APPENDIX 6.2.7-C

USE OF WETLANDS TO MANAGEMENT WATER QUALITY

Use of Wetlands to Manage Water Quality

Wetlands are unique and sensitive ecological units and provide valuable functions in the natural environment. These functions include providing necessary breeding habitat for a variety of organisms; erosion and flood control; groundwater recharge; and nutrient transport. Wetlands are generally characterized by the presence of three basic parameters, soils, hydrology and vegetation. Water is usually present at the surface or within the root zone for extended periods of time. As a result of the saturated conditions that occur as a result of this water, the soils present in wetlands develop certain unique conditions that are different from upland soils. Also, in response to the saturated conditions, wetlands support vegetative species that are adapted to living in wet conditions.

Natural wetlands have, in part, evolved in response to the chemical constituents in the water that flows through them. Water that flows over surfaces with sufficient velocity to suspend solid particles or to dissolve substances eventually makes its way to receiving waters (lakes, ponds, oceans etc.). In some areas of low hydraulic gradient, the water velocity slows appreciably, and suspended solids settle out of the water column, forming a bed of sediments. These sediments are often rich in organic matter and soil nutrients, a favorable medium for plant growth. Wetland plants, whose seeds are dispersed ubiquitously in soils, begin to grow in the sediments where water flows are quiescent and water depth is shallow enough to permit their emergence. The wetland plants, in turn, remove dissolved contaminants such as nitrogenous compounds from the water and act to further decrease water velocity, resulting in increased sediment deposition

Three large wetland complexes associated with Duke Ravine, FalC Ravine and Wapiti Ravine can be found in close proximity of the PKCF. These wetlands are a complicated system of different wetland classification types, including bogs, swamps, marshes and open waters. It has been estimated that a portion of the seepage water and potentially surface runoff from the PKCF will bypass the ditches around the toe of the facility and be discharged into those wetlands. The actual volume of seepage projected to flow into these wetlands is relatively minor (up to 1,000 m3/day or approximately 0.001 m3/s between the 3 possible wetlands); however, the water will potentially carry suspended or dissolved concentrations of a wide variety of nutrients, major ions, and metals (See Table 1).

Table 1: Potential Parameters for Treatment

Metals	Major Ions	Conventional Parameters
Aluminum	Bicarbonate	Total alkalinity
Antimony	Calcium	
Arsenic	Carbonate	
Barium	Potassium	
Beryllium	Sodium	
Bismuth	Sulfate	
Boron	Ammonia as nitrogen	
Cadmium	Nitrate	
Chromium		
Cobalt		
Copper		
Iron		
Lead		
Manganese		
Mercury		
Molybdenum		
Nickel		
Selenium		
Silver		
Strontium		
Thallium		
Tin		
Uranium		
Vanadium		
Zinc		

Surveys were conducted of the wetlands to characterize the hydrologic conditions (inundation, saturation, depth to groundwater), soil, and biological community. The wetlands in large part were heavily vegetated, dominated by diverse strata of trees, shrubs and herbaceous species. Field results are presented in Attachment A.

The tree layers contained a variety of species including trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), jack pine (*Pinus banksiana*), black spruce (*Picea mariana*), white spruce (*Picea glauca*), and larch (*Larix laricina*). Several species of willows (*Salix* sp.) were also identified. Shrub species included such species as bog birch (*Betula pumila*), marsh Labrador tea (*Rhododendron tomentosum*), and lingonberry (*Vaccinium vitis-idaea*). Herbaceous species included marsh reed grass (*Calamagrostis canadensis),* arrow-leaved coltsfoot (*Petasites sagittatus),* water sedge **(***Carex aquatilis) and* horsestail (*Equisetum arvense*).

Some small bogs were found in association with the larger swamps, dominated by such species as peat moss (Sphagnum) and feather moss (Hylocomium splendens).

Soils were generally comprised of an organic stratum of varying thickness, overlaying mineral strata of sands and loamy sands. Soils were dark and anoxic, with high levels of organic material (averaging about 30% total organic carbon). The water found within the wetland generally had a neutral to basic pH. Soil and water chemistry results are presented in attachment B.

The complex of wetlands into which the water will be discharged will act as a natural treatment system to passively manage these constituents and prevent them from being carried further downstream. One of the primary functions of wetlands is in filtering water moving through the system and removal of both dissolved and suspended constituents. Treatment efficiencies presented in the literature and used in the water quality model are summarized in 6.2.7-A.

Natural wetlands possess biogeochemical processes to remove organic and/or inorganic constituents that are found in constructed wetlands used to treat wastewater streams. The dominant constituent removal processes in wetlands are settling, biotransformation (microbial and plant-mediated), and plant uptake.

Physical processes play an important role in constituent reduction, especially for removal of inorganic and suspended solids. Gravitational settling is responsible for most of the removal of suspended solids. Gravity promotes settling by acting upon the relative density differences between suspended particles and water. Efficiency of TSS removal is proportional to the particle settling velocity and length of the wetland. Wetlands promote sedimentation by decreased water velocity and the filtering effect of plant stems and leaves. While settling and sedimentation are often used interchangeably (Tchobanoglous 1991), sedimentation represents physical compression and consolidation of settled solids in the detritus (litter layer). The compression is due to the ever-increasing mass of particles landing in this area. Although sedimentation is usually irreversible, resuspension may occur due to high water flow rate, wind-driven turbulence, bioturbation and gas lift (resulting from oxygen, methane, carbon dioxide production during photosynthesis and organic matter decomposition).

Wetlands remove metals from water through a variety of biogeochemical processes. Wetlands remove metals through filtration of suspended particles out of the water column, uptake and absorption of metals by plants within the wetlands, and precipitation of the metals as a result of adjustments in the pH. The ability of the wetlands to remove metals is generally a function of the high proportion of humic material and other organic substances that is found within the wetlands substrate (Wildeman et al., 1991). The processes of note include adsorption on to plants or soil particles, ion exchange, bioaccumulation, bacterial and abiotic oxidation, sedimentation, neutralization, reduction, and dissolution of carbonate materials (Perry and Kleinman, 1991). Sobolewski (1997) notes that plant roots will retain arsenic and other metals. Schnoor (1997) notes that emergent and submergent aquatic plants within created wetlands will remove lead, copper, nickel, cadmium and zinc through rhizofiltration processes.

Fenessy and Mitsch (1989) note that soluble metals are converted to insoluble forms as a result of the anoxic conditions found within wetland sediments. One of the control factors in this function is the pH of the supporting waters. In acidic waters, metals are soluble and tend to remain mobilized. In waters with higher pH's, the metals are insoluble and are acted upon by adsorption and precipitation mechanisms.

