Total	mg/L			0.0215	0.0217	0.0261	0.0231	0.0261	0.0215					0.005 - 0.1	0.005 - 0.1		
Antimony (Sb)-Total	mg/L			<0.000050	<0.000050	<0.000050	0.000025	0.000025	0.000025			0.006					
Arsenic (As)-Total	mg/L			0.00028	0.00027	0.00021	0.00025	0.00028	0.00021			0.025		0.15 mg/L (4-Day, 3-Year) [A]	0.005[k]	0.5	1
Barium (Ba)-Total	mg/L			0.045	0.0445	0.061	0.050	0.061	0.0445		1						
Beryllium (Be)-Total	mg/L			<0.00020	<0.00020	<0.00020	0.0001	0.0001	0.0001								
Bismuth (Bi)-Total	mg/L			<0.00050	<0.00050	<0.00050	0.00025	0.00025	0.00025								
Boron (B)-Total	mg/L			0.401	0.391	0.197	0.330	0.401	0.197			5					
Cadmium (Cd)-Total	mg/L			<0.000017	<0.000017	<0.000017	0.0000057	0.0000057	0.0000057		0.005				0.000017[c,l]		
Calcium (Ca)-Total	mg/L			32	31.6	51.5	45.7	56.8	31.6								
Chromium (Cr)-Total	mg/L			<0.0020	<0.0020	<0.0020	0.001	0.001	0.001		0.05						
Trivalent Chromium (Cr-III)	mg/L														0.0089[c,k]		
Hexavalent Chromium (Cr-VI)	mg/L														0.001[k]		
Cobalt (Co)-Total	mg/L			<0.00010	<0.00010	0.00019	0.00010	0.00019	0.00005								
Copper (Cu)-Total	mg/L			0.00024	0.00022	0.00029	0.00025	0.00029	0.00022				≤1.0		0.002-0.004[m]	0.3	0.6
Iron (Fe)-Total	mg/L			0.172	0.169	0.13	0.16	0.17	0.13				≤0.3	0.3	0.3[d]		
Lead (Pb)-Total	mg/L			0.000329	0.000304	0.000733	0.00046	0.00073	0.00030		0.01				0.001-0.007[d]	0.2	0.4
Lithium (Li)-Total	mg/L			0.0455	0.0447	0.0286	0.0396	0.0455	0.0286								
Magnesium (Mg)- Total	mg/L			21.1	21	31.2	29.4	37.1	21								
Manganese (Mn)-Total	mg/L			0.00833	0.00839	0.012	0.00957	0.01200	0.00833				≤0.05				
Mercury (Hg)-Total	mg/L			<0.000010	<0.000010	<0.000010	0.000005	0.000005	0.000005		0.001			0.0001			
Inorganic Mercury	mg/L														0.000026		
Methylmercury	mg/L														0.000004[c,w]		
Molybdenum (Mo)-Total	mg/L			0.00114	0.00112	0.00113	0.0011	0.0011	0.00112					0.073			
Nickel (Ni)-Total	mg/L			0.00013	0.00019	0.00101	0.0004	0.0010	0.00013						0.025-0.15[p]	0.5	1
Phosphorus (P)-Total	mg/L			<0.30	<0.30	<0.30	0.15	0.15	0.15						narrative [x]		
Potassium (K)-Total	mg/L			9.39	9.23	5.74	8.12	9.39	5.74								
Selenium (Se)-Total	mg/L			<0.0010	<0.0010	<0.0010	0.0005	0.0005	0.0005		0.01			0.001	0.001[d]		
Silicon (Si)-Total	mg/L			4.03	4.01	4.06	4.03	4.06	4.01								
Silver (Ag)-Total	mg/L			<0.000010	<0.000010	<0.000010	0.000005	0.000005	0.000005					0.0001	0.0001[d]		
Sodium (Na)-Total	mg/L			83.2	83.4	34	66.9	83.4	34				≤200				
Strontium (Sr)-Total	mg/L			0.372	0.372	0.314	0.353	0.372	0.314		5 Bq/L						
Thallium (Tl)-Total	mg/L			<0.000050	<0.000050	<0.000050	0.000025	0.000025	0.000025					0.0008	0.0008[l]		
Tin (Sn)-Total	mg/L			<0.00010	<0.00010	<0.00010	0.00005	0.00005	0.00005								
Titanium (Ti)-Total	mg/L			<0.010	<0.010	<0.010	0.005	0.005	0.005								
Uranium (U)-Total	mg/L			0.000188	0.000183	0.00105	0.00047	0.00105	0.000183			0.02					
Vanadium (V)-Total	mg/L			<0.0010	<0.0010	<0.0010	0.0005	0.0005	0.0005								
Zinc (Zn)-Total	mg/L			0.0486	0.0727	0.0037	**0.042**	**0.073**	0.004				≤5		0.03[d]	0.5	1

Notes:

1 If a reported concentration was below the detection limit, half the detection limit was used for the calculations.

MAC - Maximum Acceptable Concentration

IMAC - InterimMaximum Acceptable Concentration

AO - Aesthetic Objectives

FDA = field duplicate (split sample) available

FD = field duplicate

0.073 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

NOTES

Footnotes for the CCME Aquatic Guidelines (Canadian Council of Ministers of the Environment. 2006.Environment, Winnipeg. Canadian water quality guidelines for the protection of aquatic life).Environment, Winnipeg.

c Interim guideline.
d No fact sheet created.
j The technical document for the guideline is available from the Ontario Ministry of the Environment.
k Substance has been re-evaluated since CCREM 1987 + Appendixes. Either a new guideline has been derived or insufficient data existed to derive a new guideline.
l Cadmium guideline = 10{0.86[log(hardness)] - 3.2}.
m Copper guideline = 2 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–120 $mg \cdot L^{-1}$
= 3 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 4 $\mu g \cdot L^{-1}$ at [CaCO3] >180 $mg \cdot L^{-1}$
o Lead guideline = 1 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–60 $mg \cdot L^{-1}$
= 2 $\mu g \cdot L^{-1}$ at [CaCO3] = 60–120 $mg \cdot L^{-1}$
= 4 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 7 $\mu g \cdot L^{-1}$ at [CaCO3] = >180 $mg \cdot L^{-1}$
p Nickel guideline = 25 $\mu g \cdot L^{-1}$ at [CaCO3] = 0–60 $mg \cdot L^{-1}$
= 65 $\mu g \cdot L^{-1}$ at [CaCO3] = 60–120 $mg \cdot L^{-1}$
= 110 $\mu g \cdot L^{-1}$ at [CaCO3] = 120–180 $mg \cdot L^{-1}$
= 150 $\mu g \cdot L^{-1}$ at [CaCO3] = >180 $mg \cdot L^{-1}$
w May not protect fully higher trophic level fish; see factsheet for details.
x Canadian Trigger Ranges (for further narrative see factsheet), Total Phosphorus ($ug \cdot .L^{-1}$):
ultra-oligotrophic <4
oligotrophic 4-10
mesotrophic 10-20
meso-eutrophic 20-35
eutrophic 35-100
hyper-eutrophic >100

Table 7.6-B-3 Reportable Detection Limits (RDLs) for Total Metals

		Reportable Detection Limit (RDL)		
	Date Sampled	**2007**	**27-Mar-08**	**15-AUG-08**
PARAMETER				
	Units			
Physical Tests				
Dissolved Hardness (CaCO3)	mg/L	0.5		
Hardness (as CaCO3)	mg/L	0.5	0.5	0.7
Conductivity	µS/cm	1	2	2
pH	pH Units	0.1	0.01	0.01
Total Metals				
Aluminum (Al)-Total	mg/L		0.001	0.001
Antimony (Sb)-Total	mg/L		0.00005	0.00005
Arsenic (As)-Total	mg/L		0.00003	0.00010
Barium (Ba)-Total	mg/L		0.00005	0.00005
Beryllium (Be)-Total	mg/L		0.0002	0.0002
Bismuth (Bi)-Total	mg/L		0.0005	0.0005
Boron (B)-Total	mg/L		0.001	0.001
Cadmium (Cd)-Total	mg/L		0.000017	0.000017
Calcium (Ca)-Total	mg/L			0.02
Chromium (Cr)-Total	mg/L		0.0001	0.002
Cobalt (Co)-Total	mg/L		0.0001	0.0001
Copper (Cu)-Total	mg/L		0.0001	0.0001
Iron (Fe)-Total	mg/L		0.01	0.01
Lead (Pb)-Total	mg/L		0.00005	0.00005
Lithium (Li)-Total	mg/L		0.005	0.005
Magnesium (Mg)- Total	mg/L			0.005
Manganese (Mn)-Total	mg/L		0.00005	0.00005
Mercury (Hg)-Total	mg/L		0.00001	0.00001
Molybdenum (Mo)-Total	mg/L		0.00005	0.00005
Nickel (Ni)-Total	mg/L		0.0001	0.0001
Phosphorus (P)-Total	mg/L		0.3	0.3
Potassium (K)-Total	mg/L		0.05	0.05
Selenium (Se)-Total	mg/L		0.0001	0.001
Silicon (Si)-Total	mg/L		0.05	0.05
Silver (Ag)-Total	mg/L		0.00001	0.00001
Sodium (Na)-Total	mg/L		0.01	0.01 - 2
Strontium (Sr)-Total	mg/L		0.0001	0.0001
Thallium (Tl)-Total	mg/L		0.00005	0.00005
Tin (Sn)-Total	mg/L		0.0001	0.0001
Titanium (Ti)-Total	mg/L		0.01	0.01
Uranium (U)-Total	mg/L		0.00001	0.0001
Vanadium (V)-Total	mg/L		0.00005	0.001
Zinc (Zn)-Total	mg/L		0.001	0.001

APPENDIX 7.6-C

Detailed Groundwater Quality Results – Dissolved Metals

Table 7.6-C-1 Dissolved Metals Groundwater Water Quality Parameters Measured in Limestone

	SAMPLE ID	LM	LM2	LM2 Duplicate	HG-3 LS	HG-7 LS	HG-7 LS	LIMESTONE AVERAGE [1]	LIMESTONE MAXIMUM [1]	LIMESTONE MINIMUM [1]	REGULATIONS				
	Date Sampled	3-Mar-07	3-Mar-07	3-Mar-07	15-AUG-08	15-AUG-08	15-AUG-08	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
												TIER III - Water Quality Guidelines			
PARAMETER	Lab Sample ID				L672682-1	L672682-3	L672682-6				TIER II Water Quality Objectives	Drinking			Freshwater
	Units				Water	Water	Water					MAC	IMAC	AO	
Physical Tests															
Dissolved Hardness (CaCO3)	mg/L	285	290	297				291	297	285					
Hardness (as CaCO3)	mg/L	287	307	304	242	287	271	283	307	242					
Dissolved Elements															
Aluminum (Al)-Dissolved	mg/L	<0.0002	0.0007	0.0005	<0.0010	<0.0010	0.0215	0.00397	0.0215	0.0001					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	0.00045	0.00033	0.00035	<0.000050	<0.000050	<0.000050	0.00020	0.00045	0.000025			0.006		
Arsenic (As)-Dissolved	mg/L	0.0003	0.0009	0.0008	0.0011	0.000988	0.00122	0.00088	0.00122	0.0003	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.111	0.0898	0.0904	0.07	0.0743	0.0542	0.0816	0.1110	0.0542		1			
Beryllium (Be)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00020	<0.00020	<0.00020	0.00006	0.00010	0.00003					
Bismuth (Bi)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	0.00014	0.00025	0.00003					
Boron (B)-Dissolved	mg/L	0.199	0.172	0.169	0.166	0.0986	0.102	0.1511	0.199	0.0986			5		
Cadmium (Cd)-Dissolved	mg/L	0.00003	0.00003	0.00002	<0.000017	<0.000017	<0.000017	0.00002	0.00003	0.0000057	Hardness dependent [B] (e.g. 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	54.2	55.5	56.7	46.2	53.5	23.9	48.3	56.7	23.9					
Cesium (Cs) - Dissolved	mg/L	0.00003	<0.00003	<0.00003				0.00002	0.00003	0.000015					
Chromium (Cr)-Dissolved	mg/L	<0.0002	<0.0002	<0.0002	<0.0020	<0.0020	<0.00070	0.00046	0.001	0.0001	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	0.00075	0.00069	0.00078	0.00016	<0.00010	<0.00010	0.00041	0.00078	0.00005					
Copper (Cu)-Dissolved	mg/L	<0.0001	<0.0001	<0.0001	0.00092	0.00049	0.00033	0.000315	0.00092	0.00005	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.011	0.049	0.031	<0.010	<0.010	<0.010	0.018	0.049	0.005				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	<0.00002	0.00161	0.00378	<0.000050	<0.000050	<0.000050	0.00091	0.00378	0.00001	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	0.0299	0.0253	0.0256	0.0265	0.0163	0.0157	0.0232	0.0299	0.0157					
Magnesium (Mg)-Dissolved	mg/L	36.4	36.9	37.6	31.7	33.6	32.1	34.7	37.6	31.7					
Manganese (Mn)-Dissolved	mg/L	**0.0824**	**0.0631**	**0.0659**	0.00815	0.00489	0.000318	0.0375	**0.0824**	0.000318				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.000010	<0.000010	<0.000010	0.000015	0.000025	0.000005		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.00320	0.00220	0.00222	0.000418	0.00051	0.000525	0.001512	0.003200	0.000418					0.073
Nickel (Ni)-Dissolved	mg/L	0.0023	0.0017	0.0017	0.00112	0.00114	0.00075	0.00145	0.00230	0.00075	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	<0.1	<0.1	<0.1	<0.30	<0.30	<0.30	0.1	0.15	0.05					
Phosphorus (P) - Dissolved by SM 4500 PF Method	mg/L	0.018	0.005	0.005				0.009	0.018	0.005					
Potassium (K)-Dissolved	mg/L	6.88	6.02	5.91	8.03	4.18	4.36	5.90	8.03	4.18					
Rubidium (Rb) - Dissolved	mg/L	0.00293	0.00252	0.00255				0.00267	0.00293	0.00252					
Selenium (Se)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	0.0001	0.00013	<0.0010	0.0002	0.0005	0.0001		0.01			0.001
Silicon (Si)-Dissolved	mg/L	4.97	5.14	5.24	5.08	5.04	5.04	5.09	5.24	4.97					
Silver (Ag)-Dissolved	mg/L	0.00002	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	0.0000075	0.00002	0.000005					0.0001
Sodium (Na)-Dissolved	mg/L	38.7	32.0	32.2	33.8	20.6	22.3	29.9	38.7	20.6				≤200	
Strontium (Sr)-Dissolved	mg/L	0.328	0.310	0.316	0.281	0.217	0.191	0.274	0.328	0.191		5 Bq/L			
Sulphur (S) - Dissolved	mg/L	5.8	4.7	4.7				5.1	5.8	4.7					
Tellurium (Te) - Dissolved	mg/L	<0.001	<0.001	<0.001				0.0005	0.0005	0.0005					
Thallium (Tl)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	0.000025	0.000025	0.000025					0.0008
Tin (Sn)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	0.0000375	0.00005	0.000025					
Titanium (Ti)-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.010	<0.010	<0.010	0.002625	0.005	0.00025					
Tungsten (W) - Dissolved	mg/L	0.00217	0.00122	0.00137				0.00159	0.00217	0.00122					
Uranium (U)-Dissolved	mg/L	0.00052	0.00047	0.00050	0.000279	0.000591	0.000542	0.00048	0.000591	0.000279			0.02		
Vanadium (V)-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.0010	<0.0010	<0.0010	0.000263	0.0005	0.000025					
Zinc (Zn)-Dissolved	mg/L	**0.611**	**0.649**	**0.591**	<0.0010	0.001	0.0026	**0.3092**	**0.6490**	0.0005	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II
Zirconium (Zr) - Dissolved	mg/L	<0.005	<0.005	<0.005				0.0025	0.0025	0.0025					

Notes:

1 If a reported concentration was below the detection limit, half the detection limit was used for the calculations.

MAC - Maximum Acceptable Concentration

IMAC - InterimMaximum Acceptable Concentration

AO - Aesthetic Objectives

FDA = field duplicate (split sample) available

FD = field duplicate

0.611 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

Table 7.6-C-2 Dissolved Metals Groundwater Water Quality Parameters Measured in Sandstone

