

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W12											W8										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	16	3.06	4.25	3.51	3.43	0.36	0.09	9.70	0	16	100	13	6.90	7.80	7.48	7.60	0.31	0.08	24.42	0	0	0
Conductivity	-	µS/cm	16	209	1610	875	930	379	95	2.31	0	0	0	13	72	373	244	265	95	26	2.56	0	0	0
Total Hardness CaCO <sub>3</sub>	-	mg/L	16	56	521	294	286	143	36	2.06	0	0	0	13	30	156	106	107	41	11	2.61	0	0	0
Dissolved Hardness CaCO <sub>3</sub>	-	mg/L	5	57	589	353	397	212	95	1.67	0	0	0	6	31	164	115	131	50	20	2.31	0	0	0
Ion Balance	-	no unit	4	0.87	1.10	0.99	1.00	0.09	0.05	10.53	0	0	0	4	0.89	1.00	0.95	0.95	0.06	0.03	14.88	0	0	0
Total Dissolved Solids	-	mg/L	16	120	1120	590	610	273	68	2.16	0	0	0	13	54	238	166	160	53	15	3.13	0	0	0
Total Suspended Solids	-	mg/L	15	2.0	77.6	18.7	11.0	21.2	5.5	0.88	0	0	0	13	2.0	30.9	8.3	5.0	7.8	2.2	1.07	0	0	0
Turbidity	-	NTU	16	2.5	59.6	19.4	15.4	15.5	3.9	1.25	0	0	0	13	1.0	13.4	5.3	3.4	3.7	1.0	1.40	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	16	0.007	0.180	0.061	0.050	0.049	0.012	1.25	0	0	0	13	0.005	0.048	0.017	0.014	0.012	0.003	1.39	2	0	0
Alkalinity, Total (as CaCO <sub>3</sub> )	-	mg/L	16	0.25	0.25	0.25	0.25	0	-	-	16	0	0	13	8.19	59.0	37.37	38.0	16.42	4.55	2.28	0	0	0
Acidity (pH 4.5) as CaCO <sub>3</sub>	-	mg/L	5	2.43	130.00	51.17	33.70	51.94	23.23	0.99	0	0	0	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0
Acidity (pH8.3) as CaCO <sub>3</sub>	-	mg/L	14	22.20	229.00	110.15	113.00	56.28	15.04	1.96	0	0	0	9	0.25	4.60	2.01	2.10	1.40	0.47	1.44	2	0	0
Bromide (Br)	-	mg/L	12	0.01	0.20	0.17	0.20	0.07	0.02	2.35	12	0	0	10	0.01	0.20	0.16	0.20	0.08	0.03	1.96	10	0	0
Chloride (Cl)	120	mg/L	16	0.25	1.10	0.53	0.55	0.29	0.07	1.82	7	0	0	13	0.25	2.00	0.56	0.25	0.53	0.15	1.07	8	0	0
Fluoride (F)	0.12	mg/L	12	0.066	0.410	0.241	0.220	0.104	0.030	2.33	0	11	92	10	0.049	0.140	0.098	0.100	0.026	0.008	3.84	0	1	10
Sulphate (SO <sub>4</sub> )	-	mg/L	16	79.20	820.00	370.76	380.00	203.61	50.90	1.82	0	0	0	13	18.90	126.00	75.45	73.00	31.52	8.74	2.39	0	0	0
Total Nitrogen (N)	-	mg/L	5	0.16	0.58	0.32	0.30	0.17	0.07	1.90	0	0	0	6	0.21	0.60	0.29	0.23	0.15	0.06	1.85	0	0	0
Nitrate (as N)	13	mg/L	16	0.014	0.105	0.048	0.031	0.031	0.008	1.56	0	0	0	13	0.011	0.165	0.088	0.090	0.049	0.013	1.81	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	5	0.014	0.105	0.057	0.042	0.041	0.018	1.40	0	0	0	6	0.032	0.165	0.109	0.114	0.051	0.021	2.14	0	0	0
Nitrite (as N)	0.06	mg/L	16	0.001	0.010	0.004	0.003	0.003	0.001	1.28	6	0	0	13	0.001	0.010	0.002	0.001	0.003	0.001	0.91	10	0	0
Total Kjeldahl Nitrogen	-	mg/L	16	0.05	0.56	0.24	0.19000	0.1552	0.0388	1.56	0	0	0	13	0.05	0.57	0.18	0.12000	0.1443	0.0400	1.25	0	0	0
Ortho Phosphate as P	-	mg/L	16	0.0005	0.0150	0.0027	0.0020	0.0035	0.0009	0.77	3	0	0	13	0.0005	0.0070	0.0017	0.0010	0.0017	0.0005	1.02	3	0	0
Cyanide, Total	0.005	mg/L	15	0.00025	0.00130	0.00034	0.00025	0.00027	0.00007	1.23	13	1	7	13	0.00025	0.00140	0.00048	0.00025	0.00036	0.00010	1.34	8	0	0
Cyanide, Weak Acid Diss	-	mg/L	15	0.00025	0.00070	0.00028	0.00025	0.00012	0.00003	2.41	14	0	0	13	0.00025	0.00110	0.00043	0.00025	0.00030	0.00008	1.43	9	0	0
Dissolved Organic Carbon	-	mg/L	9	1.70	7.00	3.08	2.20	1.98	0.66	1.56	0	0	0	8	1.40	12.20	4.67	3.75	3.63	1.28	1.29	0	0	0
Total Organic Carbon	-	mg/L	13	1.50	14.20	5.56	3.00	4.76	1.32	1.17	0	0	0	10	1.50	18.20	6.18	4.30	6.00	1.90	1.03	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	16	2.26	18.50	8.97	8.04	4.79	1.20	1.87	0	16	100	13	0.3580	0.9870	0.5746	0.5340	0.1820	0.0505	3.16	0	13	100