MΦhlum (1999) cites a large number of studies in cold weather (mean temperatures below 26.6^{o} F in winter and above 50^{o} F in the summer) regions of the world (Canada, northern United States, Scandinavia, and Eastern Europe) documenting the success of constructed wetlands to treat wastewaters. He reports that the processes that primarily effect metals in

wetlands (sorption and precipitation) are unaffected by temperature. Kadlec and Knight (1996) support this premise.

Wetlands sequentially degrade and eliminate most organic pollutants, other organic matter, and nutrients primarily through biological activity. Some chemicals will be transformed into less noxious or less hazardous substances while others will be translocated, immobilized, or concentrated. The majority of compound transformations and immobilization occurs as a result of biological activity within wetland soils, sediment, and detritus layers. The layers bind organic chemicals, inorganic compounds, and metals. At the same time, bound biodegradable compounds are either fully degraded or further transformed into less toxic compounds. Partially treated pollutants, transformed contaminants, and volatile compounds can exit a wetland through atmospheric diffusion, groundwater leakage, and the system outlet.

In conclusion, the three wetlands surrounding the PKCF comprise a large, heterogeneous complex supporting all the components of functioning wetlands able to passively accept low volumes of water containing organic and/or inorganic constituents. These wetlands support natural biogeochemical and physical processes that will remove these constituents. As documented in the water quality modeling, the removal efficiencies that are expected will address those constituents.

References

Fennessy, S. and W.J. Mitsch. 1989. Design and use of wetlands for renovation of drainage from coal mines. *in* W.J. Mitsch and S.E. Jorgensen (*eds.*) Ecological Engineering: An Introduction to Ecotechnology. John Wiley & Sons, New York, NY.

Kadlec, R.H. and G.A. Keoleian. 1986. Metal Ion Exchange on Peat. *in* C.H. Fuchsman (*ed*.) Peat and Water. Elsevier Press, NY.

Kadlec, R.H. and R.L. Knight. 1996. Treatment Wetlands. Lewis Publishers, Baco Raton, FL.

Kleinman, R.L. 1985. Treatment of acid mine water by wetlands. *in* Control of Acid Mine Drainage. Proceedings of Technology Transfer Seminar. Bureau of Mines Circulator #9027. U.S. Department of Interior. pp. 48-52.

Maehlum, T., 1999, “Wetlands for Treatment of Landfill Leachates in Cold Climates,” Chapter 3, pp 33–46, *Constructed Wetlands for the Treatment of Landfill Leachates*, eds. G.

Maulamoottil, E.A. McBean, and F. Rovers. Boca Raton, Fla.: Lewis Publishers, Inc.

Schnoor, J.L. 1997. Phytoremediation. Technology Evaluation Report TE-98-01. Ground-Water Remediation Technologies Analysis Center.

Sobolewski, A. 1997. Wetlands for treatment of mine drainage. Infomine Website http://www.enviromine.com/wetlands/Welcome.htm.

Weider, R.K., G.E. Lang, and A.E. Whitehouse. 1985. Metal removal in Sphagnum dominated wetlands: experience with a man-made wetland system. *in* Wetlands and Water Management on Mined Lands: Proceedings of an Oct 23-24, 19985 Conference at The Pennsylvania State University, University Park, PA, pp. 353-364.

Wildeman, T., J. Gusek, J. Dietz, and S. Morea. 1991. Handbook for Constructed Wetlands Receiving Acid Mine Drainage, USEPA, Cincinnati, OH.