	SAMPLE ID	SS	SS-2	HG-3 SS	HG-3 SS	HG-7 SS	SANDSTONE AVERAGE [1]	SANDSTONE MAXIMUM [1]	SANDSTONE MINIIMUM [1]	REGULATIONS				
	Date Sampled	7-Mar-07	7-Mar-07	15-AUG-08	15-AUG-08	15-AUG-08	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)				
				FDA	FD						TIER III - Water Quality Guidelines			
PARAMETER	Lab Sample ID			L672682-2	L672682-5	L672682-4				TIER II Water Quality Objectives	Drinking			
	Units			Water	Water	Water					MAC	IMAC	AO	Freshwater
Physical Tests														
Dissolved Hardness (CaCO3)	mg/L	287	285				286	287	285					
Hardness (as CaCO3)	mg/L	294	293	167	165	257	235	294	165					
Dissolved Elements														
Aluminum (Al)-Dissolved	mg/L	<0.0002	0.0006	<0.0010	0.0344	<0.0010	0.00722	0.0344	0.0005					0.005 - 0.1
Antimony (Sb)-Dissolved	mg/L	0.00060	0.00022	<0.000050	<0.000050	<0.000050	0.000179	0.0006	0.000025			0.006		
Arsenic (As)-Dissolved	mg/L	0.0004	0.0021	0.000218	0.000227	0.000162	0.0006214	0.0021	0.000162	0.15 mg/L (4-Day, 3-Year) [A]		0.025		Tier II
Barium (Ba)-Dissolved	mg/L	0.0753	0.0839	0.0473	0.0474	0.0631	0.0634	0.0839	0.0473		1			
Beryllium (Be)-Dissolved	mg/L	<0.00005	<0.00005	<0.00020	<0.00020	<0.00020	0.00007	0.0001	0.000025					
Bismuth (Bi)-Dissolved	mg/L	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	0.00016	0.00025	0.000025					
Boron (B)-Dissolved	mg/L	0.200	0.207	0.361	0.347	0.171	0.2572	0.361	0.171			5		
Cadmium (Cd)-Dissolved	mg/L	0.00002	<0.00001	<0.000017	<0.000017	<0.000017	0.00001	0.00002	0.000005	Hardness dependent [B] (e.g., 0.00163 mg/L chronic; 0.00267 mg/L acute at hardness 65 mg/L $CaCO_3$)	0.005			Tier II
Calcium (Ca)-Dissolved	mg/L	55.0	55.1	31.4	30.4	49.9	44.4	55.1	30.4					
Cesium (Cs) - Dissolved	mg/L	<0.00003	<0.00003				0.000015	0.000015	0.000015					
Chromium (Cr)-Dissolved	mg/L	<0.0002	<0.0002	0.00107	0.00092	<0.0020	0.000638	0.00107	0.0001	Hardness dependent [C] (e.g.,0.052 mg/L Cr-III chronic at hardness 65 mg/L; 0.011 mg/L Cr-VI 4-Day, 3-Year)	0.05			Tier II
Cobalt (Co)-Dissolved	mg/L	0.00036	0.00035	<0.00010	<0.00010	0.00014	0.00019	0.00036	0.00005					
Copper (Cu)-Dissolved	mg/L	<0.0001	<0.0001	0.00021	0.00034	0.00055	0.00024	0.00055	0.00005	Hardness dependent [D] (e.g.,0.0062 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤1.0	Tier II
Iron (Fe)-Dissolved	mg/L	0.093	0.085	<0.010	<0.010	<0.010	0.0386	0.093	0.005				≤0.3	0.3
Lead (Pb)-Dissolved	mg/L	0.00003	0.00005	<0.000050	0.000074	<0.000050	0.0000408	0.000074	0.000025	Hardness dependent [E] (e.g., 0.00157 mg/L chronic at hardness 65 mg/L $CaCO_3$)	0.01			Tier II
Lithium (Li)-Dissolved	mg/L	0.0290	0.0285	0.0413	0.0405	0.0265	0.03316	0.0413	0.0265					
Magnesium (Mg)-Dissolved	mg/L	36.3	35.7	20.4	19.9	29.7	28.4	36.3	19.9					
Manganese (Mn)-Dissolved	mg/L	**0.0965**	0.0216	0.00741	0.00734	0.0111	0.02879	**0.09650**	0.00734				≤0.05	
Mercury (Hg)-Dissolved	mg/L	<0.00005	<0.00005	<0.000010	<0.000010	<0.000010	0.00001	0.00003	0.00001		0.001			0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.00242	0.00139	0.00112	0.0011	0.00108	0.00142	0.00242	0.00108					0.073
Nickel (Ni)-Dissolved	mg/L	0.0019	0.0020	0.00033	<0.00010	0.0012	0.00110	0.00200	0.00005	Hardness dependent [F] (e.g., 0.036 mg/L chronic at hardness 65 mg/L $CaCO_3$)				Tier II
Phosphorus (P)-Dissolved	mg/L	<0.1	<0.1	<0.30	<0.30	<0.30	0.11	0.15	0.05					
Phosphorus (P) - Dissolved by SM 4500 PF Method	mg/L	0.010	0.004				0.007	0.01	0.004					
Potassium (K)-Dissolved	mg/L	6.15	6.05	9.17	8.84	5.48	7.138	9.17	5.48					
Rubidium (Rb) - Dissolved	mg/L	0.00285	0.00246				0.00266	0.00285	0.00246					
Selenium (Se)-Dissolved	mg/L	<0.0005	<0.0005	<0.00010	0.00012	0.00011	0.00016	0.00025	0.00005		0.01			0.001
Silicon (Si)-Dissolved	mg/L	5.00	5.73	4.24	4.25	4.33	4.71	5.73	4.24					
Silver (Ag)-Dissolved	mg/L	<0.00001	0.00004	<0.000010	<0.000010	<0.000010	0.00001	0.00004	0.000005					0.0001
Sodium (Na)-Dissolved	mg/L	42.2	41.7	85	86.9	34.4	58.0	86.9	34.4				≤200	
Strontium (Sr)-Dissolved	mg/L	0.324	0.336	0.386	0.377	0.316	0.3478	0.386	0.316		5 Bq/L			
Sulphur (S) - Dissolved	mg/L	5.3	5.0				5.15	5.3	5					
Tellurium (Te) - Dissolved	mg/L	<0.001	<0.001				0.0005	0.0005	0.0005					
Thallium (Tl)-Dissolved	mg/L	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	0.000025	0.000025	0.000025					0.0008
Tin (Sn)-Dissolved	mg/L	0.00005	0.00005	<0.00010	<0.00010	<0.00010	0.00005	0.00005	0.00005					
Titanium (Ti)-Dissolved	mg/L	<0.0005	<0.0005	<0.010	<0.010	<0.010	0.0031	0.005	0.00025					
Tungsten (W) - Dissolved	mg/L	0.00129	0.00115				0.00122	0.00129	0.00115					
Uranium (U)-Dissolved	mg/L	0.00038	0.00047	0.000168	0.000166	0.000996	0.000436	0.000996	0.000166			0.02		
Vanadium (V)-Dissolved	mg/L	<0.00005	<0.00005	<0.000050	0.000082	<0.0010	0.00013	0.00050	0.00003					
Zinc (Zn)-Dissolved	mg/L	**2.54**	0.0054	0.0127	0.0201	0.0038	**0.52**	**2.54**	0.004	Hardness dependent [G] (e.g., 0.082 mg/L chronic at hardness 65 mg/L $CaCO_3$)			≤5	Tier II
Zirconium (Zr) - Dissolved	mg/L	<0.005	<0.005				0.0025	0.0025	0.0025					

Notes:

1 If a reported concentration was below the detection limit, half the detection limit was used for the calculations.

MAC - Maximum Acceptable Concentration

IMAC - InterimMaximum Acceptable Concentration

AO - Aesthetic Objectives

FDA = field duplicate (split sample) available

FD = field duplicate

2.54 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

NOTES:

A	Arsenic limits:	0.15 mg/L for averaging duration 4 days (4-Day, 3-Year or 7Q10 Design Flow); 0.34 mg/L for averaging duration 1 hr (1-Day, 3-Year or 1Q10 Design Flow)
B	Cadmium limits:	[e{0.7852[ln(Hardness)]-2.715}]×[1.101672-{ln(Hardness)(0.041838)}] for 4 days averaging duration. [e{1.128[ln(Hardness)]-3.6867}]×[1.136672-{ln(Hardness)(0.041838)}] for 1 hour averaging duration.
C	Chromium limits:	Chromium III: [e{0.8190[ln(Hardness)]+0.6848}]×[0.860] for 4 days averaging duration. Chromium III: [e{0.8190[ln(Hardness)]+3.7256}]×[0.316] for 1 hour averaging duration. Chromium VI: 0.011 mg/L for averaging duration 4 days (4-Day, 3-Year or 7Q10 Design Flow); 0.016 mg/L for averaging duration 1 hr (1-Day, 3-Year or 1Q10 Design Flow)
D	Copper limits:	[e{0.8545[ln(Hardness)]-1.702}]×[0.960] for 4 Days hour averaging duration. [e{0.9422[ln(Hardness)]-1.700}]×[0.960] for 1 hour averaging duration.
E	Lead limits:	[e{1.273[ln(Hardness)]-4,705}]×[1.46203 -{ln(Hardness)(0.145712)}] for 4 Days averaging duration. [e{1.273[ln(Hardness)]-1.460}]×[1.46203 -{ln(Hardness)(0.145712)}] for 1 hour averaging duration.
F	Nickel limits:	[e{0.8460[ln(Hardness)]+0.0584}]×[0.997] for 4 Days averaging duration. [e{0.8460[ln(Hardness)]+2.255}]×[0.998] for 1 hour averaging duration.
G	Zinc limits:	[e{0.8473[ln(Hardness)]+0.884}]×[0.976] for 4 Days averaging duration. [e{0.8473[ln(Hardness)]+0.884}]×[0.978] for 1 hour averaging duration.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

Table 7.6-C-3 Reportable Detection Limits (RDLs) for Dissolved Metals Water Quality Parameters

PARAMETER	Unit	Reportable Detection Limit (RDL)		
		2007	27-Mar-08	15-AUG-08
Physical Tests				
Dissolved Hardness (CaCO3)	mg/L	0.5		
Hardness (as CaCO3)	mg/L	0.5	0.5	0.7
Conductivity	µS/cm	1	2	2
pH	pH Units	0.1	0.01	0.01
Dissolved Elements				
Aluminum (Al)-Dissolved	mg/L	0.0002	0.001	0.001
Antimony (Sb)-Dissolved	mg/L	0.00005	0.00005	0.00005
Arsenic (As)-Dissolved	mg/L	0.0001	0.00003	0.00003
Barium (Ba)-Dissolved	mg/L	0.00002	0.00005	0.00005
Beryllium (Be)-Dissolved	mg/L	0.00005	0.0002	0.0002
Bismuth (Bi)-Dissolved	mg/L	0.00005	0.0005	0.0005
Boron (B)-Dissolved	mg/L	0.008	0.001	0.001
Cadmium (Cd)-Dissolved	mg/L	0.00001	0.000017	0.000017
Calcium (Ca)-Dissolved	mg/L	0.05	0.02	0.02
Cesium (Cs) - Dissolved	mg/L	0.00003		
Chromium (Cr)-Dissolved	mg/L	0.0002	0.0001	0.002
Cobalt (Co)-Dissolved	mg/L	0.00002	0.0001	0.0001
Copper (Cu)-Dissolved	mg/L	0.0001	0.0001	0.0001
Iron (Fe)-Dissolved	mg/L	0.005	0.01	0.01
Lead (Pb)-Dissolved	mg/L	0.00002	0.00005	0.00005
Lithium (Li)-Dissolved	mg/L	0.0002	0.005	0.005
Magnesium (Mg)-Dissolved	mg/L	0.05	0.005	0.005
Manganese (Mn)-Dissolved	mg/L	0.00002	0.00005	0.00005
Mercury (Hg)-Dissolved	mg/L	0.00005	0.00001	0.00001
Molybdenum (Mo)-Dissolved	mg/L	0.00002	0.00005	0.00005
Nickel (Ni)-Dissolved	mg/L	0.0005	0.0001	0.0001
Phosphorus (P)-Dissolved	mg/L	0.1	0.3	0.3
Phosphorus (P) - Dissolved by SM 4500 PF Method	mg/L	0.002		
Potassium (K)-Dissolved	mg/L	0.05	0.05	0.05
Rubidium (Rb) - Dissolved	mg/L	0.00008		
Selenium (Se)-Dissolved	mg/L	0.0005	0.0001	0.0001
Silicon (Si)-Dissolved	mg/L	0.05	0.05	0.05
Silver (Ag)-Dissolved	mg/L	0.00001	0.00001	0.00001
Sodium (Na)-Dissolved	mg/L	0.05	0.1	0.01
Strontium (Sr)-Dissolved	mg/L	0.00001	0.0001	0.0001
Sulphur (S) - Dissolved	mg/L	0.1		
Tellurium (Te) - Dissolved	mg/L	0.001		
Thallium (Tl)-Dissolved	mg/L	0.00005	0.00005	0.00005
Tin (Sn)-Dissolved	mg/L	0.00005	0.0001	0.0001
Titanium (Ti)-Dissolved	mg/L	0.0005	0.01	0.01
Tungsten (W) - Dissolved	mg/L	0.00007		
Uranium (U)-Dissolved	mg/L	0.00001	0.00001	0.00001
Vanadium (V)-Dissolved	mg/L	0.00005	0.00005	0.001
Zinc (Zn)-Dissolved	mg/L	0.0005	0.001	0.001
Zirconium (Zr) - Dissolved	mg/L	0.005		

APPENDIX 7.6-D

Detailed Groundwater Quality Results – Other Parameters

Table 7.6-D-1 Other Groundwater Water Quality Parameters in Limestone Measured at Minago

											REGULATIONS							
	SAMPLE ID	LM	LM2	LM2 Duplicate	HG-3 LS	HG-7 LS	HG-7 LS	LIMESTONE AVERAGE [1]	LIMESTONE MAXIMUM [1]	LIMESTONE MINIMUM [1]	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)					Canadian Water Quality Guidelines for the Protection of Aquatic Life	Metal Mining Liquid Effluents (2002)	
	Date Sampled	3-Mar-07	3-Mar-07	3-Mar-07	15-AUG-08	15-AUG-08	15-AUG-08	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008		TIER III - Water Quality Guidelines						
	Time Sampled					FDA	FD					Drinking						
PARAMETER	Lab Sample ID				L672682-1	L672682-3	L672682-6				TIER II Water Quality Objectives	MAC	IMAC	AO	Freshwater	(CCME, 2007)	Monthly Mean	Grab Sample
	Units				Water	Water	Water											
Field-Measured Parameters																		
Conductivity	µS/cm				443	451	451	448	451	443	1000							
Dissolved Oxygen	mg/L				2.3	8	8	6.2	8.0	2.5	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)							
Iron II	mg/L				0.6	0.3	0.3	0.4	0.6	0.3					0.3	0.3[d]		
pH	pH units				7.49	7.44	7.44	7.46	7.49	7.44				6.5-8.5		6.5-9		
Redox	mV				31	51	51	44.3	51	31								
Temperature	°C				5.5	6.1	6.1	5.9	6.1	5.5								
Physical Tests																		
Dissolved Hardness (CaCO3)	mg/L	285	290	297				291	297	285								
Hardness (as CaCO3)	mg/L	287	307	304	242	287	271	283	307	242								
Conductivity	µS/cm	682	675	672	606	610	611	643	682	606	1000							
pH	pH Units	8.2	8.1	8.2	8.05	8.04	8.12	8.12	8.2	8.04				6.5-8.5		6.5-9	6-9.5	6-9.5
Total Dissolved Solids	mg/L	372	362	366	335	284	344	344	372	284	700			≤500				
Total Suspended Solids					4.6	<3.0	7.9	4.7	7.9	1.5	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)				Tier II	narrative	15	30
Turbidity (NTU)	NTU	54.4	69.8	54.7	12.3	4.82	6	33.7	69.8	4.82		1.0		≤5.0	Tier II	narrative		
Colour, True					7.9	5.7	5.6	6.4	7.9	5.6								
Anions and Nutrients																		
Ammonia as N	mg/L	0.103	0.087	0.085	0.143	0.058	0.06	0.089	0.143	0.058	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)				Tier II	see factsheet		
Alkalinity, Total (as CaCO3)	mg/L	336	342	342	300	301	318	323	342	300								
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	<0.5				0.25	0.25	0.25								
Bicarbonate (HCO3)	mg/L	410	417	418				415	418	410								
Alkalinity, Carbonate (as CaCO3)	mg/L	<0.5	<0.5	<0.5				0.25	0.25	0.25								
Alkalinity, Hydroxide (as CaCO3)	mg/L	<0.5	<0.5	<0.5				0.25	0.25	0.25								
Chloride (Cl)	mg/L	17.8	15.4	12.9	11.9	9.82	9.82	12.9	17.8	9.8				≤250				
Fluoride (F)	mg/L	0.41	0.36	0.35	0.301	0.244	0.248	0.32	0.41	0.244		1.5				0.12[c]		
Sulfate (SO4)	mg/L	13.3	11.7	11.7	12.9	16.4	16.4	13.7	16.4	11.7				≤500				
Nitrate (as N)	mg/L	0.008	0.005	0.003	<0.0050	<0.0050	<0.0050	0.0039	0.008	0.0025		10				2.93 [c,u]		
Nitrite (as N)	mg/L	0.005	0.005	0.002	<0.0010	<0.0010	<0.0010	0.0023	0.005	0.0005		0.97			CCME	0.06 [z]		
Nitrate plus Nitrite (as N)	mg/L	0.013	0.010	0.005				0.009	0.013	0.005	10							
Total Kjeldahl Nitrogen	mg/L	0.26	0.26	0.27	0.163	0.094	0.094	0.190	0.270	0.094								
Total Nitrogen	mg/L	0.27	0.27	0.28				0.273	0.280	0.270								
Calcium (Ca)-Total	mg/L	55.7	59.7	59.0				58.1	59.7	55.7								
Magnesium (Mg)-Total	mg/L	35.9	38.4	38.2				37.5	38.4	35.9								
Radiological Parameters																		
Radium-226	Bq/L	0.11	0.04	0.06				0.07	0.11	0.04		0.6					0.37	1.11
XNo class																		
Total Organic Carbon					3.11	2.19	2.19	2.50	3.11	2.19								
Cyanides																		
Cyanide, Weak Acid Diss					<0.0050	<0.0050	<0.0050	0.0025	0.0025	0.0025	0.0052 mg/L (4-Day, 3-Year)				Tier II	0.005 (as free CN)		

Notes:

1 If a reported concentration was below the detection limit, half the detection limit was used for the calculations.

MAC - Maximum Acceptable Concentration

IMAC - Interim Maximum Acceptable Concentration

AO - Aesthetic Objectives

FDA = field duplicate (split sample) available

FD = field duplicate

33.7 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

Table 7.6-D-2 Other Groundwater Water Quality Parameters in Sandstone Measured at Minago