Attachment A - Field Results

Attachment A - Field Results

Site	Observer	Date	UTM N	E	Photo?	Depth to Water	Slope Position	Drainage	Slope	Aspect	Topography	Horizon	Depth Upper	Lower	Von Post/ Texture	Color	Stoniness	Consistency	Samples?	Field pH	EC	Temp	Fizz?	% Water	% tree	% shrub	Trees (10x10) Species	count	height	Shrubs (10x10) Species	Cover	Shrubs (10x10) Species	Cover	Comments
01 (1)	ER/CW	12-Aug-11	5902206	516268	No	0	depression	VP	0	na	level	Om	0	50	H3	Black	0	VL	No	6.4	336	17.6	No	15	50	5	Salix Sp.	Many	6	Bog birch	1	Salix Sp.	1	Wetland width approx. 10m, plot location in center of wetland width
												Om	50	85	H5	Dark Brown	0	VL									tA	35	8	Marsh reed grass	7	Current	1	
												Oh	85	100	H6	Dark Brown	0	VL									bPo	20	8	Fireweed	+	Feather Moss	1	
												CG	100	+	Sandy Loam	Grey	0	VL												Dewberry	+	Woodsy leafy moss	2	
01 (2)	ER/CW	12-Aug-11	5902140	516217	No	0	depression	VP	0	na	level	Om	0	40	H3	Black	0	VL	No					60	80	5	Same as 01 (1)			Same as 01 (1)				Small channel at 516214E 5902145N
												CG	40	+	Loamy Sand	Grey	0	VL															Organic depth at the center of channel is (0-100cm Om H4, 100+ cG)
																																	West side of wetland 516210E, 5902152N (0-35cm Om H3, 35+ cm cG)
01(3)	ER/CW	12-Aug-11	5902024	516195	No	0	level	VP	0	na	level	Om	0	75	H3	Black	0	VL	No					50	5	70	Salix Sp.	Many	3	Salix Sp.	2	Dewberry	+	Small channel appears to be 2m West of plot
												Om	75	110	H4	Dark Brown	0	VL												Water Sedge	7			West side of a open pond meets upland @ 516181, 5901091N.
												CG	110	+	Sandy Loam	Grey	0	VL												Marsh Reed Grass	1			East side od pond meets wepland @ 516206E, 5902080N.
01 (4)	ER/CW	12-Aug-11	5902003	516163	No	5 cm	level	P	0	na	level	Om	0	20	H4	Black	0	VL	No															Forbs were indicative of tA overstory
												CG	20	+	Sandy Loam	Grey	0	VL															
01 (5)	ER/CW	12-Aug-11	5901896	516125	No	0	level	VP	0	na	level	Om	0	45	H4	Black	0	VL	No															5cm LFH into Bg horizon at 5 m East of plot.
												CG	45	+	Sandy Loam	Grey	0	VL															West side of wetland @ 516100E 5901902N - OmH4 (0-30cm)
01 (6)	ER/CW	12-Aug-11	5901804	516060	Yes - #1a	0	level	VP	0	na	level	Om	0	70	H4	Black	0	VL	No	6.4	528	16.8	No	50	30	40	wB	20	5	Marsh Reed Grass	1			East side of beaver pond @ 516094, 5901789
												Om	70	120	H3	Dark Brown	0	VL									Salix sp.	Many	5	Water Sedge	6			Upland/Wetland border @ 516081, 5901707
												Om	120	210+	H5	Light Brown	0	VL									wS	20	2	Bog Birch	+			Small channel @ 516053, 5901804 (0.5m wide, not flowing
																											jP	5	3	Arrow leaved coltsfoot	+			
01 (7)	ER/CW	12-Aug-11	5901683	516025	No	5 cm	level	VP	0	na	level	Om	0	30	H3	Black	0	VL	No	7.04	602	15.1	No	20	40	40	wS	Many	4	Arrow leaved coltsfoot	+	Marsh reed grass	1	East side of wetland at 516038E 5901687N.
												Om	30	65	H6	Brown	0	M									jP	10	4	Water Sedge	+	Feather Moss	1	
												CG	65	+	Loamy Sand	Grey	0	M									tA	Many	6	Solomon Seal	+	Bishops Cap	+	
																											Salix Sp.	Many	3					
01 (8)	ER/CW	12-Aug-11	5901687	516004	No	0	level	VP	0	na	level	Om	5	80	H4	Dark Brown	0	VL	No															West side of wetland at 515972E 5901680N.
												CG	80	+	Loamy sand	Grey	0	VL															
01 (9)	ER/CW	12-Aug-11	5901679	515973	No	5 cm	level	I	0	na	level	Om	0	40	H3	Black	0	VL	No	6.95	368	14.1	No	20	40	40	tL	Many	3	Bog birch	1	Water Sedge	1	Frozen at a depth of 40 cm.
													***Frozen at 40 cm						40cm		392	8.2					jP	Many	3	Labrador Tea	+	Salix Sp.	+	
																											bS	Many	2					
01(10)	ER/CW	12-Aug-11	5901556	515879	No	10 cm	level	VP	0	na	level	Om	0	15	H3	Black	0	VL	No															East side of wetland at 515870E 5901555N
												Om	15	55	H4	Dark Brown	0	VL															
												CG	55	+	Loamy Sand	Grey	0	VL															
01(11)	ER/CW	12-Aug-11	5901506	515917	No	18cm	level	VP	0	na	level	Of	0	10	H1	Black	0	VL	No															
												Om	10	15	H4	Brown	0	VL															
												Ah	15	18	Loamy Sand	Brown	0	VL															
												Cg	18	+	Loamy Sand	Grey	0	VL															
01(12)	ER/CW	12-Aug-11	5901517	515907	Yes - #3a	0	level	VP	0	na	level	Om	0	50	H3	Black	0	VL	Yes	7.2	454	16.7	No	20	30	40	wS	35	5	Horsetail	+	Woodsy leafy moss	+	
												CG	50	+	Loamy Sand	Grey	0	M									tA	10	3	Labrador Tea	+	Bog Birch	1	
																											Salix Sp.	20	3	Water Sedge	7			
01(13)	DP/CW	15-Aug-11	5901383	515864	No	0	level	VP	0	na	level	Om	0	100	H3	Dark Brown	0	VL	No					25	20	50	jP	80	3	bS	3	Labrador Tea	1	East side of wetland at 515675E 5901382N.
												CG	100	+	Loamy Sand	Grey	0	VL									bS	20	2	Salix Sp.	+	Water Sedge	1	
																														Bog birch	+	Peat Moss	2	
																																Feather Moss	2	
01(14)	DP/CW	15-Aug-11	5901294	515769	No	10 cm	level	VP	0	na	level	Om	0	40	H3	Dark Brown	0	VL	No															
												***Frozen	40																					
01(15)	DP/CW	15-Aug-11	5901683	516025	No	5 cm	level	VP	0	na	level	Of	0	20	H2	Dark Brown	0	VL	No															West edge of wetland at 515750E 5901298N
												Om	20	210+	H3	Black	0	VL															
01(16)	DP/CW	15-Aug-11	5901297	515844	No	0	dep	VP	0	na	level	Of	0	30	H2	Black	0	VL	Yes	7.6	471	18.8	No	50	35	20	tL	35	4	Salix Sp.	+	Feather Moss	1	
												Om	30	100	H3	Dark Brown	0	VL									jP	10	2	Water Sedge	6	Current	+	
												CG	100	+	Loamy Sand	Grey	0	M									bS	5	2	Bog birch	1			
01(17)	Skipped, obvious upland																																	
01(18)	DP/CW	15-Aug-11	5901185	515861	No	0	level	I	0	na	level	Om	0	15	H3	Dark Brown	0	VL	No					0	60	20	tA	10		Gooseberry	+	Knights Plume Moss	+	East side of wetland at 515881E 5901185N.
												Cg	30	+	Sandy Loam	Mottled	0	M									jP	Many		Fireweed	+	Feather Moss	+	
																											bS	30		Horsetail	4	Palmate Leaved Coltsf	+	
																											Salix Sp.	10		Labrador Tea	3			
01(19)	DP/CW	15-Aug-11	5901184	515769	No	0	dep	VP	0	na	level	Oh	0	15	H2	Black	0	VL	No															
												Om	15	45	H3	Black	0	VL															
												***Frozen at 45																					
01(20)	DP/CW	15-Aug-11	5901181	515769	No	0	level	VP	0	na	level	Oh	0	25	H2	Black	0	VL	No															West side of wetland at 515730E, 5901180N
												Om	25	120	H3	Black	0	VL															
												Om	120	210+	H4	Brown	0	VL															
01(21)	DP/CW	15-Aug-11	5901062	515738	No	0	toe	VP	0	na	level	Om	0	210+	H3	Dark Brown	0	VL	Yes	7.25	292	13.3	NA	20	10	40	tL	8	5	bS	1	Water Sedge	+	West side of wetland at 515723E 5901071N
																											jP	20	4	Bog birch	4	Feather Moss	2	
																											bS	20	3	Labrador Tea	1	Peat Moss	3	
01(22)	DP/CW	15-Aug-11	5901059	515808	Yes #1	0	level	VP	0	na	level	Of	0	20	H2	Black	0	VL	No															
												Om	20	60	H4	Dark Brown	0	VL															
												Oh	60	105	H6	Grey Brown	0	M															
												CG	105	+	Sandy Loam	Grey	0	M															
01(23)	DP/CW	15-Aug-11	5901028	515845	No	30	lower	I	2_5	W	incline	Oh	0	80	H2	Black	0	VL	No															East side of wetland at 515865E 5901030N.
												Om	80	150	H4	Dark Brown	0	M															
												CG	150	+	Loamy Sand	Dark Brown	0	M															
01(24)	Skipped, obvious upland																																	
01(25)	DP/CW	15-Aug-11	5900995	515777	No	25	level	VP	0	na	level	Om	0	80	H3	Black	0	VL	No					5	35	35	bS	Many	7	Labrador Tea	5	Feather Moss	1	East side of wetland at 515855E 5901000N.
												CG	80	+	Sandy Loam	Grey	0	L									tL	Many	4	Lingonberry	2	Bog Birch	1	
																											jP	35	3	Peat Moss	4	Fireweed	+	
01(26)	DP/CW	15-Aug-11	5901002	515729	Yes #2	0	level	VP	0	na	level	Om	0	120	H3	Dark Brown	0	VL	Yes	7.44	263	12.7	No											
												Om	120	170	H5	Brown	0	VL															
												Oh	170	210	H7	Brown	0	L															
01(27)	Skipped, obvious upland																																	
01(28)	DP/CW	15-Aug-11	5900936	515725	Yes #4a	20	level	VP	0	na	level	Om	0	45	H3	Dark Brown	0	VL	No															
												CG	45	+	Sandy Loam	Grey	0	VL															
01(29)	DP/CW	15-Aug-11	5900933	515640	No	5	level	VP	0.5-2	E	level	Om	0	20	H2	Black	0	VL	No					20	15	25	jP	Many	3	Peat Moss	7	Lingonberry	+	
												CG	20	210+	H3	Dark Brown	0	VL									bS	Many	3	Labrador Tea	5			
																											tL	10	4	Bog birch	2			
01(30)	DP/CW	15-Aug-11	5900868	515626	No	0	dep	VP	0.5-2	W	level	Of	0	10	H2	Black	0	VL	No															West edge of wetland at 515609E 5900868N
												Om	10	40	H3	Dark Brown	0	VL															
												Om	40	210+	H5	Dark Brown	0	VL															
01(31)	DP/CW	15-Aug-11	5900838	515670	No	10	level	I	0	na	level	Om	0	50	H5	Dark Brown	0	VL	No															
												CG	50	+	Loamy Sand	Grey	0	VL															
01(32)	DP/CW	15-Aug-11	5900847	515721	No	10	level	MW	0	na	level	LFH	0	15		Black	0	VL	No					5	70	5	tA	Many	6	wS	+	Labrador Tea	2	East side of wetland at 515739E 5900868N.
												Cg	30	+	Loamy Sand	Mottled	0	VL									jP	Many	6	Palmate Leaved Coltsfoo	+	Marsh Reed Grass	1	
																											wB	Many	6	Horsetail	2	Peat Moss	3	
																														Bunchberry	1	Blueberry	+	
																														Dewberry	+			