		SS	SS-2	HG-3 SS	HG-3 SS	HG-7 SS				REGULATIONS							
	SAMPLE ID	7-Mar-07	7-Mar-07	15-AUG-08	15-AUG-08	15-AUG-08	SANDSTONE AVERAGE [1]	SANDSTONE MAXIMUM [1]	SANDSTONE MINIIMUM [1]	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)					Canadian Water Quality Guidelines for the Protection of Aquatic Life	Metal Mining Liquid Effluents (2002)	
	Date Sampled						Mar-2007 & Aug-2008	Mar-2007 & Aug-2008	Mar-2007 & Aug-2008								
	Time Sampled			FDA	FD						TIER III - Water Quality Guidelines						
PARAMETER	Lab Sample ID			L672682-2	L672682-5	L672682-4					Drinking						
	Units			Water	Water	Water				TIER II Water Quality Objectives	MAC	IMAC	AO	Freshwater	(CCME, 2007)	Monthly Mean	Grab Sample
Field-Measured Parameters																	
Conductivity	µS/cm			504	504	451	486	504	451.0	1000							
Dissolved Oxygen	mg/L			2	2	3	2.3	3	2	varies with life-stages & temperature; 6.5 mg/L (30-Day, 3-Year if temp. > 5°C); Instantaneous Minimum 5 mg/L (if T>5°C)							
Iron II	mg/L			0.3	0.3	0.2	0.27	0.3	0.2					0.3	0.3[d]		
pH	pH units			7.61	7.61	7.47	7.56	7.61	7.47				6.5-8.5		6.5-9		
Redox	mV			51	51	37	46.3	51.0	37.0								
Temperature	°C			6.2	6.2	7	6.5	7.0	6.2								
Physical Tests																	
Dissolved Hardness (CaCO3)	mg/L	287	285				286	287	285								
Hardness (as CaCO3)	mg/L	294	293	167	165	257	235	294	165								
Conductivity	µS/cm	688	677	683	684	633	673	688	633	1000							
pH	pH Units	8.1	8.1	8.17	8.18	8.05	8.12	8.18	8.05				6.5-8.5		6.5-9	6-9.5	6-9.5
Total Dissolved Solids	mg/L	364	354	390	388	351	369.4	390	351	700			≤500				
Total Suspended Solids				<3.0	<3.0	<3.0	1.5	1.5	1.5	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)				Tier II	narrative	15	30
Turbidity (NTU)	NTU	77.6	23.0	1.02	1.28	1.93	21.0	77.6	1.02		1.0		≤5.0	Tier II	narrative		
Colour, True				<5.0	<5.0	5.1	5.1	5.1	5.1								
Anions and Nutrients																	
Ammonia as N	mg/L	0.10	0.08	0.207	0.265	0.104	0.151	0.265	0.080	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)				Tier II	see factsheet		
Alkalinity, Total (as CaCO3)	mg/L	344	340	305	312	294	319	344	294								
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5				0.25	0.25	0.25								
Bicarbonate (HCO3)	mg/L	420	414				417	420	414								
Alkalinity, Carbonate (as CaCO3)	mg/L	<0.5	<0.5				0.25	0.25	0.25								
Alkalinity, Hydroxide (as CaCO3)	mg/L	<0.5	<0.5				0.25	0.25	0.25								
Chloride (Cl)	mg/L	15.4	14.2	23.9	23.8	18.9	19.2	23.9	14.2				≤250				
Fluoride (F)	mg/L	0.36	0.36	0.698	0.689	0.401	0.50	0.70	0.36		1.5				0.12[c]		
Sulfate (SO4)	mg/L	14.2	14.3	27.7	27.6	22.2	21.2	27.7	14.3				≤500				
Nitrate (as N)	mg/L	<0.002	0.003	<0.0050	<0.0050	<0.0050	0.0023	0.003	0.0025		10				2.93 [c,u]		
Nitrite (as N)	mg/L	0.003	<0.002	<0.0010	<0.0010	<0.0010	0.0011	0.003	0.0005		0.97			CCME	0.06 [z]		
Nitrate plus Nitrite (as N)	mg/L	<0.002	0.003				0.002	0.003	0.003	10							
Total Kjeldahl Nitrogen	mg/L	0.21	0.23	0.189	0.224	0.139	0.198	0.230	0.139								
Total Nitrogen	mg/L	0.21	0.23				0.220	0.230	0.230								
Calcium (Ca)-Total	mg/L	56.7	56.8				56.8	56.8	56.8								
Magnesium (Mg)-Total	mg/L	37.1	36.8				37.0	37.1	36.8								
Radiological Parameters																	
Radium-226	Bq/L	0.02	0.01				0.015	0.02	0.01		0.6					0.37	1.11
XNo class																	
Total Organic Carbon				0.82	0.81	1.17	0.93	1.17	0.81								
Cyanides																	
Cyanide, Weak Acid Diss				<0.0050	<0.0050	<0.0050	0.0025	0.0025	0.0025	0.0052 mg/L (4-Day, 3-Year)				Tier II	0.005 (as free CN)		

Notes:

1 If a reported concentration was below the detection limit, half the detection limit was used for the calculations.

MAC - Maximum Acceptable Concentration

IMAC - InterimMaximum Acceptable Concentration

AO - Aesthetic Objectives

FDA = field duplicate (split sample) available

FD = field duplicate

77.6 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

Table 7.6-D-3 Other Groundwater Water Quality Parameters Measured at Various Minago Locations

								REGULATIONS						
	SAMPLE ID	OB	OB2	MW-SLS-5	RG	GR	MW-GR-5	Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson, 2002)					Canadian Water Quality Guidelines for the	Metal Mining Liquid Effluents
	Date Sampled	1-Mar-07	1-Mar-07	27-Mar-08	13-Mar-07	14-Mar-07	27-Mar-08							(2002)
	Time Sampled			10:00			08:30		TIER III - Water Quality Guidelines				Protection of Aquatic Life	
PARAMETER	Lab Sample ID			L614153-2			L614153-1		Drinking					
	Units							TIER II Water Quality Objectives	MAC	IMAC	AO	Freshwater	(CCME, 2007)	Monthly Mean / Grab Sample
Field-Measured Parameters														
Iron II	mg/L											0.3	0.3[d]	
pH	pH units			8.35			7.94				6.5-8.5		6.5-9	
Temperature	°C			1.74			1.8							
Physical Tests														
Dissolved Hardness (CaCO3)	mg/L	274	231		not measured	not measured								
Hardness (as CaCO3)	mg/L	471	277	192	171	194	220							
Conductivity	µS/cm	539	461	765	628	**3770**	743	1000						
pH	pH Units	8.0	7.8	7.97	8.6	8.8	8.21				6.5-8.5		6.5-9	6-9.5 / 6-9.5
Total Dissolved Solids	mg/L	378	314	362	354	**2370**	413	700			≤500			
Total Suspended Solids				**10700**			**117**	Dependent on background TSS (5 mg/L (30-Day, 3 Year) or 25 mg/L (1-Day, 3-Year) or 10% (1-Day, 3-Year) of induced change from background)				Tier II	narrative	15 / 30
Turbidity (NTU)	NTU	**1450**	**131**	**>4000**	**51.9**	**1760**	**89.8**		1.0		≤5.0	Tier II	narrative	
Anions and Nutrients														
Ammonia as N	mg/L	<0.005	<0.005	0.134	0.154	0.493	0.149	pH and temperature dependent (lowest concentration for all categories = 1.17 mg/L for pH 7.8)				Tier II	see factsheet	
Acidity (as CaCO3)				4.7			1.9							
Alkalinity, Total (as CaCO3)	mg/L	289	250	292	277	284	330							
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5		8.7	19.5								
Bicarbonate (HCO3)	mg/L	352	305		317	298								
Alkalinity, Bicarbonate (as CaCO3)				292			330							
Alkalinity, Carbonate (as CaCO3)	mg/L	<0.5	<0.5	<1.0	10.4	23.4	<1.0							
Alkalinity, Hydroxide (as CaCO3)	mg/L	<0.5	<0.5	<1.0	<0.5	<0.5	<1.0							
Bromide (Br)				<0.050			0.102							
Chloride (Cl)	mg/L	0.6	<0.5	27.5	24.3	**610**	30.8				≤250			
Fluoride (F)	mg/L	0.11	0.10	**0.337**	**0.59**	**5.91**	**0.955**		1.5				0.12[c]	
Sulfate (SO4)	mg/L	9.2	<0.5	105	33.1	**667**	35.8				≤500			
Nitrate (as N)	mg/L	0.008	0.009	1.53	0.051	0.078	0.91		10				2.93 [c,u]	
Nitrite (as N)	mg/L	0.011	0.005	0.12	**0.074**	0.043	**0.13**		0.97			CCME	0.06[z]	
Nitrate plus Nitrite (as N)	mg/L	0.019	0.014		0.125	0.121		10						
Total Kjeldahl Nitrogen	mg/L	0.90	0.93	13	0.15	0.97	0.211							
Total Nitrogen	mg/L	0.92	0.94	14.7	0.27	1.10	1.24							
Calcium (Ca)-Total	mg/L	113	70.2	-	25.5	20.4	-							
Magnesium (Mg)-Total	mg/L	45.7	24.7	-	26.2	34.6	-							
Radiological Parameters														
Radium-226	Bq/L	0.06	0.007		0.20	0.23			0.6					0.37 / 1.11
XNo class														
Dissolved Organic Carbon	mg/L			3.56			2.39							
Cyanides														
Cyanide, Weak Acid Diss	mg/L			<0.0050			<0.0050	0.0052 mg/L (4-Day, 3-Year)				Tier II	0.005 (as free CN)	

Notes:

MAC - Maximum Acceptable Concentration
IMAC - Interim Maximum Acceptable Concentration
AO - Aesthetic Objectives

117 BOLD AND UNDERLINED NUMBER IS EXCEEDING GUIDELINE VALUE.

References:

Williamson, D. 2002. Manitoba Water Quality Standards, Objectives, and Guidelines. Manitoba Conservation Report 2002-11, Water Quality Management Section, Water Branch, Manitoba Conservation, Winnipeg, MB.

ADDITIONAL NOTES:

Footnotes for the CCME Aquatic

c Interim guideline.
d No fact sheet created.
u For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.
z Guideline is expressed as µg nitrite-nitrogen·L^{-1}. This value is equivalent to 197 µg nitrite·L^{-1}.

Sample Identification

OB & OB2 = Groundwater samples collected from shallow Monitoring Well #1 completed in overburden unit only. Samples collected from pump discharge near beginning and end of pumping test.
LM & LM2 = Groundwater samples collected from Test Well # 1 completed in carbonate (limestone) unit only. Samples collected from pump discharge near beginning and end of pumping test.
SS & SS2 = Groundwater samples collected from Test Well #1 extended and sealed in sandstone unit only. Samples collected from pump discharge near beginning and end of pumping test.
RG = Groundwater sample collected from Test Well #2 drilled into Regolith (weathered granite) zone. Sample collected using a dedicated bailer lowered into the well since there was insufficient groundwater inflow for performance of a pumping test.
GR = Groundwater sample collected from Test Well #2 extended into solid granite zone. Sample collected using a dedicated bailer lowered into the well since there was insufficient groundwater inflow for performance of a pumping test.

UTM Coordinates - Monitoring Well #1 (OB samples) =	Northing:	5993484.901	Easting:	487433.36
UTM Coordinates - Test Well #1 (LM and SS samples) =	Northing:	5993483.154	Easting:	487452.38
UTM Coordinates - Test Well #2 (RG and GR samples) =	Northing:	5993787.926	Easting:	487669.87

UTM coordinates listed above are listed in UTM 14 North, NAD 83.

Table 7.6-D-4 Reportable Detection Limits (RDLs) for Other Groundwater Water Quality Parameters

PARAMETER	Units	Reportable Detection Limit (RDL)		
		2007	27-Mar-08	15-AUG-08
Physical Tests				
Dissolved Hardness (CaCO3)	mg/L	0.5		
Hardness (as CaCO3)	mg/L	0.5	0.5	0.7
Conductivity	µS/cm	1	2	2
pH	pH Units	0.1	0.01	0.01
Total Dissolved Solids	mg/L	1	10	10
Total Suspended Solids	mg/L		3	3
Turbidity (NTU)	NTU	0.1	0.1	0.1
Colour, True				5
Anions and Nutrients				
Ammonia as N	mg/L	0.005	0.02	0.02
Acidity (as CaCO3)	mg/L		1	
Alkalinity, Total (as CaCO3)	mg/L	0.5	1	2
Alkalinity (PP as CaCO3)	mg/L	0.5		
Bicarbonate (HCO3)	mg/L	0.5		
Alkalinity, Bicarbonate (as CaCO3)	mg/L		1	
Alkalinity, Carbonate (as CaCO3)	mg/L	0.5	1	
Alkalinity, Hydroxide (as CaCO3)	mg/L	0.5	1	
Bromide (Br)	mg/L		0.05	
Chloride (Cl)	mg/L	0.5	0.5	0.5
Fluoride (F)	mg/L	0.01	0.02	0.02
Sulfate (SO4)	mg/L	0.5	0.5	0.5
Nitrate (as N)	mg/L	0.002	0.5	0.005
Nitrite (as N)	mg/L	0.002	0.1	0.001
Nitrate plus Nitrite (as N)	mg/L	0.002		
Total Kjeldahl Nitrogen	mg/L	0.02	0.05 - 0.1	0.05
Total Nitrogen	mg/L	0.02	0.7	
Calcium (Ca)-Total	mg/L	0.05	0.02	0.02
Magnesium (Mg)-Total	mg/L	0.05	0.005	0.005
Radiological Parameters				
Radium-226	Bq/L	0.005		
XNo class				
Dissolved Organic Carbon	mg/L		0.5	
Total Organic Carbon	mg/L			0.5
Cyanides				
Cyanide, Weak Acid Diss	mg/L		0.005	0.005

APPENDIX 7.6-E

Results of Manual Flow Measurements during the Groundwater Pump Test

Results of August 2008 Discharge Measurements at Minago

		Oakley Creek								
Date and Time		OCW1 02/08/2008 14:10	OD1 - OCW1?? 08/08/2008 11:45	OCW1 10/08/2008 11:00	OCW1 11/08/2008 10:00	OCW1 13/08/2008 9:00	OCW1 14/08/2008 14:45	OCW1 15/08/2008 10:45	OCW1 16/08/2008 9:15	OCW1 17/08/2008 12:15
Water temperature	°C	18.1	17.7	18.3	18.0	16.2	18.7	18.1	18.1	19.9
Width	m	4.14	3.95	3.9	3.9	3.95	3.9	3.9	3.9	3.9
Average velocity	m/s	0.879	0.7489	0.733	0.590	0.802	0.800	0.778	0.763	0.682
Average depth	m	0.27	0.19	0.17	0.17	0.25	0.24	0.22	0.20	0.19
Area	m^2	1.03	0.74	0.63	0.63	0.95	0.86	0.81	0.75	0.71
Flow	m^3/s	0.95	0.6315	0.50	0.41	0.79	0.72	0.68	0.60	0.53
Staff Gauge	m	0.24	0.18	0.16	0.15	0.22	0.20	0.20	0.18	0.18

		Northern Roadside Ditch draining into Oakley Creek at OD1				
Date and Time		OD1 02/08/2008 15:15	OD1 09/08/2008 15:00	OD1 11/08/2008 9:55	OD1 13/08/2008 15:00	OD1 15/08/2008 10:10
Water temperature	°C	12.2	13.0	13.0	12.8	12.5
Width	m	5.92	5.6	4.9	5.2	5.2
Average velocity	m/s	-0.0003	0.0051	0.0048	0.0041	0.0033
Average depth	m	0.71	0.86	0.86	0.80	0.86
Area	m^2	3.92	4.32	3.79	3.88	4.19
Flow	m^3/s	0.0026	0.0237	0.0180	0.0159	0.0139
Staff Gauge	m		0.68	0.69	0.71	0.71

		Northern Roadside Ditch draining into Oakley Creek at OD2		
Date and Time		OD2 05/08/2008 15:15	OD2 09/08/2008 14:15	OD2 12/08/2008 9:45
Water temperature	°C	16.6	16.6	18.3
Width	m	7.7	6.65	6.6
Average velocity	m/s	0.0026	0.0068	0.0077
Average depth	m	0.62	0.77	0.63
Area	m^2	4.43	4.80	3.83
Flow	m^3/s	0.0152	0.0348	0.0276
Staff Gauge	m		0.40	0.39

		Southern Roadside Ditch draining into Minago River at MD1			
		MD1	**MD1**	**MD1**	**MD1**
Date and Time		05/08/2008 10:00	09/08/2008 11:00	11/08/2008 9:00	13/08/2008 9:50
Water temperature	**°C**	14.1	15.4	15.5	15.0
Width	**m**	8.4	4.85	4.9	5.3
Average velocity	**m/s**	0.0107	0.0077	0.0090	0.0120
Average depth	**m**	0.61	0.72	0.69	0.75
Area	**m^2**	4.61	3.18	3.33	3.79
Flow	**m^3/s**	0.0513	0.0304	0.0352	0.0481
Staff Gauge	**m**		0.47	0.46	0.49

		Southern Roadside Ditch draining into Oakley Creek at ODS1				
		ODS1	**ODS1**	**ODS1**	**ODS1**	**ODS1**
Date and Time		08/08/2008 10:45	10/08/2008 10:50	12/08/2008 12:00	14/08/2008 14:15	16/08/2008 13:20
Water temperature	**°C**	17.9	17.6	16.7	21.5	21.8
Width	**m**	5.03	4.6	4.84	4.5	4.8
Average velocity	**m/s**	0.0298	0.0606	0.0330	0.036	0.036
Average depth	**m**	0.18	0.11	0.18	0.29	0.22
Area	**m^2**	0.85	0.47	0.84	1.23	0.98
Flow	**m^3/s**	0.029	0.026	0.029	0.039	0.034
Staff Gauge	**m**	0.20	0.15	0.19	0.28	0.23

Note:

The 0.6 Method was used for the streamflow measurements.

APPENDIX 7.6-F

Golder Associates (2008b) Report
"Hydrogeologic Investigations of Dewatering Requirements for the Proposed Open Pit Minago, Manitoba"

Please refer to the
electronic version of the
Final Golder Associates (2008b) Report:

“Final Golder Associates Hydrogeo Report.pdf”

APPENDIX 7.7

Supplemental Material for the Benthic, Periphyton and Sediment Assessments

APPENDIX 7.7-A

Supplemental Material for the 2006 Benthic Invertebrates Assessments

Table 7.7-A1. Zoobenthos community and abundance at Oakley Creek Station OCW-1 on Spet. 19, 2006

Phylum	Class	Order	Family	OCW-1 Rep 2	OCW-1 Rep 3	OCW-1 Rep 4	OCW-1 Rep 5	Max	Min	Median	Mean	SD	% of community
Annelida	Hirudinea	Acanthobdellida	Glossiphonidae	0	0	1	2	2	0	0	0.6	0.9	1.1
		Arhynchobdellida	Erpobdellidae	1	0	1	0	1	0	0	0.4	0.5	0.7
	Oligochaeta	Lumbriculida	Lumbriculidae	0	0	0	4	4	0	0	1	1.7	1.8
		Tubificida	Naididae	3	4	0	0	4	0	0	1.4	1.9	2.5
			Tubificidae	0	0	0	4	4	0	0	1.4	1.9	2.5
Arthropoda	Arachnida	Araneae		0	0	0	0	0	0	0	0	-	0
	Hydracarina			0	0	0	0	0	0	0	0	-	0
Crustacea	Amphipoda	Gammaridae		0	0	0	0	0	0	0	0	-	0
		Hyalellidae		0	0	0	0	0	0	0	0	-	0
	Copepoda			0	0	0	0	0	0	0	0	-	0
Insecta	Coleoptera	Elmidae		8	4	12	15	15	4	8	9	4.5	15.8
		Haliplidae		0	0	0	0	0	0	0	0	-	0
		Hydraenidae		0	0	0	0	0	0	0	0	-	0
		Staphylinidae		0	0	0	0	1	0	0	0.2	0.4	0.4
	Diptera	Ceratopogonidae		7	3	6	6	9	3	6	6.2	2.2	10.9
		Chironomidae		8	5	45	15	45	5	15	17.8	15.9	31.2
		Empididae		0	0	0	0	1	0	0	0.2	0.4	0.4
		Tabanidae		0	0	0	0	1	0	0	0.2	0.4	0.4
		Tipulidae		0	0	0	0	0	0	0	0	-	0
	Ephemeroptera	Damaged		0	0	1	0	1	0	0	0.2	0.4	0.4
		Caenidae		11	0	2	3	11	0	3	5.4	5.2	9.5
		Ephemerellidae		0	0	0	0	0	0	0	0	-	0
		Ephemeridae		12	5	0	2	12	0	4	4.6	4.6	8.1
		Heptageniidae		0	0	0	0	0	0	0	0	-	0
		Leptophlebiidae		0	0	0	0	0	0	0	0	-	0
	Hemiptera	Corixidae		0	0	0	0	0	0	0	0	-	0
	Lepidoptera	Pyralidae		0	0	1	0	1	0	0	0.2	0.4	0.4
	Odonata-Anisoptera	Corduliidae		0	0	0	0	0	0	0	0	-	0
	Plecoptera	Capniidae		0	0	0	0	0	0	0	0	-	0
		Chloroperlidae		0	0	0	0	0	0	0	0	-	0
	Trichoptera	Damaged		0	0	0	0	0	0	0	0	-	0
		Hydroptilidae		0	0	7	1	7	0	0	1.6	3	2.8
		Lepidostomatidae		0	0	0	0	0	0	0	0	-	0
		Leptoceridae		0	0	0	0	0	0	0	0	-	0
		Limnephilidae		2	0	1	0	2	0	0	0.6	0.9	1.1
		Molannidae		0	0	0	0	0	0	0	0	-	0
		Phryganeidae		1	0	0	0	1	0	0	0.2	0.4	0.4
		Polycentopodidae		0	0	0	1	1	0	0	0.2	0.4	0.4
Mollusca	Bivalvia	Veneroida	Sphaeriidae	1	0	8	15	15	0	1	5	6.4	8.8
	Gastropoda	Ctenobranchiata	Valvatidae	0	0	0	0	0	0	0	0	-	0
		Pulmonata	Ancylidae	0	0	0	0	0	0	0	0	-	0
			Lymnaeidae	0	0	0	0	0	0	0	0	-	0
Nematoda				0	2	1	0	2	0	0	0.6	0.9	1.1
	Total Number of Organisms			54	23	86	68	86	23	54	57		
	Density (ind/m^2)			2322	989	3698	2924	3698	989	2322	2451		
	Taxon Richness			10	6	12	11	12	6	11	10		
	Evenness			0.118	0.242	0.037	0.089	0.242	0.037	0.103	0.118		
	Simpson's Index of Diversity			0.843	0.82	0.685	0.835	0.843	0.685	0.82	0.801		
	Bray-Curtis Index			0.663	0.743	0.459	0.426	0.743	0.406	0.459	0.539		

Table 7.7-A2. Zoobenthos community and abundance at Oakley Creek Station OCW-2 on Spet. 20, 2006

Phylum	Class	Order	Family	OCW-2 Rep 1	OCW-2 Rep 2	OCW-2 Rep 3	OCW-2 Rep 4	OCW-2 Rep 5	Max	Min	Median	Mean	SD	% of community
Annelida	Hirudinea	Acanthobdellida	Glossiphonidae	4	1	4	6	0	6	0	4	3	2.4	1.4
		Arhynchobdellida	Erpobdellidae	1	0	0	2	3	3	0	1	1.2	1.3	0.5
	Oligochaeta	Lumbriculida	Lumbriculidae	4	4	2	7	3	7	2	4	4	1.9	1.8
		Tubificida	Naididae	11	3	3	1	3	11	1	3	4.2	3.9	1.9
			Tubificidae	7	4	14	2	34	34	2	7	12.2	13	5.5
Arthropoda	Arachnida	Araneae		2	0	0	0	0	2	0	0	0.4	0.9	0.2
		Hydracarina		0	0	2	0	0	2	0	0	0.4	0.9	0.2
	Crustacea	Amphipoda	Gammaridae	1	0	0	0	1	1	0	0	0.4	0.5	0.2
			Hyalellidae	1	0	0	0	0	1	0	0	0.2	0.4	0.1
		Copepoda		5	0	1	2	0	5	0	1	1.6	2.1	0.7
	Insecta	Coleoptera	Elmidae	0	0	0	0	0	0	0	0	0	-	0
			Haliplidae	1	0	1	0	0	1	0	0	0.4	0.5	0.2
			Hydraenidae	0	0	0	0	0	0	0	0	0	-	0
			Staphylinidae	0	0	0	0	0	0	0	0	0	-	0
		Diptera	Ceratopogonidae	15	10	24	38	6	38	6	15	18.6	12.8	8.4
			Chironomidae	181	11	282	137	103	282	11	137	142.8	99.8	64.3
			Empididae	1	0	0	1	0	1	0	0	0.4	0.5	0.2
			Tabanidae	1	0	0	0	0	1	0	0	0.2	0.4	0.1
			Tipulidae	0	1	0	1	0	1	0	0	0.4	0.5	0.2
		Ephemeroptera	Damaged	4	1	5	0	0	5	0	1	2	2.3	0.9
			Caenidae	0	1	3	1	0	3	0	1	1	1.2	0.5
			Ephemerellidae	9	0	1	0	0	9	0	0	2	3.9	0.9
			Ephemeridae	0	0	0	0	0	0	0	0	0	-	0
			Heptageniidae	0	0	0	1	0	1	0	0	0.2	0.4	0.1
			Leptophlebiidae	4	0	1	0	0	4	0	0	1	1.7	0.5
		Hemiptera	Corixidae	0	0	0	0	0	0	0	0	0	-	0
		Lepidoptera	Pyralidae	0	0	0	0	0	0	0	0	0	-	0
		Odonata-Anisoptera	Corduliidae	1	0	0	0	1	1	0	0	0.4	0.5	0.2
		Plecoptera	Capniidae	0	0	0	0	0	0	0	0	0	-	0
			Chloroperlidae	0	2	0	2	0	2	0	0	0.8	1.1	0.4
		Trichoptera	Damaged	0	0	0	0	1	1	0	0	0.2	0.4	0.1
			Hydroptilidae	29	0	25	3	0	29	0	3	11.4	14.4	5.1
			Lepidostomatidae	0	0	0	0	0	0	0	0	0	-	0
			Leptoceridae	2	0	0	0	0	2	0	0	0.4	0.9	0.2
			Limnephilidae	0	0	0	0	1	1	0	0	0.2	0.4	0.1
			Molannidae	0	0	0	0	0	0	0	0	0	-	0
			Phryganeidae	0	0	2	0	0	2	0	0	0.4	0.9	0.2
			Polycentopodidae	0	0	0	0	0	0	0	0	0	-	0
Mollusca	Bivalvia	Veneroida	Sphaeriidae	6	1	4	3	12	12	1	4	5.2	4.2	2.3
	Gastropoda	Ctenobranchiata	Valvatidae	0	0	0	0	1	1	0	0	0.2	0.4	0.1
		Pulmonata	Ancylidae	0	0	0	0	2	2	0	0	0.4	0.9	0.2
			Lymnaeidae	1	0	0	0	0	1	0	0	0.2	0.4	0.1
Nematoda				2	0	3	24	0	24	0	2	5.8	10.3	2.6
	Total Number of Organisms			293	39	377	231	171	377	39	231	222	127.7075	
	Density (ind/m^2)			12,599	1,677	16,211	9,933	7,353	16,211	1,677	9,933	9,555	5,491	
	Taxon Richness			23	11	17	16	13	23	11	16	16	5	
	Evenness			0.009	0.144	0.005	0.011	0.014	0.144	0.005	0.011	0.036	0.060	
	Simpson's Index of Diversity			0.601	0.822	0.430	0.608	0.590	0.822	0.430	0.601	0.610	0.139	
	Bray-Curtis Index			0.724	0.302	0.788	0.683	0.615	0.788	0.302	0.683	0.622	0.190	

Table 7.7-A3. Zoobenthos community and abundance at Oakley Creek Station OCW-3 on Spet. 20, 2006

Phylum	Class	Order	Family	OCW-3 Rep 1	OCW-3 Rep 2	OCW-3 Rep 3	OCW-3 Rep 4	OCW-3 Rep 5	Max	Min	Median	Mean	SD	% of community
Annelida	Hirudinea	Acanthobdellida	Glossiphonidae	3	0	0	3	0	3	0	0	1.2	1.6	1.4
		Arhynchobdellida	Erpobdellidae	0	0	0	0	0	0	0	0	0	-	0
	Oligochaeta	Lumbriculida	Lumbriculidae	4	6	1	4	0	6	0	4	3	2.4	3.4
		Tubificida	Naididae	0	0	1	0	0	1	0	0	0.2	0.4	0.2
			Tubificidae	3	26	8	1	2	26	1	3	8	10.4	9.1
	Arthropoda	Arachnida	Araneae	0	0	0	0	0	0	0	0	0	-	0
		Hydracarina		0	0	0	0	0	0	0	0	0	-	0
	Crustacea	Amphipoda	Gammaridae	2	0	0	4	0	4	0	0	1.2	1.8	1.4
			Hyalellidae	0	0	0	2	0	2	0	0	0.4	0.9	0.5
		Copepoda		3	0	1	3	0	3	0	1	1.4	1.5	1.6
	Insecta	Coleoptera	Elmidae	0	0	0	0	0	0	0	0	0	-	0
			Haliplidae	0	0	0	0	1	1	0	0	0.2	0.4	0.2
			Hydraenidae	0	0	1	0	0	1	0	0	0.2	0.4	0.2
			Staphylinidae	0	0	0	0	0	0	0	0	0	-	0
		Diptera	Ceratopogonidae	10	18	13	25	10	25	10	13	15.2	6.4	17.3
			Chironomidae	24	5	95	34	6	95	5	24	32.8	36.9	37.4
			Empididae	0	0	0	0	0	0	0	0	0	-	0
			Tabanidae	0	0	1	1	0	1	0	0	0.4	0.5	0.5
			Tipulidae	0	0	0	0	0	0	0	0	0	-	0
		Ephemeroptera	Damaged	1	0	0	4	0	4	0	0	1	1.7	1.1
			Caenidae	0	0	0	0	0	0	0	0	0	-	0
			Ephemerellidae	1	0	1	4	1	4	0	1	1.4	1.5	1.6
			Ephemeridae	0	0	0	0	0	0	0	0	0	-	0
			Heptageniidae	0	0	0	0	0	0	0	0	0	-	0
			Leptophlebiidae	4	0	0	7	0	7	0	0	2.2	3.2	2.5
		Hemiptera	Corixidae	0	1	12	0	0	12	0	0	2.6	5.3	3
		Lepidoptera	Pyralidae	0	0	0	0	0	0	0	0	0	-	0
		Odonata-Anisoptera	Corduliidae	1	0	0	0	0	1	0	0	0.2	0.4	0.2
		Plecoptera	Capniidae	0	0	0	1	0	1	0	0	0.2	0.4	0.2
			Chloroperlidae	0	0	0	0	0	0	0	0	0	-	0
		Trichoptera	Damaged	0	0	0	0	0	0	0	0	0	-	0
			Hydroptilidae	2	0	0	1	0	2	0	0	0.6	0.9	0.7
			Lepidostomatidae	0	0	0	2	0	2	0	0	0.4	0.9	0.5
			Leptoceridae	0	0	0	0	0	0	0	0	0	-	0
			Limnephilidae	0	0	0	0	0	0	0	0	0	-	0
			Molannidae	0	0	1	0	0	1	0	0	0.2	0.4	0.2
			Phryganeidae	0	0	0	0	0	0	0	0	0	-	0
			Polycentopodidae	0	0	0	0	0	0	0	0	0	-	0
Mollusca	Bivalvia	Veneroida	Sphaeriidae	5	32	17	8	0	32	0	8	12.4	12.6	14.1
	Gastropoda	Ctenobranchiata	Valvatidae	0	0	0	0	0	0	0	0	0	-	0
		Pulmonata	Ancylidae	1	0	0	0	0	1	0	0	0.2	0.4	0.2
			Lymnaeidae	0	0	0	0	0	0	0	0	0	-	0
Nematoda				0	0	0	11	0	11	0	0	2.2	4.9	2.5
	Total Number of Organisms			64	88	152	115	20	152	20	88	88	50	
	Density (ind/m^2)			2,752	3,784	6,536	4,945	860	6,536	860	3,784	3,775	2,153	
	Taxon Richness			14	6	12	17	5	17	5	12	11	5	
	Evenness			0.083	0.042	0.016	0.055	0.141	0.141	0.016	0.055	0.067	0.048	
	Simpson's Index of Diversity			0.812	0.731	0.580	0.841	0.645	0.841	0.580	0.731	0.722	0.110	
	Bray-Curtis Index			0.171	0.615	0.558	0.457	0.463	0.615	0.171	0.463	0.453	0.171	

APPENDIX 7.7-B

Supplemental Material for the 2007 Benthic Invertebrates Assessments

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FIELD GUIDELINES - BENTHIC SAMPLING PROTOCOL

The reliability and comparability of benthic data used for environmental assessments begin in the field. The consistency in size of grab samples retrieved and the care with which the samples are treated and processed (sieving and fixing) will reflect on the quality and numbers of specimens being delivered to the taxonomist(s), and ultimately the statistician. Variability within and amongst benthic samples is natural but those small variations can easily be increased, biased or exaggerated if poor field procedures are practiced. These protocols are intended as a guideline to assist with collection of consistent, high quality benthic samples.

For Northern Manitoba project, there are 9 stations identified for benthic sampling with 3 replicates at each station = 27 replicate samples.
Sampling equipment and supplies provided (see also Suggested Shopping List below)

- 9” x 9” Ponar grab; 6” x 6” Ponar grab
- 2 x 250µ (0.25mm) mesh sieves
- 2 x 1.0mm mesh sieves
- 54 x 1L sample jars with lids (2 jars for each of 27 replicates)
- 2 squirt bottles
- 90 large waterproof labels
- 60 small waterproof labels
- 15 large Ziploc bags (Freezer thickness)
- 40 small Ziploc bags (Freezer thickness)

Use of the 9” x 9” Ponar grab is recommended. The 6” x 6” Ponar grab is a back-up alternative. Record which of these grabs is being used in your waterproof logbook. Quantitative data analyses will be based on grab sampling area and/or volume so it is necessary to know which of the grab samplers is used. Use the same grab sampler for the entire sampling program unless unforeseen sampling difficulties arise, requiring a change in the sampling gear.

Grab sample retrieval and labelling:

Lower the grab slowly over the side of the boat. The preference is not to just drop the grab in the water. Too much speed creates a ‘bow’ wave that disrupts or scatters surface sediments where most of the benthos would be living. However, in shallow depths (<10m) some speed will be necessary to enable the grab to penetrate to a sufficient depth into the substrate. Keep the line attached to the grab taunt so as to prevent the grab from tipping over on its side once it hits bottom. Similarly, pull the grab out slowly to ensure maximum biting leverage as the jaws close through the pulling action. A full grab will be heavy. Be careful with your back and hands when lowering and retrieving the grab sample.

The sampling effort focuses on retrieving 3 similar replicate grab samples of similar fullness and sediment type. The sample is rejected if the grab misfires or if the jaws are jammed with rocks or

any other items that prevent complete closer of the grab jaws. In these scenarios, benthic organisms will already have been lost before the grab is even onboard. Try again, perhaps at another location, especially if the bottom sediments have obviously been stirred up.

Place the retrieved grab immediately from the water into a Rubbermaid tote onboard the boat. DO NOT tip the grab when bringing it onboard, as ANY LOSS OF WATER through the top screens of the grab ALWAYS means a direct loss of organisms (the grab screen mesh size, for several reasons, is larger than 250µ). Open the top screen on the grab to determine the grab fullness – the fuller the grab the better. Several attempts may be necessary to obtain as full a grab as possible. Each replicate grab sample taken at each station should be as consistent in fullness as possible to ensure comparability of replicate samples. Differences in substrate may reflect how full of a grab can be retrieved at any one location. Estimate the fullness of each grab as a percentage, 50%, 80%, 100%, etc. and record. An alternate measure of fullness can be done using a ruler positioned at the centerline of the grab and perpendicular to the surface, to measure the depth of sediment retrieved.