Site	Observer	Date	UTM N	E	Photo?	Depth to Water	Slope Position	Drainage	Slope	Aspect	Topography	Horizon	Depth Upper	Lower	Von Post/ Texture	Color	Stoniness	Consistency	Samples?	Field pH	EC	Temp	Fizz?	% Water	% tree	% shrub	Trees (10x10) Species	count	height	Shrubs (10x10) Species	Cover	Shrubs (10x10) Species	Cover	Comments
02(1)	BD/CW	23-Aug-11	5901740	517912	No	50	level	I	0	na	level	Om	0	45	H3	Black	0	VL	No															Wetland width approx. 40m, plot location in center of wetland width
												CG	45	+	Loamy Sand	Dark Brown	0	VL															
02(2)	BD/CW	23-Aug-11	5901661	517905	No	80	level	MW	0	na	level	LFH	0	10		Black	0	VL	No															
												A	10	+	Loamy Sand	Brown	0	VL															
02(3)	BD/CW	23-Aug-11	5901629	517820	No	0	level	VP	0	na	level	Om	0	60	H3	Black	0	VL	No															
												CG	60	+	Sandy Loam	Grey	0	VL															
02(4)	BD/CW	23-Aug-11	5901629	517770	No	20	level	VP	0	na	level	Om	0	25	H3	Black	0	VL	No					5	20	70	bS	Many	3	Salix Sp.	2	Knights Plume Moss	+	West edge of wetland @517760E 5901631N
												CG	25	+	Loamy Sand	Grey	0	VL								tA	Many	4	Water Sedge	3	Arrow Leaved Coltsfoo	1	
																											Salix Sp.	Many	3	Peat Moss	1	Palmate Leaved Coltsf	+	
																											jP	5	4	Feather Moss	1			
02(5)	DP/CW	23-Aug-11	5901523	517623	No	0	toe	P	0.5-2	E	level	Om	0	15	H3	Black	0	VL	No															
												CG	15	+	Sandy Loam	Grey	0	VL															
02(6)	DP/CW	23-Aug-11	5901479	517720	Yes #3	0	level	VP	0	na	level	Om	0	40	H3	Black	0	VL	Yes	6.94	503	13.5	No	5	60	20	Salix Sp.	Many	3	Water Sedge	4			
												CG	40	+	Loamy Sand	Grey	0	VL								tA	Many	3	Marsh Reed Grass	3			
																											jP	30	4	Labrador Tea	+			
																											bS	30	3	Horsetail	+			
																											tL	2	5	Feather Moss	+			
02(7)	DP/CW	23-Aug-11	5901440	517804	No	5	level	VP	0	na	level	Om	0	30	H3	Dark Brown	0	VL	No															
												Oh	30	70	H6	Dark Grey	0	VL															
												CG	70	+	Loamy Sand	Grey	0	VL															
02(8)	DP/CW	23-Aug-11	5901349	517804	Yes #4	60	level	I	0	na	level	LFH	0	20	H2	Black	0	VL	No					0	30	25	bPo	Many	4	Labrador Tea	2	Arrow Leaved Coltsfoo	+	
												A	20	+	Loamy Sand	Grey Brown	0	L									tA	30	3	Shrubby Cinquefoil	+	Prickly Rose	+	
																											jP	Many	4	Strawberry	+	Palmate Leaved Coltsf	+	
																											bS	Many	3	Fireweed	+			
02(9)	DP/CW	23-Aug-11	5901349	517685	No	0	level	VP	0	na	level	Om	0	25	H3	Black	0	VL	No															
												CG	25	+	Loamy Sand	Grey	0	L															
02(10)	DP/CW	23-Aug-11	5901343	517590	No	30	toe	MW	0.5-2	E	level	LFH	0	25	H3	Black	0	VL	No															West edge of wetland at 517582E 5901343N
												A	25	+	Sand	Brown grey	0	L															
02(11)	DP/CW	23-Aug-11	5901204	517634	No	5	level	P	0	na	level	Om	0	15	H3	Black	0	VL	No					0	75	10	tA	Many	5	Horsetail	1	Fireweed	+	
																											bS	30	3	Marsh Reed Grass	1	Prickly Rose	+	
												CG	15	+	Loamy Sand	Grey Brown	0	L											Palmate Leaved Coltsf	+	Twinflower	+	
02(12)	DP/CW	23-Aug-11	5901182	517672	Yes#5	50	level	I	0	na	level	LFH	0	5		Black	0	VL	No															East edge of wetland at 517705 5901173
												A	5	+	Sand	Brown	0	VL															
02(13)	DP/CW	23-Aug-11	5901101	517644	No	45	dep	P	0.5-2	W	incl.	Oh	0	20	H2	Black	0	VL	No															East edge of wetland at 5901103N 517684E.
												Om	20	25	H3	Black	0	VL															
												CG	25	+	Loamy Sand	Grey Brown	0	M															
02(14)	BD/CW	23-Aug-11	5901073	517560	No	5	toe	VP	0.5-2	W	incl.	Om	0	30	H3	Black	0	VL	Yes	6.85	296	17.5	No	5	65	10	tA	Many	7	River Alder	2	Leafy Woodsy Moss	+	Small Neaver Pond just west of plot
												Om	30	145	H5	Black	0	M									wB	20	7	Violet	+	Fireweed	+	West edge of wetland at 5901075N 517539E.
												CG	145	+	Loamy Sand	Grey	0	F											Water Sedge	3	Dewberry	+	
02(15)	BD/CW	23-Aug-11	5900950	517386	No	20	toe	P	0.5-2	E	incl.	Oh	0	10	H2	Black	0	VL	No															
												Cg	10	+	Sand	Brown grey	0	L															
02(16)	BD/CW	23-Aug-11	5900920	517419	Yes #6	0	dep	VP	0	na	level	Om	0	60	H3	Black	0	VL	Yes	7.39	318	23.1	No	50	0	20				River Alder	1	Marsh Reed Grass		1 East side of wetland at 517470E 5900921N.
												Om	60	85	H5	Black	0	VL											Marsh Merigold	+	Water Moss		2 Very slow moving wide, pitted channel. Defined channel 2' deep and
												CG	85	+	Sand	Grey	0	VL											Salix Sp.	+			3' wide 5m east of 02(16).
02 (17)	BD/CW	23-Aug-11	517294	5900844	Yes #7,8,9,10																													No plot, open water. Beaver damn flooding entire wetland. Pond approx 60m wide, 60m long, fills entire wetland. No peat, mineral soil under pond. Flowing Spring at 517399E 5900901N.

Attachment A - Field Results

Site	Observer	Date	UTM N	E	Photo?	Depth to Water	Slope Position	Drainage	Slope	Aspect	Topography	Horizon	Depth Upper	Lower	Von Post/ Texture	Color	Stoniness	Consistency	Samples?	Field pH	EC	Temp	Fizz?	% Water	% tree	% shrub	Trees (10x10) Species	count	height	Shrubs (10x10) Species	Cover	Shrubs (10x10) Species	Cover	Comments
03(1)	BD/CW	24-Aug-11	5901005	519360	No	5	dep	P	0.5-2	W	incl	Om	0	40	H3	Black	0	VL	No															East edge of wetland at 519370E, 5901006N.
												CG	40	+	Loamy Sand	Grey	0	VL																
03(2)	BD/CW	24-Aug-11	5900995	519337	Yes #11	20	toe	VP	09-May	E	incl	Om	0	65	H4	Dark Brown	0	VL	No					5	50	30	tA	Many	6	River Alder	+	Labrador Tea	+	West edge of wetland at 519333E, 5900994N.
												CG	65	+	Loamy Sand	Grey	0	VL									bS	20	4	Willow Sp.	+	Fireweed	+	
																											wB	10	6	Bunchberry	+	Prickly Rose	+	
																											jP	25	4	Blueberry	+	Marsh Reed Grass	4	
03(3)	BD/CW	24-Aug-11	5900920	519351	No	5	toe	VP	2_5	na	incl	Om	0	80	H3	Dark Brown	0	VL	No															West edge of wetland 3m west of plot
												Oh	80	210+	H6	Dark Brown	0	F															
03(4)	BD/CW	24-Aug-11	5900913	519369	Yes #12	5	dep	VP	0	na	level	Om	0	120	H3	Dark Brown	0	VL	Yes	7.11	214	10.7	No	5	25	30	jP	Many	3	bS	+	Water Sedge	3	
												Om	120	210+	H4	Brown	0	F									bS	30	3	Salix Sp.	+	Fireweed	+	
																														Labrador Tea	4	River Alder	+	
																														Peat Moss	4			
03(5)	BD/CW	24-Aug-11	5900765	519447	Yes #13	0	toe	VP	2_5	W	incl	Om	0	90	H3	Dark Brown	0	VL	No															E. edge of wetland 5m from plot.
												Om	90	120	H5	Black	0	F															
												CG	120	+	Loamy Sand	Grey		F															
03(6)	BD/CW	24-Aug-11	5900739	519444	No	0	dep	VP	0	na	level	Om	0	50	H3	Dark Brown	0	VL	No															W. edge of wetland 5m from plot. Meandering channel @ 519438E 5900758N. 0.5-1m wide, 0.5m deep, strong flow.
												CG	50	+	Loamy Sand	Grey	0	VL															
03(7)	BD/CW	24-Aug-11	5900646	519506	Yes #14	10	dep	VP	0	na	level	Om	0	60	H3	Dark Brown	0	VL	Yes	6.94	232	14.3	No	0	70	20	jP	Many	5	River Alder	2	Salix Sp.	+	Meandering flowing creek at 519487E. 1-2m wide x 0.5m deep.
												Om	60	200	H5	Dark Brown	0	F									bS	20	3	Lab Tea	2	Peat Moss	1	Sand creekbed.
												CG	200	+	Loamy Sand	Grey	0	L												Lingonberry	+			
03(8)	BD/CW	24-Aug-11	5900646	519506	No	30	toe	VP	2_5	W	level	Om	0	90	H3	Black	0	VL	No															
												Om	90	+	Loamy Sand	Grey	0	L															