If the grab sample is as full as can be obtained, empty the entire grab contents into the tote. Each replicate grab sample is kept completely distinct. There is no mixing of sediments from several grab samples to obtain a larger volume of sediment. Mixing or combining samples is totally unacceptable for benthic sampling! Use the squirt bottle containing filtered water (see below) to wash all sediment from inside the grab out and into the tote. Rinse the inside of the grab in the stream to clean and prepare it for the next grab sample.

In addition to fullness, describe the grab sample in terms of sediment grain-size (fine, coarse, pebbly, etc.), colour (black, brown, red?), odour (rotten eggs smell sulfides?) and organic matter (fine debris or large pieces of plant material?), etc. If you know the water depth, record it. Records of weather and temperature are also good field practice.

Take all three replicate grab samples from each station, one after the other, and hold them in three separate Rubbermaid totes. Immediately label each of the grab samples with the station number and replicate number, e.g., Station 1A, 1B, 1C. Blank waterproof labels (large and small) are provided. Pencil ONLY should be used to write on field labels (i.e. pencil doesn't run). Photographs of the grab sample within the Rubbermaid tote is recommended for each replicate sample prior to sieving. Include the station identification label on the surface of each grab in the photograph. Cover each of the totes with lids and transport the totes to the sieving location. Do not continue to take grab samples if there is not enough time to sieve them all during the same day.

Grab sample sieving and labelling:

Samples should NOT be left in the totes in the heat for any length of time. Keep the samples cool and out of the sun where possible. Organisms/animals in the sample will start to die and decompose within half an hour of an increase in the sample substrate temperature. Therefore, start the sieving process as soon as possible.

Find a location in the stream or waterbody where the person sieving can stand in the water to sieve the samples. (The assumption is that the field location is remote and that hose and water-pump gear generally used for sieving samples are not practical or available). It will be necessary to use water from the stream to process the samples. Contamination from pelagic organisms within the water column may occur as a result of using this procedure. To prevent or minimize contamination the water from the stream should first be strained or filtered through the 250µ

sieve. It is easiest to fill up the buckets with filtered water and then use this as the source to fill the squirt bottles.

The 250µ sieve is the primary sieve used for this procedure (as identified by URS). Larger, 1.0mm sieves have been provided in case coarse sediments or considerable plant material is encountered in the grab samples. If the latter occurs, nest the 1.0mm sieve on top of the 250µ sieve to help separate large material from fine. Do NOT throw anything away – especially plants with root structures where small organisms live. The preference is to place any plant material collected from a grab into a Ziploc bag and consider it as part of the sample. Label accordingly, e.g., Station 1A 1.0mm sieve residue. Otherwise, it is assumed that all samples have been sieved on just the 250µ sieve.

NOTE: if sieves are nested one on top of the other during the sieving process please ensure that the 250µ sieve is constantly checked. Fined sediments can easily clog the sieve mesh and cause the water to build up and overflow. This can occur when using just the one sieve on its own or between the contact rims of the two nested sieves. Gentle tapping or messaging of the outside bottom of the 250µ sieve can help to re-suspend sediments sufficiently to get the water draining through again. BE CAREFUL! As a last resort, insert your index finger and within an area of about 3-4 cm gently scrape the surface of the sieve in a circular motion to encourage and re-establish the flow of water and movement of fine sediment through this area. DO NOT USE YOUR HAND OR FINGERS WITHIN THE SAMPLE FOR ANY OTHER REASON. Specimens are easily damaged by this activity.

Whether working with just the 250µ sieve (or the nested 1.0mm and 250µ) pour some of the grab sample from the tote onto the sieve. Don't overload the amount of sediment placed on the sieve as this will ultimately slow down and clog the sieving process, as mentioned above. The preferred method is to add enough filtered water to the tote such that the grab sample can be gently worked into a slurry by using a rocking motion. BE GENTLE. Don't stir the sample with a spoon or with your hand – this damages or breaks the organisms in the sediment! Allow the sediment to naturally mix into suspension just from the gradual movement of water within the tote. The slurried sample will make the sieving process easier.

Hold the sieve in the stream such that the water level (entering from below) surrounds the sediment on the sieve and gently rotate the sieve horizontally, back and forth, to wash sediments finer that 250µ through the sieve. The water level within the sieve should be less than half the height of the sieve. DO NOT allow water to flow in over the top of the sieve as contamination by pelagic organisms will occur. DO NOT allow any of the residue (sample staying on top of the sieve) to flow out over the edge of the sieve via water as this will result in an immediate loss of organisms (as per NOTE above). A gentle rocking motion can also be used, again being careful not to allow unfiltered water into the sieve.

Once the water runs clear from the sieve and no more sediment appears to be washing through, the residue remaining on the sieve can be transferred into a sample jar. Rinsing with the filtered water or gently tapping on the side of a tilted sieve can help to move and consolidate the residue into one 'corner' of the sieve. Make use of the squirt bottle and large funnel provided to wash the sample directly into the jar. It is safest to place the sample jar in a small ice cream bucket as a precautionary measure to prevent and/or contain possible spillage and/or sample landing on the ground.

Use of a spoon or flat spatula is discouraged except to lift collected residue off of the sieve and into the funnel. This must be done GENTLY. DO NOT SCRAPE THE SPOON OVER THE

SURFACE OF THE SIEVE to remove residue as organisms are easily damaged by this activity. Use of the funnel and squirt bottle should allow easy transfer of the residue from the sieve into the jar.

Do not fill the sample jars more than half full of the sample residue. Use another jar (or Ziploc bag) if necessary. During the transfer of residue from the sieve to the jar a large amount of water from the squirt bottle may have been required. The amount of water in the jar should be kept to a minimum. To reduce the volume, it may be necessary to pour off some of the jar liquid. Pour it through the 250µ sieve. Using minimal water from the squirt bottle, return any of the residue on the sieve back to the jar. BE VERY CAREFUL - it is very easy to lose the organisms concentrated in the residue at this stage. The volume of liquid in the jar needs to be reduced to allow room for the fixative (see *Fixing* below).

Repeat the slurry and sieving process until all of the sediment from one replicate grab = 1 tote, has been sieved and the residue transferred to a jar(s). Make sure that the waterproof label from the tote goes INSIDE the sample jar. If 2 jars (and/or Ziploc bags) are used to hold the residue from the same replicate sample, additional labels will be required. The addition of ½ and 2/2, etc. on the label will help to identify the fact that more than one jar/sample has been required to hold the residue. Label the jars internally (pencil on waterproof label) and externally (indelible marker). Always keep the lid on the jar during the sieving process to prevent any spillage.

After the entire grab sample from the tote has been processed and the sieved residue put into the jar, hold the sieve to the sky and examine it to make sure nothing has been left behind. Forceps or tweezers can be used to remove any organisms found on the sieve into the jar. Rinse out both the tote and the sieve before using them to process another replicate sample, i.e. don't cross-contaminate samples.

Sieving takes time but time taken during the sieving procedure ensures that good quality and quantity of specimens (not torn or damaged) will reach the taxonomist. Good quality specimens ensure that detailed identification levels (to species, if necessary) can be achieved. Depending on the grab size, fullness and sediment size, it is anticipated that 1.5-2 hrs per grab sample will be necessary to properly sieve each sample. Two sets of sieves have been supplied so that two people can be sieving samples simultaneously.

Sample fixing:

URS is apparently being supplied with 10% formalin solution. Formalin is mildly acidic but enough so as to interact with the calcium carbonate that makes up the shell of clams. Etching or digestion of the shell can occur quickly and can damage the clams beyond identification. To buffer this acidity add approximately 1 tablespoon (~10gm) of Borax for every 1L of 10% formalin. Shake well to dissolve the borax (not all will necessarily dissolve into solution).

Fill the jar containing the sieved residue to the top with 10% buffered formalin. Even with the squirt bottle water in the jar the final concentration of formalin must not be less than 5% or samples with high organic loadings will not fix properly. The jars need to be filled not only to ensure that the organisms are properly fixed but that damage to the specimens through sloshing about during transport is kept to a minimum. Tape the lid of the jar to the jar using PVC tape or Duct tape to minimize any slippage of the lid or leakage.

TO PROPERLY FIX THE ORGANISMS IT IS IMPORTANT THAT THE FORMALIN BE ABLE TO PENETRATE AND MOVE THROUGH THE RESIDUE.

The fixation process will take a minimum of 24 hrs. Each sample jar should be re-rolled on its side and rotated up and down after about 4-6 hrs, to redistribute the formalin within the residue.

At the end of the day the field log should indicate an itemized list for each station and replicate grab sample as follows:
Date, Station #/Replicate, Depth, Fullness (% or cm depth), # jars for 250µ sieve, # jars for 1.0mm sieve (if used), # Ziploc bags (if used), size of Ponar grab used, and any Comments regarding content or of special interest.

It is recommended that each cooler is lined with a large garbage bag to contain any escaped formalin and/or fumes. Carefully pack sample jars as tightly as possible inside the garbage bags in such a way as to prevent any movement. Close the garbage bag using duct tape. Newspaper or cardboard can be used to fill in spaces at the sides or on top of the garbage bag. Newspaper will aid in absorption should any spillage occur. Duct tape the coolers shut. Label the outside of the coolers with the IRC shipping address noted above.

Because of the mildly acidic state of formalin the general practice is to transfer samples fixed in formalin to an alcohol preservative within two weeks from when the samples were fixed. The transfer from fixative to preservative helps to minimize damage to calcareous-containing organisms. IRC understands that URS will ensure that the fixed samples are transported from Northern Manitoba to the IRC Richmond office as quickly as possible and within a short period of time. IRC will then transfer the samples into 70% ethanol for long-term storage.

NOTE: a formalin solution of less than 25% (24.999 %) is not regulated or restricted as a dangerous goods liquid for any form of shipment at least according to the *Transportation of Dangerous Goods Act 1992* unless more recent updates to the Act have been introduced.

Suggested Shopping List (usually obtainable at any hardware store):

- 3 blue Rubbermaid totes with lids (approximately 50cm long x 30cm wide x 20cm deep) (Rubbermaid totes are strong enough to withstand the 9” Ponar grab while still providing some flexibility. Other brands of plastic are too brittle to withstand the sharp edges of the grab.)
- 2 x buckets (at least 20L)
- 1 ice cream-sized bucket
- 4 or 5 rolls of PVC or electrical tape to secure the lids of 54 jars
- 1 or 2 rolls of duct tape to secure samples in the coolers
- 1 box of borax buffer, granular (in kitchen or cleansers section)
- large garbage bags to line each cooler
- 1 x 30cm ruler
- soft HB (#2?) pencils to be used on labels and in logbook
- indelible, permanent Sharpie or Staedler markers for labeling jars and Ziploc bags
- 1 set of forceps or tweezers from a Swiss Army knife
- 1 small flat spatula or plastic soup spoon

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SUMMARY OF BENTHIC INVERTEBRATES COLLECTED FOR THE MINAGO PROJECT, MANITOBA - AUGUST 2007, WITH THREE RATIOS FOR EXISTING EPT POPULATIONS

	OCW1				OCW2				OCW3				WRW1				WRW2			
	R1	R2	R3	Ave.	R1	R2	R3	Ave.	R1	R2	R3	Ave.	R1	R2	R3	Ave.	R1	R2	R3	Ave.
Total Ephmeroptera	10.0	3.0	0.0	4.3	2.0	0.0	0.0	0.7	17.0	3.0	10.0	10.0	30.0	10.0	17.0	19.0	25.0	20.0	21.0	22.0
Total Tricoptera	16.0	1.0	2.0	6.3	0.0	0.0	1.0	0.3	2.0	4.0	9.0	5.0	0	1.0	0	0.3	3.0	5.0	2.0	3.3
Total Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chironomids	6.0	0	0	2.0	23.0	19.0	54.0	32.0	112.0	43.0	74.0	76.3	3.0	5.0	8.0	5.3	0	0	0	0
Total Crustacea	3.0	0	5.0	2.7	1.0	1.0	0	0.7	9.0	5.0	2.0	5.3	1.0	1.0	0	0.7	0	3.0	1.0	1.3
Total Number of Organisms	73.0	14.0	39.0	42.0	111.0	109.0	270.0	163.3	335.0	167.0	296.0	266.0	50.0	55.0	52.0	52.3	50.0	81.0	55.0	62.0
EPT/total numbers ratio				25.40%				0.61%				5.64%				36.94%				40.86%
EPT/Chironomid ratio				5.3				0.03				0.2				3.6				-
EPT/EPT+Chironomid Ratio				0.84				0.03				0.16				0.78				1.00

Ave. = average

Total numbers do not include terrestrial organisms identified in sample.

SUMMARY OF BENTHIC INVERTEBRATES COLLECTED FOR THE MINAGO PROJECT, MANITOBA - AUGUST 2007, WITH THREE RATIOS FOR EXISTING EPT POPULATIONS

	MRW1				MRW2				MRW3				HRW1			
	R1	R2	R3	Ave.	R1	R2	R3	Ave.	R1	R2	R3	Ave.	R1	R2	R3	Ave.
Total Ephmeroptera	4.0	1.0	3.0	2.7	20.0	4.0	2.0	8.7	3.0	33.0	37.0	24.3	3.0	3.0	0	2.0
Total Tricoptera	0.0	1.0	1.0	0.7	3.0	1.0	0.0	1.3	0	2.0	0	0.7	4.0	3.0	0	2.3
Total Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chironomids	1.0	0	2.0	1.0	1.0	2.0	5.0	2.7	3.0	6.0	6.0	5.0	3.0	0	3.0	2.0
Total Crustacea	2.0	0	7.0	3.0	98.0	22.0	6.0	42.0	245.0	909.0	85.0	413.0	0	2.0	2.0	1.3
Total Number of Organisms	32.0	17.0	35.0	28.0	202.0	173.0	36.0	137.0	278.0	1136.0	239.0	551.0	140.0	49.0	33.0	74.0
EPT/total numbers ratio				11.90%				7.30%				4.54%				5.86%
EPT/Chironomid ratio				3.3				3.8				5.0				2.2
EPT/EPT+Chironomid Ratio				0.77				0.79				0.83				0.68

Ave. = average
Total numbers do not include terrestrial organisms identified in sample.

APPENDIX 7.7-C

Supplemental Material for the 2006 – 2007 Sediment Assessments

Table 7.7-C1. Sediment Quality at OCW-1 in September 2006

		OCW-1					OCW-1				REGULATIONS Canadian Sediment Quality of Aquatic Life (CCME, 2002)	
Sample ID		OCW-1 REP1	OCW-1 REP2	OCW-1 REP3	OCW-1 REP4	OCW-1 REP5	Average [1]	Coefficient of Variation	REPORTED DETECTION LIMIT (RPD)	QC Batch		
		C87996	C87997	C87998	C87999	C88000						
Sampling Date		19/09/2006 18:00	19/09/2006 18:00	19/09/2006 18:00	19/09/2006 18:00	19/09/2006 18:00			Sep-06			
COC Number / Lab ID		8186370	8186370	8186370	8186370	8186370		%			ISQG	PEL
Depth	**Units**											
Moisture	%	44.9	40.4	49.3	76.7	27.8	47.8	38%	0.3	1284230 & 1284223		
pH												
Organic Matter	%	5.9	3.8	6.1	21	1.8	7.72	99%	0.2	1295577		
Total Organic Carbon (C)	%	3.4	2.2	3.6	12.2	1	4.48	99%	0.2	1295577		
Soluble (Hot water) Boron (B)	mg/kg	0.2	0.3	0.6	0.6	0.3	0.4	47%	0.1-0.2	1285171		
Elements												
Total Aluminum (Al)	mg/kg	18,800	17,700	11,400	9,390	20,200	15,498	31%	10	1302489		
Total Antimony (Sb)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Arsenic (As)	mg/kg	3	5	2	1	3	2.8	53%	1	1286198	**5.9**	**17**
Total Barium (Ba)	mg/kg	141	162	96	108	148	131	21%	10	1286198		
Total Beryllium (Be)	mg/kg	0.9	1.1	0.6	0.4	0.9	0.78	36%	0.4	1286198		
Total Boron (B)	mg/kg	11	11	8	7	10	9.4	19%	2	1302489		
Total Cadmium (Cd)	mg/kg	**0.8**	**1.0**	0.6	0.5	0.5	0.68	32%	0.1		**0.6**	**3.5**
Total Chromium (Cr)	mg/kg	**75**	**80**	**60**	**56**	**84**	**71**	17%	1	1286198	**37.3**	**90**
Total Cobalt (Co)	mg/kg	15	17	10	8	16	13	30%	1	1286198		
Total Copper (Cu)	mg/kg	23	25	15	7	18	18	40%	5	1286198		
Total Iron (Fe)	mg/kg	19,800	20,200	13,200	11,700	20,800	17,140	25%	10	1302489		
Total Lead (Pb)	mg/kg	12	14	8	6	12	10	32%	1	1286198	**35**	**91.3**
Total Lithium (Li)	mg/kg	27	26	16	13	27	22	31%	10	1302489		
Total Manganese (Mn)	mg/kg	339	428	302	315	521	381	24%	10	1302489		
Total Mercury (Hg)	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	0.025	0%	0.05-0.3	1305893 & 1303919	**0.17**	**0.486**
Total Molybdenum (Mo)	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4	0.2	0%	0.4	1286198		
Total Nickel (Ni)	mg/kg	41	44	27	19	41	34	32%	1	1286198		
Total Phosphorus (P)	mg/kg	402	501	352	420	347	404	15%	20	1302489		
Total Selenium (Se)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	0.25	0%	0.5	1286198		
Total Silver (Ag)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Strontium (Sr)	mg/kg	37	44	23	20	27	30	33%	10	1302489		
Total Thallium (Tl)	mg/kg	<0.3	0.3	<0.3	<0.3	<0.3	0.18	37%	0.3	1286198		
Total Tin (Sn)	mg/kg	<1	4	<1	<1	<1	1.2	130%	1	1286198		
Total Uranium (U)	mg/kg	1	1	<1	1	<1	0.8	34%	1	1286198		
Total Vanadium (V)	mg/kg	54	58	34	23	54	45	34%	1	1286198		
Total Zinc (Zn)	mg/kg	74	76	52	56	76	67	18%	10	1286198	**123**	**315**

NOTES:

1 If the sample concentration was less than the detection limit, half the detection limit was used to compute the average.