***Entire wetland is very small, approx. 30mx400m, and 120m of length has a flowing channel.

Site	Observer	Date	UTM N	UTM E	Photo?	Depth to Water	Slope Position	Drainage	Slope	Aspect	Topography	Horizon	Depth Upper	Depth Lower	Von Post/ Texture	Color	Stoniness	Consistency	Samples?	Field pH	EC	Temp	Fizz?	% Water	% tree	% shrub	Trees (10x10) Species	count	height	Shrubs (10x10) Species	Cover	Shrubs (10x10) Species	Cover	Comments
04(1)	DP/CW	26-Aug-11	5898352	518546	No	0	level	VP	0	NA	level	Om	0	50	H3	Black	0	VL	No															
												Om	50	75	H5	Black	0	VL																
												CG	75	85	Silt loam	Grey	0	VL																
												CG	85	+	Loamy sand	Grey	0	VL																
04(2)	DP/CW	26-Aug-11	5898439	518600	Yes #18	0	level	VP	0	NA	level	Om	0	40	H3	Black	0	VL	No					5	20	55	bS	Many	3	bS	2	Feather Moss	2	
												CG	40	+	Frozen												jP	10	3	Labrador Tea	+	Salix Sp.	+	
																											tA	2	3	Peat Moss		Water Sedge	+	
04(3)	DP/CW	26-Aug-11	5898492	518633	No	0	level	VP	0	NA	level	Om	0	50	H3	Black	0	VL	No															
												Om	50	+	Frozen																		
04(4)	DP/CW	26-Aug-11	5898495	518721	No	5	level	VP	0	NA	level	Om	0	50	H3	Black	0	VL	No															
												Cg	50	60	Sand	Brown	0	VL																
												Cg	60	+	Loam	Grey	0	VL																
04(5)	DP/CW	26-Aug-11	5898562	518750	No	0	level	VP	0	NA	level	Om	0	50	H3	Black	0	VL	Yes	7.01	441	15.9	No	5	40	30								
												Cg	50	+	Sand	Brown	0	VL																
04(6)	DP/CW	26-Aug-11	5898605	518775	Yes #20	0	level	VP	0	NA	level	Om	0	50	H3	Black	0	VL	No															
												Om	50	75	H5	Black	0	VL																
04(7)	DP/CW	26-Aug-11	5898640	518926	No	5	level	VP	0	NA	level	Om	0	50	H3	Black	0	VL	No															
												CG	50	80	Clay loam	Brown C	0	M																
												CG	80	+	Loamy sand	Grey	0	M																
04(8)	DP/CW	26-Aug-11	5898578	518948	No	0	dep	VP	0	NA	level	Om	0	90	H3	Black	0	VL	No															
												Oh	90	210+	H8	Light Br	0	M																
04(9)	DP/CW	26-Aug-11	5898514	518982	Yes #21	0	level	VP	0	NA	level	Om	0	80	H3	Black	0	VL	No					25	10	70	tL	Many	4	Salix Sp.	2	Peat Moss	1	South edge of wetland at 518944E 5898547N.
												Om	80	+	Loamy sand	Grey	0	VL								bS	20	3	River Alder	+	Water Sedge	2	
																													Feather Moss	1	bPo	+	
04(10	DP/CW	26-Aug-11	5898517	519090	No	0	level	VP	0	NA	level	Om	0	90	H3	Black	0	VL	No															
												Om	90	+	Sand	Grey	0	VL																
04(11	DP/CW	26-Aug-11	5898581	519128	Yes #22	0	level	VP	0	NA	level	Om	0	140	H3	Black	0	VL	Yes	7.41	371	12.9	No	20	10	30	tL	30	4	Bog birch	2	bS	+	
												Oh	140	160	H5	Grey bla	0	VL								jP	12	3	Water Sedge	2	Labrador Tea		1
												CG	160	+	Sandy Loam	Grey	0	VL								bS	10	3	Peat Moss	1	Northern Bog Laurel	+	
																													Feather Moss	2			
04(12	DP/CW	26-Aug-11	5898645	519137	No	5	level	VP	0	NA	level	Om	0	90	H3	Black	0	VL	No															
												CG	90	+	Loamy Sand	Grey	0	VL																
04(13	DP/CW	26-Aug-11	5898633	519271	No	0	level	VP	0	NA	level	Om	0	30	H3	Black	0	VL	No					5	25	20	bS	40	7	Labrador Tea	+	Salix Sp.	+	
												CG	30	+	Loamy Sand	Grey	0	VL								Salix Sp.	20	5	Water Sedge	2	Bog birch	+	
																											tA	30	5	Arrow Leaved Coltsfo	+	Beaked Sedge	2	
04(14	DP/CW	26-Aug-11	5898450	519466	Yes #23	0	toe	VP	2_5	S	Incl.	Of	0	35	H2	Black	0	VL	No															
												Cg	35	+	Clay Loam	Brown	0	F																
04(15	DP/CW	26-Aug-11	5898754	519463	Yes #25	0	dep	VP	0	NA	level	Om	0	90	H3	Black	0	VL	Yes	7.65	352	20.4	No	10	5	20	tL	10	3	Bog birch	1	Peat Moss	2	Edge of upland at 519468E 5898686N.
												CG	90	+	Loamy sand	Grey	0	L								bS	10	2	Water Sedge	3	Labrador Tea	+	
																											jP	7	2	Marsh Reed Grass	+			Flowing channel at 519462E 5898445N, 4m wide, 1m deep, slow, steady flow. Beaver activity .
04(16	DP/CW	26-Aug-11	5898390	519700	No	0	dep	MW	0.5_2	S	Incl	Of	0	50	H2	Black	0	VL	No															
												A	50	+	Loamy Sand	Brown	0	VL																
04(17	DP/CW	26-Aug-11	5898617	519727	Yes #24	5	toe	MW	0.5_2	N	Incl	Of	0	20	H2	Black	0	VL	No															
												Om	20	50	H3	Black	0	VL																
												CG	50	+	Loamy Sand	Grey	0	VL																