ISQG Interim freshwater sediment quality guidelines

PEL Probable effects levels

0.0056 Bold and underlined number is exceeding guideline value.

Table 7.7-C2. Sediment Quality at OCW-2 in September 2006

		OCW-2					OCW-2				REGULATIONS Canadian Sediment Quality of Aquatic Life (CCME, 2002)	
Sample ID		OCW-2 REP1	OCW-2 REP2	OCW-2 REP3	OCW-2 REP4	OCW-2 REP5	Average [1]	Coefficient of Variation	REPORTED DETECTION LIMIT (RPD)	QC Batch		
		C88001	C88002	C88003	C88004	C88005						
Sampling Date		20/09/2006 11:20	20/09/2006 11:20	20/09/2006 11:20	20/09/2006 11:20	20/09/2006 11:20			Sep-06			
COC Number / Lab ID		8186370	8186370	8186371	8186371	8186371		%			ISQG	PEL
Depth	**Units**											
Moisture	%	72.7	79.1	78.3	75	82.4	77.5	5%	0.3	1284230 & 1284223		
pH												
Organic Matter	%	19.5	36.7	25.2	25.6	19.7	25.3	28%	0.2	1295577		
Total Organic Carbon (C)	%	11.4	21.3	14.6	14.9	11.5	14.7	27%	0.2	1295577		
Soluble (Hot water) Boron (B)	mg/kg	0.9	0.7	0.8	0.6	0.9	0.8	17%	0.1-0.2	1285171		
Elements												
Total Aluminum (Al)	mg/kg	4,390	3,390	4,090	4,610	3,370	3,970	14%	10	1302489		
Total Antimony (Sb)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Arsenic (As)	mg/kg	<1	1	1	<1	<1	0.7	39%	1	1286198	**5.9**	**17**
Total Barium (Ba)	mg/kg	58	61	68	66	54	61	9%	10	1286198		
Total Beryllium (Be)	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4	0.2	0%	0.4	1286198		
Total Boron (B)	mg/kg	6	6	6	6	5	5.8	8%	2	1302489		
Total Cadmium (Cd)	mg/kg	0.3	0.4	0.4	0.3	0.3	0.34	16%	0.1		**0.6**	**3.5**
Total Chromium (Cr)	mg/kg	37	**39**	**38**	**44**	34	**38.4**	9%	1	1286198	**37.3**	**90**
Total Cobalt (Co)	mg/kg	4	4	4	5	3	4	18%	1	1286198		
Total Copper (Cu)	mg/kg	<5	<5	<5	<5	<5	3	0%	5	1286198		
Total Iron (Fe)	mg/kg	6,180	5,620	6,410	6,460	5,510	6,036	7%	10	1302489		
Total Lead (Pb)	mg/kg	3	3	3	3	3	3	0%	1	1286198	**35**	**91.3**
Total Lithium (Li)	mg/kg	<10	<10	<10	<10	<10	1	0%	10	1302489		
Total Manganese (Mn)	mg/kg	168	215	364	221	252	244	30%	10	1302489		
Total Mercury (Hg)	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	0.025	0%	0.05-0.3	1305893 & 1303919	**0.17**	**0.486**
Total Molybdenum (Mo)	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4	0.2	0%	0.4	1286198		
Total Nickel (Ni)	mg/kg	8	8	9	10	7	8	14%	1	1286198		
Total Phosphorus (P)	mg/kg	328	274	322	349	294	313	9%	20	1302489		
Total Selenium (Se)	mg/kg	<0.5	0.8	0.7	0.7	<0.5	0.54	50%	0.5	1286198		
Total Silver (Ag)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Strontium (Sr)	mg/kg	16	17	18	16	16	17	5%	10	1302489		
Total Thallium (Tl)	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	0.15	0%	0.3	1286198		
Total Tin (Sn)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Uranium (U)	mg/kg	<1	1	<1	1	<1	0.7	39%	1	1286198		
Total Vanadium (V)	mg/kg	9	10	10	12	8	10	15%	1	1286198		
Total Zinc (Zn)	mg/kg	22	23	24	29	19	23	16%	10	1286198	**123**	**315**

NOTES:

1 If the sample concentration was less than the detection limit, half the detection limit was used to compute the average.

ISQG Interim freshwater sediment quality guidelines

PEL Probable effects levels

0.0056 Bold and underlined number is exceeding guideline value.

Table 7.7-C3. Sediment Quality at OCW-3 in September 2006

		OCW-3					OCW-3				REGULATIONS Canadian Sediment Quality of Aquatic Life (CCME, 2002)	
Sample ID		OCW-3 REP1	OCW-3 REP2	OCW-3 REP3	OCW-3 REP4	OCW-3 REP5	Average [1]	Coefficient of Variation	REPORTED DETECTION LIMIT (RPD)	QC Batch		
		C88006	C88007	C88008	C88009	C88010						
Sampling Date		20/09/2006 13:40	20/09/2006 13:40	20/09/2006 13:40	20/09/2006 13:40	20/09/2006 13:40			Sep-06			
COC Number / Lab ID		8186371	8186371	8186371	8186371	8186371		%			ISQG	PEL
Depth	**Units**											
Moisture	%	86	83	78.8	76.9	82.5	81.4	4%	0.3	1284230 & 1284223		
pH												
Organic Matter	%	39.9	27.7	27.1	27.2	30.5	30.5	18%	0.2	1295577		
Total Organic Carbon (C)	%	23.2	16.1	15.8	15.8	17.7	17.7	18%	0.2	1295577		
Soluble (Hot water) Boron (B)	mg/kg	0.9	0.9	1.2	1	1.1	1.0	13%	0.1-0.2	1285171		
Elements												
Total Aluminum (Al)	mg/kg	3,720	3,930	5,860	4,210	3,540	4,252	22%	10	1302489		
Total Antimony (Sb)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Arsenic (As)	mg/kg	2	2	1	1	1	1.4	39%	1	1286198	**5.9**	**17**
Total Barium (Ba)	mg/kg	99	124	92	73	82	94	21%	10	1286198		
Total Beryllium (Be)	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4	0.2	0%	0.4	1286198		
Total Boron (B)	mg/kg	9	12	10	7	7	9	24%	2	1302489		
Total Cadmium (Cd)	mg/kg	0.4	0.6	0.4	0.3	0.3	0.4	31%	0.1		**0.6**	**3.5**
Total Chromium (Cr)	mg/kg	**40**	**43**	**42**	36	**38**	**39.8**	7%	1	1286198	**37.3**	**90**
Total Cobalt (Co)	mg/kg	5	5	5	4	4	5	12%	1	1286198		
Total Copper (Cu)	mg/kg	<5	5	<5	<5	<5	3	37%	5	1286198		
Total Iron (Fe)	mg/kg	8,280	9,400	8,050	6,940	7,100	7,954	13%	10	1302489		
Total Lead (Pb)	mg/kg	4	5	4	3	3	4	22%	1	1286198	**35**	**91.3**
Total Lithium (Li)	mg/kg	<10	<10	<10	<10	<10	1	0%	10	1302489		
Total Manganese (Mn)	mg/kg	341	417	157	264	416	319	35%	10	1302489		
Total Mercury (Hg)	mg/kg	0.05	<0.3	<0.3	<0.3	<0.3	0.13	34%	0.05-0.3	1305893 & 1303919	**0.17**	**0.486**
Total Molybdenum (Mo)	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4	0.2	0%	0.4	1286198		
Total Nickel (Ni)	mg/kg	10	12	13	9	9	11	17%	1	1286198		
Total Phosphorus (P)	mg/kg	459	509	508	415	405	459	11%	20	1302489		
Total Selenium (Se)	mg/kg	1.1	1.6	0.7	0.6	0.8	0.96	42%	0.5	1286198		
Total Silver (Ag)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Strontium (Sr)	mg/kg	23	28	25	19	19	23	17%	10	1302489		
Total Thallium (Tl)	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	0.15	0%	0.3	1286198		
Total Tin (Sn)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Uranium (U)	mg/kg	2	2	2			2	0%	1	1286198		
Total Vanadium (V)	mg/kg	10	12	13	9	8	10	20%	1	1286198		
Total Zinc (Zn)	mg/kg	36	46	39	28	28	35	22%	10	1286198	**123**	**315**

NOTES:

1 If the sample concentration was less than the detection limit, half the detection limit was used to compute the average.

ISQG Interim freshwater sediment quality guidelines

PEL Probable effects levels

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Table 7.7-C4. Sediment Quality at MRW1 in September 2006

		MRW-1					MRW-1				REGULATIONS Canadian Sediment Quality of Aquatic Life (CCME, 2002)	
Sample ID		MRW-1 REP1	MRW-1 REP2	MRW-1 REP3	MRW-1 REP4	MRW-1 REP5	Average [1]	Coefficient of Variation	REPORTED DETECTION LIMIT (RPD)	QC Batch		
		C87991	C87992	C87993	C87994	C87995						
Sampling Date		19/09/2006 16:00	19/09/2006 16:00	19/09/2006 16:00	19/09/2006 16:00	19/09/2006 16:00			Sep-06			
COC Number / Lab ID		8186370	8186370	8186370	8186370	8186370		%			ISQG	PEL
Depth	**Units**											
Moisture	%	87.3	72.3	85.6	83	84.7	82.6	7%	0.3	1284230 & 1284223		
pH												
Organic Matter	%	25.4	14.5	24.6	16.8	26.1	21.5	25%	0.2	1295577		
Total Organic Carbon (C)	%	14.8	8.4	14.3	9.8	15.2	12.5	25%	0.2	1295577		
Soluble (Hot water) Boron (B)	mg/kg	1.1	2.4	2.2	2.1	1.8	1.9	26%	0.1-0.2	1285171		
Elements												
Total Aluminum (Al)	mg/kg	14,000	17,700	10,600	9,830	8,120	12,050	32%	10	1302489		
Total Antimony (Sb)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Arsenic (As)	mg/kg	4	2	4	2	2	2.8	39%	1	1286198	**5.9**	**17**
Total Barium (Ba)	mg/kg	155	145	113	71	78	112	34%	10	1286198		
Total Beryllium (Be)	mg/kg	0.8	0.9	0.6	<0.4	0.4	0.58	49%	0.4	1286198		
Total Boron (B)	mg/kg	15	13	14	11	9	12.4	19%	2	1302489		
Total Cadmium (Cd)	mg/kg	**0.8**	0.6	**0.7**	0.3	0.3	0.54	43%	0.1		**0.6**	**3.5**
Total Chromium (Cr)	mg/kg	**74**	**84**	**73**	**53**	**62**	**69.2**	17%	1	1286198	**37.3**	**90**
Total Cobalt (Co)	mg/kg	15	15	12	7	8	11	33%	1	1286198		
Total Copper (Cu)	mg/kg	19	18	15	8	8	14	39%	5	1286198		
Total Iron (Fe)	mg/kg	17,600	19,800	13,700	11,800	10,300	14,640	27%	10	1302489		
Total Lead (Pb)	mg/kg	13	12	10	6	7	10	32%	1	1286198	**35**	**91.3**
Total Lithium (Li)	mg/kg	20	27	15	14	11	17	36%	10	1302489		
Total Manganese (Mn)	mg/kg	523	317	282	142	204	294	49%	10	1302489		
Total Mercury (Hg)	mg/kg	0.06	<0.05	<0.05	<0.05	<0.05	0.032	49%	0.05-0.3	1305893 & 1303919	**0.17**	**0.486**
Total Molybdenum (Mo)	mg/kg	0.5	<0.4	0.5	<0.4	<0.4	0.32	51%	0.4	1286198		
Total Nickel (Ni)	mg/kg	34	38	29	18	19	28	32%	1	1286198		
Total Phosphorus (P)	mg/kg	826	534	570	481	424	567	27%	20	1302489		
Total Selenium (Se)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	0.25	0%	0.5	1286198		
Total Silver (Ag)	mg/kg	<1	<1	<1	<1	<1	0.5	0%	1	1286198		
Total Strontium (Sr)	mg/kg	28	31	25	20	18	24	22%	10	1302489		
Total Thallium (Tl)	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	0.15	0%	0.3	1286198		
Total Tin (Sn)	mg/kg	1	2	1	<1	1	1.1	50%	1	1286198		
Total Uranium (U)	mg/kg	2	3	2	2	1	2	35%	1	1286198		
Total Vanadium (V)	mg/kg	47	50	38	24	25	37	33%	1	1286198		
Total Zinc (Zn)	mg/kg	101	95	82	49	53	76	31%	10	1286198	**123**	**315**

NOTES:

1 If the sample concentration was less than the detection limit, half the detection limit was used to compute the average.

ISQG Interim freshwater sediment quality guidelines

PEL Probable effects levels

0.0056 Bold and underlined number is exceeding guideline value.

Table 7.7-C5. Sediment Quality at Minago in August 2007

Sample ID		MRW1	MRW2	MRW3	HRW1	OCW1	OCW2	OCW3	WRW1	WRW2	REPORTED DETECTION LIMIT (RPD)	All 2007 Stations Average [1]	All 2007 Stations Coefficient of Variation %	REGULATIONS Canadian Sediment Quality of Aquatic Life (CCME, 2002)	
Sampling Date		16-Aug-07	16-Aug-07	16-Aug-07	16-Aug-07	16-Aug-07	16-Aug-07	16-Aug-07	16-Aug-07	16-Aug-07		16-Aug-07	16-Aug-07		
COC Number / Lab ID		L544316-9	L544316-10	L544316-11	L544316-12	L544316-13	L544316-14	L544316-15	L544316-16	L544316-17	Aug-2007			ISQG	PEL
Depth	**Units**	0-0.2 m	0-0.2 m	0-0.2 m	0-0.2 m	0-0.2 m	0-0.2 m	0-0.2 m	0-0.2 m	0-0.2 m					
Moisture	%	20.1	65.2	17.8	40.1	22.7	71.3	78.2	23.0	43.5	0.1	42.4	56%		
pH		7.69	7.06	8.26	7.92	8.46	7.17	6.88	8.45	8.04	0.01	7.8	8%		
Organic Matter	%														
Total Organic Carbon (C)	%	3.58	12.2	1.05	3.59	0.66	17.2	22.9	1.18	2.64	0.01	7.2	113%		
Soluble (Hot water) Boron (B)	mg/kg														
Elements															
Total Aluminum (Al)	mg/kg														
Total Antimony (Sb)	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	0.5	0%		
Total Arsenic (As)	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	2.5	0%	**5.9**	**17**
Total Barium (Ba)	mg/kg	20.8	125	12.8	40.6	117	72.6	128	53.9	100	1	74.5	60%		
Total Beryllium (Be)	mg/kg	<0.50	0.64	<0.50	<0.50	0.56	<0.50	<0.50	<0.50	0.65	0.5	0.4	50%		
Total Boron (B)	mg/kg														
Total Cadmium (Cd)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	0.25	0%	**0.6**	**3.5**
Total Chromium (Cr)	mg/kg	10	**39.2**	9.9	19.4	37.2	13.2	13.5	18.2	33.6	2	21.6	55%	**37.3**	**90**
Total Cobalt (Co)	mg/kg	2.9	9.8	2.1	4.4	13.1	3.1	4.7	5.4	8.8	2	6	62%		
Total Copper (Cu)	mg/kg	6.0	17.4	3.5	10.7	17.9	5.9	7.5	6.6	17.2	1	10	56%		
Total Iron (Fe)	mg/kg														
Total Lead (Pb)	mg/kg	<30	<30	<30	<30	<30	<30	<30	<30	<30	30	15	0%	**35**	**91.3**
Total Lithium (Li)	mg/kg														
Total Manganese (Mn)	mg/kg														
Total Mercury (Hg)	mg/kg	0.0095	0.0492	0.0076	0.0218	0.0143	0.0429	0.0586	0.0075	0.0249	0.005	0.026	74%	**0.17**	**0.486**
Total Molybdenum (Mo)	mg/kg	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	4	2	0%		
Total Nickel (Ni)	mg/kg	8.5	23.8	7.0	10.8	32.5	7.7	8.7	11.9	21.6	5	15	61%		
Total Phosphorus (P)	mg/kg														
Total Selenium (Se)	mg/kg	<2.0	<3.0	<6.0	<2.0	<2.0	<2.0	<3.0	<2.0	<3.0	3	1.4	47%		
Total Silver (Ag)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2	1	0%		
Total Strontium (Sr)	mg/kg														
Total Thallium (Tl)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1	0.5	0%		
Total Tin (Sn)	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	2.5	0%		
Total Uranium (U)	mg/kg														
Total Vanadium (V)	mg/kg	12.3	37.6	11.2	19.8	43.6	12.2	16.2	18.7	35.7	2	23	54%		
Total Zinc (Zn)	mg/kg	14.0	62.3	8.0	21.4	46.8	26.4	33.4	24.9	50.6	1	32	56%	**123**	**315**

NOTES:

1 If the sample concentration was less than the detection limit, half the detection limit was used to compute the average.