Attachment A - Field Results

Site	Observer	Date	UTM N	E	Photo?	Depth to Water	Slope Position	Drainage	Slope	Aspect	Topography	Horizon	Depth Upper	Lower	Von Post/ Texture	Color	Stoniness	Consistency	Samples?	Field pH	EC	Temp	Fizz?	% Water	% tree	% shrub	Trees (10x10) Species	count	height	Shrubs (10x10) Species	Cover	Shrubs (10x10) Species	Cover	Comments
05(1)	CW	25-Aug-11	5899509	512751	No	30	level	I	0	NA	level	LFH	0	10		Black	0	VL	No															West edge of wetland at 512724E 5899513N
												A	10	+	Sand	Grey Bro	0	M															
05(2)	CW	25-Aug-11	5899512	512822	Yes #15	0	level	VP	0	NA	humm	Of	0	20	H2	Black	0	VL	No					50	5	40	Salix Sp.	10	3	Salix Sp.	1	Water Sedge	3	Entire area floded, heavy beaver activity in area.
												Om	20	100	H3	Black	0	VL												Bog birch	2			
												CG	100	+	Loamy sand	Grey	0	VL															
05(3)	CW	25-Aug-11	5899507	512862	No	0	level	VP	0	NA	level	Om	0	60	H3	Black	0	VL	No															
												CG	60	+	Loamy sand	Black	0	VL															
05(4)	CW	25-Aug-11	5899444	512718	No	0	level	VP	0	NA	humm	Om	0	50	H3	Black	0	VL	No															
												Om	50	65	H5	Black	0	L															
												CG	65	+	Sandy loam	Grey	0	L															
05(5)	CW	25-Aug-11	5899399	512753	No	0	level	VP	0	NA	level	Om	0	30	H1	Black	0	VL	No															Completely flooded, 4-12" of water throughout area
												Om	30	95	H3	Dark bro	0	VL															
												CG	95	+	Loamy sand	Grey																	
05(6)	CW	25-Aug-11	5899380	512775	Yes #16	0	toe	VP	0.5-2	NA	level	Om	0	30	H3	Black	0	VL	Yes	7.07	495	17.8	No	80	30	20	tA	Many	6	Water Sedge	3	Dewberry	+	Completely flooded, 4-12" of water throughout area
												CG	30	+	Loamy sand	Grey	0	VL									Salix Sp.	Many	4	Salix Sp.	1	Fireweed	+	
																											bPo	Many	7	Bishops Cap	+			
05(7)	CW	25-Aug-11	5899277	512712	No	5	toe	VP	0	NA	humm	Om	0	45	H3	Black	0	VL	No															
												Om	45	65	H5	Black	0	VL															
												CG	65	+	Sandy loam	Grey	0	VL															
05(8)	CW	25-Aug-11	5899287	512670	No	5	dep	VP	0	NA	humm	Om	0	60	H3	Black	0	VL	No															
												Oh	60	110	H6	Dark Bro	0	L															
												CG	110	+	Loamy sand	Grey	0	L															
05(9)	CW	25-Aug-11	5899299	512679	No	10	level	P	0.5-2	NA	level	Om	0	40	H3	Black	0	VL	No					25	30	40	tA	Many	4	Salix Sp.	+	Palmate Leaves Colts	+	West edge of wetland 5m W of plot.
												CG	40	+	Sandy loam	Black	0	VL									bPo	Many	4	River Alder	1	Horsetail	+	
												CG																		Dewberry	+	Water Sedge	2	
05(10	CW	25-Aug-11	5899509	512751	No	0	level	VP	0	NA	level	Om	0	120	H3	Black	0	VL	No															
												Oh	120	160	H7	Black	0	M															
												CG	160	+	Loam	Dark Gre	0	M															
05(11)	CW	25-Aug-11	5899082	512581	Yes #19	0	dep	VP	0	NA	level	Om	0	140	H3	Dark Bro	0	VL	Yes	7.24	488	18.4	NA	70	20	30	tL	Many	4	Bog birch	2	Marsh Reed Grass	+	
												Oh	140	210+	H6	Light Bro	0	L									Salix Sp.	Many	3	Salix Sp.	+	Water Sedge	5	
05(12)	CW	25-Aug-11	5899058	512640	No	0	level	VP	0	NA	level	Om	0	45	H3	Black	0	L	No															West edge of wetland 5m E of plot.
												CG	45	+	Loamy sand	Grey	0	L															
05(13)	CW	25-Aug-11	5899012	512619	No	0	toe	VP	0	NA	level	Om	0	60	H3	Black	0	VL	No															
												CG	60	+	Loamy sand	Grey	0	VL															
05(14)	CW	25-Aug-11	5899001	512510	No	0	level	VP	0	NA	level	Om	0	150	H3	Black	0	VL	No					40	35	20	tL	Many	12	Hosetail	1	Feather Moss	2	
												Oh	150	200	H7	Black	0	L									bS	10	6	Marsh Reed Grass	2	River Alder	+	
												CG	200	+	Loam	Dark Gre	0	L												Labrador Tea	+	Salix Sp.	+	
05(15)	CW	25-Aug-11	5898971	512398	No	5	level	VP	0	NA	level	Om	0	120	H3	Black	0	VL	No															
												Oh	120	210+	H6	Black	0	M															
05(16)	CW	25-Aug-11	5898862	512357	No	5	level	VP	0	NA	level	Om	0	45	H3	Black	0	VL	No															Frozen at 45cm, right at mineral contact.
												CG	45	+	Loamy sand	Grey	0	VL															
05(17)	CW	25-Aug-11	5898871	512449	Yes #17	0	level	VP	0	NA	level	Om	0	100	H3	Black	0	VL	Yes	7.22	272	18.7		25	30	60	tL	Many	4	Salix Sp.	+	Water Sedge	2	
												Oh	100	210+	H6	Brown	0	VL									bS	20	2	Bog birch	1	Labrador Tea	1	
																														bS	+	Feather Moss	2	
																														River Alder	+			
05(18)	CW	25-Aug-11	5898860	512555	No	0	level	VP	0	NA	level	Om	0	160	H3-4	Black	0	VL	No															
												CG	160	+	Loam	Grey	0	VL															
05(19)	CW	25-Aug-11	5898728	512730	No	10	level	I	0	NA	level	Om	0	35	H3	Black	0	VL	No															
												CG	35	+	Sandy Loam	Grey	0	VL															
05(20)	CW	25-Aug-11	5898739	512469	No	0	level	VP	0	NA	level	Om	0	110	H3	Black	0	VL	No															
												Oh	110	+	H6	Brown	0	M															
05(21)	CW	25-Aug-11			No	0	level	VP	0	NA	level	Om	0	135	H3	Black	0	VL	No					60	10	70	tL	20	3	Water Sedge	3	Bog birch	+	
												Oh	135	190	H6	Dark bro	0	M									bS	10	3	Feather Moss	2	Labrador Tea	+	
												CG	190	+	Silt Loam	Grey	0	M												River Alder	1	Peat Moss	+	
05(22)	CW	25-Aug-11	5898546	512409	No	0	level	I	0	NA	level	Om	0	25	H3	Black	0	VL	No															
												CG	25	+	Sandy Loam	Grey	0	M															
05(23)	CW	25-Aug-11	5898556	512468	No	0	level	VP	0	NA	level	Om	0	100	H3	Black	0	VL	Yes	7.62	461	16.3	Yes	25	5	40	tL	4	3	Bog birch	4	tL	+	West edge of wetland at 512401E 5898545N
												Om	100	200	H5	Dark Bro	0	M									wB	20	3	Water Sedge	6	Peat Moss	+	Silt loam moderate Fizz.
												CG	200	+	Silt Loam	Grey	0	M												Salix Sp.	+			

Attachment B - Soil and Water Chemistry Results

Attachment B - Soil Chemistry Results

SOIL														
Group #	Sample #	Description	pH	Nitrate	Total Kjeldahl Nitrogen	Total Nitrogen	Organic Carbon	Bulk Density	Moisture	Gravel	Coarse Sand	Fine Sand	Silt	Clay
			pH units	ug/g	ug/g	ug/g	%	kg/m3	%	wt %	wt %	wt %	wt %	wt %
2011-9436	32730	8/25/2011 04-5	7.26 1:2slurry	<4	10900	10900	10.3	383	71.35	0.25	14.25	1.78	17.73	3.24
2011-9436	32731	8/25/2011 04-11	7.19 1:3slurry	<4	14000	14000	13.9	247	75.80	0.18	1.04	1.32	40.15	6.07
2011-9436	32732	8/25/2011 04-15	6.76 1:2slurry	<4	9560	9560	6.2	305	72.57	0.22	4.44	7.99	22.37	7.16
2011-8767	30436	8/24/2011 03-045	6.13 1:3slurry	<4	14400	14400	38.2	242	79.20					
2011-8767	30437	8/24/2011 03-075	6.53 1:2slurry	<4	12900	12900	32.1	309	79.09					
2011-8767	30438	8/23/2011 02-145	5.78 1:2slurry	<4	12800	12800	19.6	470	71.69					
2011-8767	30439	8/23/2011 02-065	6.38 1:2slurry	<4	9810	9810	27.8	312	77.52					
2011-8767	30440	8/23/2011 02-165	5.98 1:2slurry	<4	11900	11900	27.9	334	75.80					
2011-8767	30441	8/15/2011 01-215	5.68 1slurry	<4	19700	19700	36.2	185	86.91					
2011-8767	30442	8/15/2011 01-165	5.34 1:3slurry	<4	13800	13800	32.7	161	84.77					
2011-8767	30443	8/15/2011 01-265	5.67 1:2slurry	<4	7870	7870	17.2	336	74.93					
2011-8767	30444	01-12	5.77 1:3slurry	<4	17000	17000	36.5	161	85.63					
2011-8765	30445	8/25/2011 05-115	5.42 1:3 slurry	<4	15700	15700	36.3	120	85.37					
2011-8765	30446	8/25/2011 05-235	5.35 1:3slurry	<4	13900	13900	34.1	170	79.83					
2011-8765	30447	8/25/2011 05-065	5.74 1:3slurry	<4	17800	17800	35.9	184	80.01					
2011-8765	30448	8/25/2011 05-175	5.38 1:1slurry	<4	4350	4350	10.9	443	68.62					

Attachment B - Water Chemistry Results

WATER															
Group #	Sample #	Description	Bicarbonate	Carbonate	Hydroxide	P. alkalinity	pH	Specific Conductivity	Total Alkalinity	Nitrite+Nitrate nitrogen	Total Kjeldahl Nitrogen	Total Nitrogen	Organic Carbon	Tannin/lignin	Phosphorus
			mg/L	mg/L	mg/L	mg/L	pH units	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2011-8768	30580	8/12/2011 01-12	272	<1	<1	<1	7.57	418	223	<0.01	5.7	5.7	22	0.8	0.2
2011-8768	30581	8/15/2011 01-21	244	<1	<1	<1	7.45	397	200	<0.25*	4.3	4.3	24	1.0	2.0
2011-8768	30582	8/15/2011 01-26	238	<1	<1	<1	7.50	357	195	<2.5*	88	88	43	1.1	1.4
2011-8768	30583	8/15/2011 01-16	315	<1	<1	<1	7.34	465	258	<0.01	3.8	3.8	36	2.2	0.4
2011-8768	30584	8/23/2011 02-16	294	<1	<1	<1	7.70	429	241	<0.01	22	22	34	1.9	3.5
2011-8768	30585	8/23/2011 02-14	265	<1	<1	<1	7.41	392	217	<2.5*	360	360	79	1.3	4.8
2011-8768	30586	8/23/2011 02-06	466	<1	<1	<1	7.64	668	382	<0.01	14	14	42	2.4	1.8
2011-8768	30587	8/24/2011 03-04	187	<1	<1	<1	7.69	279	153	<0.01	4.0	4.0	15	1.2	1.3
2011-8768	30588	8/24/2011 03-07	218	<1	<1	<1	7.59	311	179	<0.01	13	13	27	0.3	<0.1
2011-8768	30589	8/26/2011 04-05	460	<1	<1	<1	7.25	685	377	<2.5*	320	320	33	2.4	90
2011-8766	30590	8/26/2011 04-11	318	<1	<1	<1	7.48	477	261	<0.01	200	200	17	1.3	4.7
2011-8766	30591	8/26/2011 04-15	318	<1	<1	<1	7.54	448	261	<2.5*	54	54	46	1.5	14
2011-8766	30592	8/25/2011 05-06	395	<1	<1	<1	7.52	596	324	<0.01	23	23	41	2.7	4.1
2011-8766	30593	8/25/2011 05-11	345	<1	<1	<1	7.53	480	283	<0.25*	71	71	55	1.8	6.1
2011-8766	30594	8/25/2011 05-17	222	<1	<1	<1	7.18	322	182	<0.25*	160	160	36	0.7	31
2011-8766	30595	8/25/2011 05-23	378	<1	<1	<1	7.44	558	310	<2.5*	34	34	40	3.4	4.2

* Increase in detection limit for nitrate due to sample matrix interference