ISQG Interim freshwater sediment quality guidelines

PEL Probable effects levels

0.0056 Bold and underlined number is exceeding guideline value.

Table 7.7-C6. Grainsize Distribution of Watercourse Sediments

	MRW1	MRW2	MRW3	HRW1	OCW1	OCW2	OCW3	WRW1	WRW2
	16-Aug-07								
	Percent Finer (%)	Percent Finer (%)	Percent Finer (%)	Percent Finer (%)	Percent Finer (%)	Percent Finer (%)	Percent Finer (%)	Percent Finer (%)	Percent Finer (%)
% Gravel (>2mm)	100.0				100.0				
% Finer than 2 mm	95.0	100.0	100.0		95.0				
% Finer than 1 mm	80.0	99.0	97.0	100.0	94.0	98.0	99.0	100.0	
% Finer than 0.5 mm	47.0	97.0	88.0	99.0	89.0	94.0	96.0	98.0	
% Finer than 0.25 mm	30.0	96.0	66.0	96.0	83.0	88.0	93.0	93.0	99.0
% Finer than 0.125 mm	24.0	93.0	12.0	81.0	80.0	76.0	88.0	48.0	97.0
% Finer than 0.063 mm	21.0	87.0	8.0	52.0	77.0	44.0	68.0	27.0	92.0
% Finer than 0.0312 mm	19.0	80.0	7.0	26.0	70.0	26.0	47.0	22.0	73.0
% Finer than 4um	9.0	36.0	5.0	12.0	50.0	11.0	17.0	16.0	36.0
% Sand Size	74.0	13.0	92.0	48.0	18.0	54.0	31.0	73.0	7.0
% Clay Size	<9	< 36	<5	<12	<50	<11	<17	<16	<36
USDA Classification	Loamy sand	Silty clay loam	Sand	Loam	Silty clay loam	Sandy loam	Silt loam	Sandy loam	Silt loam

APPENDIX 7.8

Supplemental Material for Fisheries Resources

APPENDIX 7.8-A

2006 Fisheries Program - Photographs (Wardrop, 2007)

Figure 7.8-A1 Oakley creek at OCW-1, upstream of Highway 6, 12 October 2006 (Wardrop, 2007)

Figure 7.8-A2 Oakley Creak at station OCW-2, 22 August 2006 (Wardrop, 2007)

Figure 7.8-A3 Oakley Creak at station OCW-2, 22 August 2006 (Wardrop, 2007)

Figure 7.8-A4 Oakley Creak at station OCW-3, 16 May 2006 (Wardrop, 2007)

Figure 7.8-A5 Minago River downstream of Highway 6, Station MRW-1, 22 August 2006 (Wardrop, 2007)

APPENDIX 7.8-B

Supplemental Material to 2007 Fisheries Program

APPENDIX 7.8-B1

Photographic Log of the 2007 Fisheries Program

(URS, 2008b)

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 1	Date Taken: 4 Jun 07

Description:

Preparing backpack electrofisher.

Photo No. 2	Date Taken: 31 May 07

Description:

Electrofishing sample location MRF1.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 3	**Date Taken:** 31 May 07

Description:

Electrofishing sample location MRF2.

Photo No. 4	**Date Taken:** 4 Jun 07

Description:

Electrofishing sample location MRF3.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 5	Date Taken: 4 Jun 07

Description:

Sample location MRF1Looking downstream from Highway 6.

Photo No. 6	Date Taken: 4 Jun 07

Description:

Northern pike captured at sample location MRF3.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 7	Date Taken: 4 Jun 07

Description:

Dwarf white suckers captured at sample location MRF2.

Photo No. 8	Date Taken: 16 May 07

Description:

William River corridor from air.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 9	Date Taken: 4 Jun 07

Description:

William River at Highway 6 Bridge.

Photo No. 10	Date Taken: 4 Jun 07

Description:

Electrofishing sample location WRF3.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 11	**Date Taken:** 16 May 07

Description:

Sample location WRF2.

Photo No. 12	**Date Taken:** 4 Jun 07

Description:

Sample location WRF1.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 13	Date Taken: 4 Jun 07

Description:

Electrofishing ditch on west side of Highway 6.

Photo No. 14	Date Taken: 31 May 07

Description:

Measuring fish captured at sample location OCF1.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 15	Date Taken: 31 May 07

Description:

Lake-run white sucker captured at sample location OCF1.

Photo No. 16	Date Taken: 4 Jun 07

Description:

Sample location OCF2.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 17	**Date Taken:** 4 Jun 07

Description:

North tributary to Oakley Creek.

Photo No. 18	**Date Taken:** 4 Jun 07

Description:

Stream Reach 4 on Oakley Creek between beaver dams 4 and 5.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Fisheries Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No.	**Date Taken:**
19	4 Jun 07

Description:

Typical beaver dam and pond on Oakley Creek.

APPENDIX 7.8-B2

Streamflow Measurement & Fish Tissue Sampling Protocols

(URS, 2008b)

Streamflow Measurement Protocol (URS, 2008b)

During streamflow measurements, a meter tape was stretched bank to bank, perpendicular to the channel and depth measurements were taken at 1 m intervals for stream channels over 3 m in width or 1/3 m intervals for stream channels under 3 m in width. Mean stream flow velocity in meters/second was recorded at 60% of the stream depth in each subdivision. The subdivision areas were plotted and areas for each subdivision calculated. The instantaneous stream flow was estimated by multiplying each subdivision area by the mean velocity measured in the subdivision and summing the resulting volumes into a total instantaneous stream in cubic meters/second. The William River sample locations had soft substrates with no access to the other bank of the river. Flows for the William River were estimated by using a laser sight to measure the width of the channel, estimating the average depth of the river at the sample location, and recording the mean stream flow velocity in meters/second at 60% of the stream depth as far from the bank as possible. The instantaneous stream flow was then calculated using a single area (channel width x estimated average depth) and multiplying by the single mean velocity measurement.

Fish Tissue Sampling Protocol (URS, 2008b)

After preliminary identification to species and meristic measurements of the fish collected at a sample location, all of the specimens were placed, by species, in labelled ziplock bags. Only the smaller resident species were collected for later lab analysis. This was because the smaller, short-lived, resident fish present a more accurate baseline for metals uptake at each location (EPA 2000). Ideally, the same resident insectivorous/omnivorous (feeding on either insects or a mix of insects and vegetation) and piscivorous (feeding on smaller fish) species would have been collected at each sample site, but with the exception of a single northern pike, no piscivores were collected. In addition, no single species was collected at all sample locations. Although not present at all sample locations, the central mudminnow (*Umbra limi*) was the only species collected in all three watersheds.

Each bag was marked with the date, sample location, and species before being placed on ice in a cooler. At the end of the day, the ziplock bags containing the fish specimens were frozen in a freezer. Before driving to the Winnipeg airport from the project area at the end of the field study period, all of the ziplock bags were transferred to a cooler packed with ice. The samples were then transported by plane to Vancouver, BC and driven to the URS office in Seattle, Washington, where they were transferred to a freezer for temporary storage. The following week, samples, where the preliminary species identification was in question, were pulled from the freezer and the specimens keyed out using a dissecting microscope and the species keys in Scott and Crossman (1973). The specimens were then placed by species and sample location into ziplock bags labelled with an individual sample code for each species and sample location and repacked in a cooler filled with dry ice. A chain of custody form was then filled out for all of the samples and they were transported to Vancouver, BC for delivery to the Vancouver laboratory of ALS Canada Ltd, for analysis of metal concentrations. Each sample was analyzed as a single composite, with all of the fish of each species from each sample location ground whole before analysis for metal analytes.

APPENDIX 7.8-C

Supplemental Material to 2008 Fisheries Program

APPENDIX 7.8-C1

Scientific Collection Permit (April 14, 2008)

7.8–21

Manitoba

Fax

DATE April 14, 2008

TO

Name: Simon Thabault
Office: Roche ltd. Consulting Group
Fax No.: 418-654-9699
Phone No.:

c.c. Don Macdonald, Grant McVittie, NRO Wabowden 689-2390,
NRO Norway House 359-6515, NRO Grand Rapids 639-2523

FROM

Name: Laureen Janusz
Office: Manitoba Fisheries
Fax No.: 948-2308
Phone No.: 945-7789

Total No. of Pages (including this one):

REMARKS Please sign permit and fax back to 948-2308. Thank you.

MANITOBA WATER STEWARDSHIP
AQUATIC ECOSYSTEM SECTION

SCIENTIFIC COLLECTION PERMIT

Issued under the authority of the Fisheries Act (Manitoba) and the Fishing Licence Regulation and Fishing Licence Fee Regulation made thereunder.

Issued to: Simon Thibault

of: Roche Ltd. Consulting Group, Quebec City, Quebec F 418 654-9699
is hereby authorized to collect, transport and possess fish within the Province of Manitoba subject to the following conditions:

1. Release live fish and macro invertebrates only in the water from which they were taken.

2. Fish may not be sold, traded or bartered.

3. The use of chemicals and explosives as aids in collecting fish is prohibited.

4. This permit expires on 27-May-2008 following date of issue.

5. A report must be submitted to Fisheries Branch, Box 40, 200 Saulteaux Crescent, Winnipeg, MB R3J 3W3 and the appropriate regional fisheries office (see attachment) indicating; location, species, number and disposition of the collected specimens, by the end of February, 2009.

6. Project Title: Invert, fish and fish habitat assessment within the Minago River Area

7. Special Conditions: See attachment.

Laureen Janusz — Laureen Janusz
Issued by

Fisheries Biologist
Title

April 14, 2008
Date of Issue

Signature of Permittee

Permit Number: 10-08

Attachment to Scientific Collection Permit No. 10-08

- Permittee is authorized to capture fish and invertebrates as part of a fisheries assessment within the Minago River area.

- Only fish required for scientific purposes may be retained. All other fish must be released at site of capture, or, if dead, disposed of as approved by local Natural Resource Officer or Regional Fisheries staff.

- This permit does not authorize the collection of any SARA species. Unless a permit is obtained from DFO, all SARA species are to be released immediately: size and location must be noted in collection report.

- All sturgeon to be released alive immediately to the waters they were collected from once data is collected unless the retention of sturgeon is authorized by this permit. No sturgeon may be purposely killed without prior written approval of the Regional Fisheries Manager (RFM) – Don Macdonald 677-6650. Any incidental mortality must be reported to the RFM within seven days of the mortality occurrence. Data must be collected in a manner that does not cause undue stress or mortality to the sturgeon.

- Permittee may fish within the Minago River area. Specific locations are identified below.

- Permittee may use the following gear: ponar, hoop nets, bait traps and experimental gang nets. All gear must be clearly marked with permitee's name and contact information.

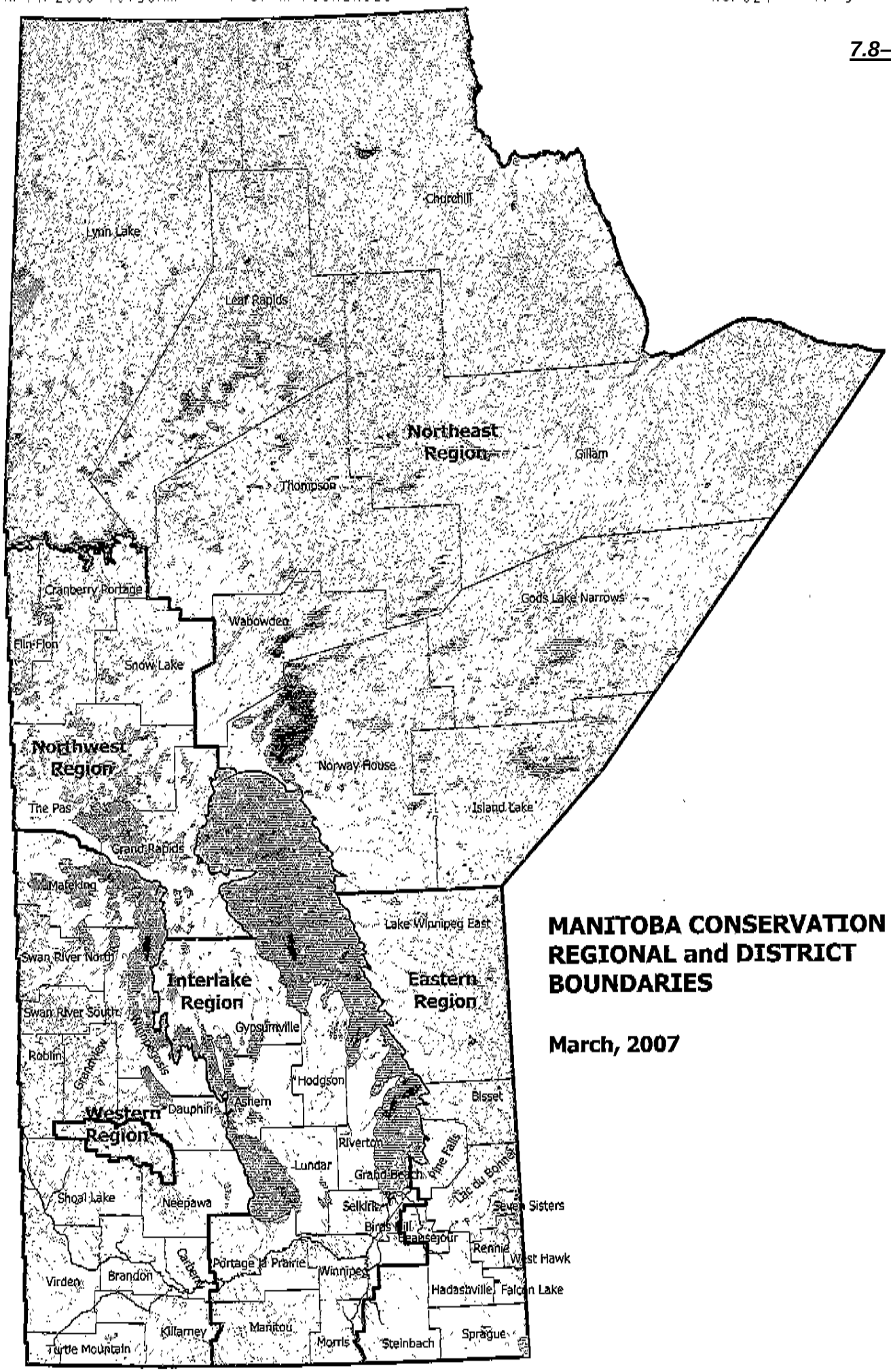
- Given the potential to transfer introduced fish species and other unwanted biota (rainbow smelt, Asian tapeworm, rusty crayfish, purple loosestrife, etc.) that are now present in some waterbodies the permittee must ensure no transfer of water and fish between sampling locations and the gear must be cleaned, disinfected and visually inspected between sampling locations.

- The permit covers those individuals who are working under the direction of the individual identified on the permit. They must retain a copy of the permit if sampling on their own.

- Appropriate district offices **must be notified** of collection activities **prior to** commencing. A contact list for the District Offices and a map are attached.

Fishing Locations (UTM; NAD83)

Stations	Water bodies	GPS Coordinates	
HLF1	Hill Lake	502163	6012828
LBF1	Limestone Bay	504066	5968952
CLF1	Cross Lake	555324	6046198
MRF1	Minago River	488684	6005275
MRF2	Minago River	488527	6004902
MRF3	Minago River	488362	6005308
OCF1	Oakley Creek	489238	5990528
OCF2	Oakley Creek	487136	5990978
OCF3	Oakley Creek	487048	5990931
WRF1	William River	495419	5987166
WRF2	William River	496578	5986330
WRF3	William River	484762	5973598



MANITOBA CONSERVATION REGIONAL and DISTRICT BOUNDARIES

March, 2007

Region	Office Type	Town	Phone	Fax
Eastern	Regional	Lac du Bonnet	345-1431	345-1440
	District	Beausejour	268-6184	268-6177
	District	Bissett	277-5212	277-5478
	District	Falcon Lake	349-2201	349-8531
	District	Hadashville	426-5313	426-2125
	District	Lac du Bonnet	345-1400	345-1409
	District	Lake Winnipeg East	345-1400	
	District	Pine Falls	367-2481	367-2840
	District	Rennie	369-5246	369-5341
	District	Seven Sisters	348-2203	348-7141
	District	Sprague	437-2348	437-2653
	District	West Hawk Lake	349-2245	349-8528
Interlake	Regional	Gimli	642-6070	642-6108
	District	Ashern	768-2368	768-2139
	District	Birds Hill	222-9151	222-4858
	District	Grand Beach	754-2212	754-8977
	District	Gypsumville	659-5208	659-2696
	District	Hodgson	372-6296	372-6360
	District	Lundar	762-5229	762-5058
	District	Riverton	378-2261	378-5274
	District	Selkirk	785-5080	785-5082
	District	Winnipeg Beach	389-2752	389-5422
Northeast	Regional	Thompson	677-6648	677-6359
	District	Churchill	675-8897	675-2423
	District	Gillam	652-2273	652-2821
	District	Gods Narrows	335-2366	335-2682
	District	Island Lake	456-2362	456-2190
	District	Leaf Rapids	473-8133	473-2574
	District	Lynn Lake	356-2413	356-2329
	District	Norway House	359-6877	359-6515
	District	Thompson	677-6640	677-6856
	District	Wabowden	689-2688	689-2390
Northwest	Regional	The Pas	627-8215	623-5733
	District	Cranberry Portage	472-3331	472-3542
	District	Flin Flon	687-1640	687-1643
	District	Grand Rapids	639-2241	639-2523
	District	Snow Lake	358-2531	358-7142
Red River	Regional	Winnipeg	945-7100	948-2420
	District	Manitou	242-2950	242-2153
	District	Morris	746-6567	746-6570
	District	Portage la Prairie	239-3204	239-3215
	District	Steinbach	346-6110	326-6768
	District	Winkler	325-1750	325-1758
	District	Winnipeg	945-7257	945-2834
Western	Regional	Brandon	726-6304	726-6301
	District	Boissevain	534-7204	534-6858
	District	Brandon	726-6441	726-6518
	District	Carberry	834-8800	834-8804
	District	Dauphin	622-2106	638-8626
	District	Grandview	546-5000	546-5005
	District	Killarney	523-5200	523-5202
	District	Mafeking	545-2263	545-2115
	District	McCreary	835-2806	835-2807
	District	Neepawa	476-2076	476-5015
	District	Roblin	937-2181	937-8091
	District	Shoal Lake	759-4080	759-2781
	District	Swan River	734-3429	734-4210
	District	Virden	748-4240	748-3765
	District	Winnipegosis	656-4871	656-4417

APPENDIX 7.8-C2

Nikolsky Scale

Stages of Sexual Maturity – Nikolsky Scale

Level	Stage	Description
1	Immature	Young individuals not yet participating in reproduction Gonads are very small in size
2	Rest	No development of the sexual products Gonads are very small in size Eggs are not visible to the naked eye
3	In maturation	Eggs are visible to the naked eye Gonads are growing very rapidly in mass The colour of the testicles changes from transparent to pale pink
4	Mature	Sexual organs are ready for reproduction Gonads are at their maximum size, but there is no discharge from the sexual organs when slight pressure is applied
5	Reproduction	Sexual products are discharged by exerting slight pressure on the stomach The mass of the gonads decreases rapidly between the beginning and the end of spawning
6	Spent	Sexual products have been released Inflammation of the genital area Gonads appear shrunken and bag-like A few eggs may remain in the ovaries and testicles may contain residual sperm
7	Recovering spent	Sexual products have been released Inflammation of the genital area diminishes Gonads are very small in size Eggs are not visible to the naked eye

APPENDIX 7.9

Supplemental Material for the Vegetation Survey

Photographs of the 2007 Vegetation Survey (URS, 2008d)

OBSERVATION SITE MN 1:

Intermediate Open Mixed Tree, looking NE

Intermediate Open Mixed Tree, ground cover

OBSERVATION SITE MN 2:

Dwarf Open Mixed Tree, looking NW

Dwarf Open Mixed Tree, ground cover

OBSERVATION SITE MN 3:

Intermediate Closed Mixed Tree, looking N

Intermediate Closed Mixed Tree, ground cover

OBSERVATION SITE MN 4:

Dwarf Open Evergreen Tree, looking N

Dwarf Open Evergreen Tree, ground cover

OBSERVATION SITE MN 5:

Intermediate Open Evergreen Tree, looking NE

Intermediate Open Evergreen Tree, ground cover

OBSERVATION SITE MN 6:

Intermediate Closed Deciduous Shrub, looking NW

Intermediate Closed Deciduous Shrub, ground cover

OBSERVATION SITE MN 7:

Intermediate Open Evergreen Tree, looking W

Intermediate Open Evergreen Tree, ground cover

OBSERVATION SITE MN 8:

Intermediate Closed Evergreen Tree, looking W

Intermediate Closed Evergreen Tree, ground cover

OBSERVATION SITE MN 10:

Low Closed Mixed Herb, looking W

Low Closed Mixed Herb, ground cover

OBSERVATION SITE MN 11:

Low Closed Mixed Herb, looking W

Low Closed Mixed Herb, ground cover

OBSERVATION SITE MN 12:

Dwarf Closed Evergreen Tree, looking N

Dwarf Closed Evergreen Tree, ground cover

OBSERVATION SITE MN 13:

Intermediate Closed Evergreen Tree, looking W

Intermediate Closed Evergreen Tree, ground cover

OBSERVATION SITE MN 14:

Dwarf Open Evergreen Tree, looking W

Dwarf Open Evergreen Tree, ground cover

OBSERVATION SITE MN 15:

Dwarf Open Evergreen Tree, looking NW

Dwarf Open Evergreen Tree, ground cover

OBSERVATION SITE MN 18:

Dwarf Closed Evergreen Tree, looking SW

Dwarf Closed Evergreen Tree, ground cover

OBSERVATION SITE MN 19:

Intermediate Sparse Deciduous Shrub, looking W

Intermediate Sparse Deciduous Shrub, looking S across river

OBSERVATION SITE MN 19 (or 20??) in URS Report MN 19:

Intermediate Sparse Deciduous Shrub, looking W across riparian area

Intermediate Sparse Deciduous Shrub, ground cover

OBSERVATION SITE MN 21:

Dwarf Open Evergreen Tree, looking NW

Dwarf Open Evergreen Tree, ground cover

OBSERVATION SITE MN 22:

Low Closed Mixed Herb, looking N

Low Closed Mixed Herb, ground cover

OBSERVATION SITE MN 23:

Intermediate Open Deciduous Shrub, looking SW

Intermediate Open Deciduous Shrub, ground cover

OBSERVATION SITE MN 25:

Low Closed Mixed Herb, looking SW

Low Closed Mixed Herb, ground cover

EAST OF OBSERVATION SITE MN 25:

Trail east of observation site MN 25: Abundant *Bidens cernua* present, indicative of invasive species spreading on some of the trails

NEAR OBSERVATION SITE MN 13:

Trail bisecting proposed project area east to west, near OBSERVATION SITE MN 13: Abundant *Equistem fluviatile*, indicative of invasive species spreading on some of the trails

HIGHWAY 6:

Highway 6, east of the proposed project area, looking N: Large cleared shoulders on either side of road have created suitable habitat for some invasive plant species (refer to observation site MN 22).

COLLECTION OF PLANT TISSUE SAMPLES:

Collecting plant tissue samples for metals analysis at observation site MN 24

APPENDIX 7.10

Supplemental Material for the Wildlife Survey

Photographs of 2007/2008 Wildlife Survey (URS, 2008e)

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Wildlife Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 1	**Date Taken:** 15 Jan 08

Description:

Bull moose in burned-over area.

Photo No. 2	**Date Taken:** 15 Jan 08

Description:

Moose Lake winter road looking west from Project Site.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Wildlife Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 3	Date Taken: 16 Jan 08

Description:

Snowshoe hare tracks.

Photo No. 4	Date Taken: 2 Apr 07

Description:

Moose habitat along Highway 6 at Minago River.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Wildlife Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 5	Date Taken: 15 Jan 08

Description:

Cow moose at edge of burned-over area.

Photo No. 6	Date Taken: 3 Jun 07

Description:

Typical shrub browse and beaver pond on Oakley Creek.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Wildlife Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 7	**Date Taken:** 7 Jun 07

Description:

Closed canopy black spruce forested wetland.

Photo No. 8	**Date Taken:** 7 Jun 07

Description:

Shrub habitat at Project Site.

URS

PHOTOGRAPHIC LOG

VICTORY NICKEL INC.	Wildlife Environmental Baseline Studies Minage Project, Near Grand Rapids, Manitoba

Photo No. 9	**Date Taken:** 7 Jun 07

Description:

Dwarf black spruce wetland.

Photo No. 10	**Date Taken:** 5 Jun 07

Description:

Typical Project Area habitat in vicinity of drilling sites.

APPENDIX 7.13

Supplemental Material for the Archaeological Impact Survey

APPENDIX 7.13-A

Heritage Permit A40-08 (Quaternary Consultants Ltd., 2008)

The Heritage Resources Act (Subsection 14(2) and Sections 52 and 53)

Manitoba
Culture, Heritage, Tourism and Spo

Heritage Permit No. A40-08

Pursuant to Section/~~Subsection~~ 53 of *The Heritage Resources Act*:

Name: Sid Kroker
Quarternary Consultants Ltd.
Address: 130 Fort Street
Winnipeg, MB R3C 1C7

Attention: **Sid Kroker**

(hereinafter referred to as "the Permittee"),

is hereby granted permission to:
Conduct HRIA of proposed Victory Nickel mining development area approximately 60 km north of Gran Rapids (Adjacent to Hwy 6) Manitoba.

during the period:

June 11 to June 30th, 2008

This permit is issued subject to the following conditions:

(1) That the information provided in the application for this permit dated the 29th day of April, 2008, is true in substance and in fact;

(2) That the permittee shall comply with all the provisions of *The Heritage Resources Act* and any regulations or orders thereunder; PLEASE NOTE ATTACHMENT RE CUSTODY AND OWNERSHIP OF HERITAGE OBJECTS;

(3) That the Permittee shall provide to the Minister a written report or reports with respect to the Permittee's activities pursuant to this permit, the form and content of which shall be satisfactory to the Minister and which shall be provided on the following dates:

March 31, 2009

(4) That this permit is not transferable;

(5) This permit may be revoked by the Minister where, in the opinion of the Minister, there has been a breach of any of the terms or conditions herein or of any provision of *The Heritage Resources Act* or any regulations thereunder;

(6) Special Conditions:

a. The permittee must obtain permission from any landowner, lessee or regulatory authority as applicable, concerning access to any property to be examined;

b. Neither the Government of Manitoba nor the party issuing this permit shall be liable for any damages resulting from any activities carried out pursuant to this permit, and the Permittee specifically agrees, in consideration for receiving this permit, to indemnify and hold harmless the Minister and the Government of Manitoba, the Minister and any employees and officials of the Government, against any and all actions, liens, demands, loss, liability, cost, damage and expense including, without limitations, reasonable legal fees, which the Government, Minister or any employee or official of the Government may suffer or incur by reasons of any of the activities pursuant to or related to this permit..

c. The permittee has, along with this permit, received enclosure: *Provisions Regarding Found Human Remains Under THE HERITAGE RESOURCES ACT, And* Manitoba's *Policy Respecting the Reporting, Exhumation and Reburial of Found Human Remains* (1987).

Dated at the City of Winnipeg, in Manitoba, this 16st day June, 2008

p Neil Em
Minister of Culture, Heritage, Tourism and Sport

Manitoba Culture, Heritage, Tourism and Sport
Historic Resources Branch

APPENDIX 7.13-B

Archaeological Impact Assessment Report

ARCHAEOLOGICAL IMPACT ASSESSMENT OF THE MINAGO MINING SITE

Submitted to

Victory Nickel Limited

QUATERNARY
CONSULTANTS
LIMITED

July, 2008

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LIST OF PLATES

1.0 INTRODUCTION

The company, Victory Nickel Limited, is planning to develop a mine adjacent to Highway 6, between Grand Rapids and Thompson. As part of the EIS, the company has retained Quaternary Consultants Ltd. to conduct an archaeological impact assessment of the development area.

A field team of archaeologists was dispatched to the area on June 19, 2008. The survey was conducted under the terms of Heritage Permit A40-08, issued by Historic Resources Branch, Manitoba Culture, Heritage and Tourism (Appendix A).

2.0 LOCATION AND SCOPE

The Victory Nickel Minago Mine development site is located 105 kilometres north of Grand Rapids, Manitoba. The area lies to the west of Highway 6 and is bounded to the south by Oakley Creek. The location is depicted on Gladish Lake 1:50,000 topographical map (63J/3). The map denotes no significant topographical features. The area, as well as most of the surrounding terrain, is depicted as marsh/swamp. A large-scale photomosaic map of the development zone confirms the designation of the topographic map as a water-saturated, marshy area where cut-lines and tracks have standing water.

The development zone consists of five components within an area of approximately 16 square kilometres. The major component is the open pit mine which lies in the north-central portion of the zone with two of the three waste dumps to the east. The third waste dump is located west of the mine and the tailings pond further to the west.

3.0 STUDY TEAM

The project was directed by Sid Kroker, Senior Archaeologist of Quaternary Consultants Ltd. The field investigation team was led by David K. Riddle with Mark Paxton-MacRae as field assistant. The report was prepared by Sid Kroker, David Riddle, and Pam Goundry.

4.0 PHYSICAL SETTING

The entire area is a sphagnum moss black spruce and tamarack swamp with an understory of willow and swamp grasses. The depth of the waterlogged sphagnum is approximately 50 centimetres where it bottoms out on a flat limestone sub-strate.

The shores of Oakley Creek grade imperceptibly into the black spruce swamp and provide no high ground for campsite locations. In addition, the creek would not be navigable by canoe if it were not for beaver dams which provide some deeper spots through which one can paddle before having to pull the canoe over the next beaver dam (Dave Tyson 2007:pers. comm.).

5.0 INVESTIGATION METHODS

The original method of investigating the development was to be foot traverses through the forest to the proposed open pit area, visually examining the ground surface. This would have been augmented by shovel testing in areas which could hold archaeological potential. Upon reaching the area (Plate 1), the crew found that an access road (Plate 2) had been constructed. They then utilized this very wet (Plate 3), but useable, winter road to gain access to the mine location. After passing a core storage area (Plate 4), the crew continued further along the winter road. In some areas, the road was too wet to walk and they were forced to utilize the undeveloped edges of the road. Conditions continued to worsen as they proceeded to the southwest. The crew continued walking until the GPS readings indicated that the northern edge of the pit had been reached.

It quickly became obvious that the thick, saturated sphagnum layer would cover any archaeological resources that would date back beyond twenty years. A few shovel tests were attempted on route from the highway to the mine pit location (Plate 5). Others were excavated on cut lines radiating from the winter road (Plate 6) or side roads (Plate 7). Once the upper layer of sphagnum was removed, the standing water would infill the hole where the moss had been. It was impossible to see through this dark water. The base of each test pit is solid limestone, approximately 50 centimetres below the top of the existing sphagnum cover.

At the pit location, the crew observed that , further to the south, open water was present on the surface. In non-flooded areas, there was no chance of locating heritage resources due to the impenetrability of the terrain and the thick sphagnum cover. The decision was made to terminate the survey.

6.0 DISCUSSION

The general area is very low and wet with the nearest lake (William Lake) being located approximately 19 kilometres to the southwest of the mine development. Drains have been developed to lower the water table in the area (Plate 8). Conditions in the past were probably much wetter than the current situation. None of the creeks are navigable and it is doubtful the area was ever utilized by Pre-contact people. Minago River, located a distance north of the development, is somewhat navigable but too far away to be an influence in the development zone.

It is virtually impossible that any use could have been made of the mine site vicinity during Pre-contact times. The area is located at a considerable distance from lakes or navigable rivers and access at any time of the year would be very difficult. Any use of this location that might have occurred would have happened during the winter months and probably would have been related to the fur trade. It would be impossible to predict where such activity would have taken place as traplines are relocated every year to accommodate animal movement. Even if resources from this activity were present, they would be buried deep in the sphagnum moss that covers the area and would be impossible to locate. Comprehensive testing in such conditions would prove nearly impossible and the odds of finding anything using such a technique would be astronomical.

Plate 1: Access to Development Site off Highway 6

Plate 2: Winter Road into Development Site

Plate 3: Saturated Condition of Winter Road

Plate 4: Core Storage Area

Plate 5: Excavating Test Pit along Winter Road

Plate 6: Excavating Test Pit on Cut Line

Plate 7: Secondary Access Road Within Development Site

Plate 8: Drainage Ditch Leading from Development Site along Highway 6

7.0 RECOMMENDATIONS

The original analysis of the location indicated a very low potential for archaeological resources. The field investigations confirmed that archaeological potential was extremely low. It is highly improbable that the area was used by inhabitants prior to the introduction of the fur trade. The possibility of finding any evidence of Pre-contact utilization of the area is next to impossible and the likelihood of locating any evidence of Fur Trade or later use, other than prospecting and mining activities, is extremely minimal.

The field team leader, David Riddle, has nearly forty years of experience in Boreal Forest archaeology. Based upon his assessment of the area, Quaternary Consultants Ltd. **can recommend that the development proceed as there will be no impact upon archaeological resources**.

APPENDIX A

HERITAGE PERMIT

The Heritage Resources Act (Subsection 14(2) and Sections 52 and 53)

Manitoba
Culture, Heritage, Tourism and Spc

Heritage Permit No. A40-08

Pursuant to Section/~~Subsection~~ 53 of *The Heritage Resources Act*:

Name: Sid Kroker
Quarternary Consultants Ltd.
Address: 130 Fort Street
Winnipeg, MB R3C 1C7

Attention: **Sid Kroker**

(hereinafter referred to as "the Permittee"),

is hereby granted permission to:
Conduct HRIA of proposed Victory Nickel mining development area approximately 60 km north of Gran Rapids (Adjacent to Hwy 6) Manitoba.

during the period:

June 11 to June 30th, 2008

This permit is issued subject to the following conditions:

(1) That the information provided in the application for this permit dated the 29th day of April, 2008, is true in substance and in fact;

(2) That the permittee shall comply with all the provisions of *The Heritage Resources Act* and any regulations or orders thereunder; PLEASE NOTE ATTACHMENT RE CUSTODY AND OWNERSHIP OF HERITAGE OBJECTS;

(3) That the Permittee shall provide to the Minister a written report or reports with respect to the Permittee's activities pursuant to this permit, the form and content of which shall be satisfactory to the Minister and which shall be provided on the following dates:

March 31, 2009

(4) That this permit is not transferable;

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Dated at the City of Winnipeg, in Manitoba, this 16st day June, 2008

Minister of Culture, Heritage, Tourism and Sport

Manitoba Culture, Heritage, Tourism and Sport
Historic Resources Branch

APPENDIX 7.13-C

Letter from Manitoba regarding Archaeological Impact

Manitoba

Memorandum

DATE: August 5, 2008

TO: Quarternary Consultants Limited
130 Fort Street
Winnipeg, MB R3C 1C7

FROM: Myra Sitchon
Impact Evaluation Archaeologist
Historic Resources Branch
Main Floor 213 Notre Dame Avenue
Winnipeg MB
R3B 1N3
PHONE NO: (204) 945-6539

SUBJECT: Victory Nickel Limited - Assessment of the Minago Mining Site

We have reviewed the final report for permit A40-08 - Archaeological Impact Assessment of the Minago Mining Site. We have accepted the report as a fullfillment of the conditions outlined for permit A40-08 and have no further concerns or recommendations. Clearance is set for Victory Nickel Limited to proceed with the project.

If at any time however, significant heritage resources are found in association with these lands during the undertaking of this project , the Historic Resources Branch may require that an acceptable heritage resource management strategy be implemented by the developer to mitigate the affects of development on the heritage resources.

If you have any questions or comments, please contact me at 945 6539.

Myra Sitchon