Total Antimony	-	mg/L	16	0.00009	0.00035	0.00016	0.00016	0.00006	0.00002	2.62	0	0	0	13	0.00006	0.00014	0.00009	0.00009	0.00002	0.00001	4.15	0	0	0
Total Arsenic	0.005	mg/L	16	0.00027	0.00235	0.00070	0.00042	0.00062	0.00016	1.12	0	0	0	13	0.00023	0.00090	0.00037	0.00030	0.00019	0.00005	2.02	0	0	0
Total Barium	-	mg/L	16	0.01	0.04	0.02	0.02510	0.0114	0.0029	1.90	0	0	0	13	0.04	0.07	0.05	0.05240	0.0103	0.0029	5.24	0	0	0
Total Beryllium	-	mg/L	16	0.00010	0.00088	0.00046	0.00049	0.00022	0.00006	2.05	0	0	0	13	0.000020	0.000050	0.000036	0.000040	0.000010	0.000003	3.64	0	0	0
Total Bismuth	-	mg/L	16	0.0000025	0.0000820	0.0000149	0.0000060	0.0000214	0.0000053	0.70	9	0	0	13	0.0000025	0.0000307	0.0000057	0.0000025	0.0000078	0.0000022	0.73	9	0	0
Total Boron	1.5	mg/L	16	0.03	0.15	0.04	0.02500	0.0427	0.0107	0.95	16	0	0	13	0.03	0.03	0.03	0.02500	0	-	-	13	0	0
Total Cadmium	0.00032 <sup>c</sup>	mg/L	16	0.000520	0.004600	0.002355	0.002355	0.001155	0.000289	2.04	0	16	100	13	0.000152	0.000382	0.000242	0.000252	0.000068	0.000019	3.58	0	13	100
Total Calcium	-	mg/L	16	16.50	151.00	87.16	84.80	41.93	10.48	2.08	0	0	0	13	9.08	46.40	31.51	31.30	12.00	3.33	2.63	0	0	0
Total Chromium	0.001	mg/L	16	0.00030	0.00080	0.00059	0.00060	0.00015	0.00004	3.99	0	0	0	13	0.00005	0.00051	0.00017	0.00010	0.00015	0.00004	1.16	5	0	0
Total Cobalt	-	mg/L	16	0.007200	0.079700	0.035865	0.036000	0.019245	0.004811	1.86	0	0	0	13	0.001130	0.005020	0.002349	0.002310	0.001015	0.000281	2.31	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	16	0.1790	1.4300	0.7808	0.7905	0.3697	0.0924	2.11	0	16	100	13	0.0317	0.0922	0.0573	0.0581	0.0155	0.0043	3.70	0	13	100
Total Iron	0.3	mg/L	16	6.480	39.100	21.694	19.850	10.591	2.648	2.05	0	16	100	13	0.076	1.650	0.873	0.873	0.508	0.141	1.72	0	11	85
Total Lead	0.003 <sup>e</sup>	mg/L	16	0.000661	0.002730	0.001487	0.001500	0.000518	0.000129	2.87	0	1	6	13	0.000176	0.001370	0.000501	0.000293	0.000437	0.000121	1.14	0	1	8
Total Lithium	-	mg/L	16	0.00093	0.00800	0.00472	0.00530	0.00208	0.00052	2.27	0	0	0	13	0.00025	0.00140	0.00092	0.00100	0.00035	0.00010	2.65	2	0	0
Total Magnesium	-	mg/L	16	3.67	37.20	18.60	17.90	9.31	2.33	2.00	0	0	0	13	1.87	10.30	6.65	7.03	2.61	0.73	2.55	0	0	0
Total Manganese	-	mg/L	16	0.2430	1.9700	0.9774	1.0105	0.4688	0.1172	2.08	0	0	0	13	0.0539	0.1570	0.0780	0.0679	0.0278	0.0077	2.80	0	0	0
Total Mercury	0.000026	mg/L	14	0.0000050	0.0000250	0.0000093	0.0000050	0.0000078	0.0000021	1.19	12	0	0	10	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	10	0	0
Total Molybdenum	0.073	mg/L	16	0.00003	0.00034	0.00019	0.00017	0.00009	0.00002	2.09	3	0	0	13	0.00014	0.00078	0.00027	0.00023	0.00016	0.00004	1.65	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	16	0.00176	0.01230	0.00596	0.00575	0.00269	0.00067	2.22	0	0	0	13	0.00071	0.00126	0.00093	0.00092	0.00018	0.00005	5.27	0	0	0
Total Phosphorus	-	mg/L	14	0.0040	0.1110	0.0213	0.0095	0.0314	0.0084	0.68	1	0	0	10	0.0010	0.0310	0.0107	0.0045	0.0117	0.0037	0.91	3	0	0
Total Potassium	-	mg/L	16	1.05	2.50	1.71	1.80	0.47	0.12	3.67	0	0	0	13	0.73	1.16	0.89	0.88	0.13	0.04	7.05	0	0	0
Total Selenium	0.001	mg/L	16	0.00008	0.00040	0.00022	0.00023	0.00008	0.00002	2.82	0	0	0	13	0.00002	0.00009	0.00005	0.00006	0.00002	0.00001	2.69	2	0	0
Total Silicon	-	mg/L	16	2.78	13.00	7.88	8.35	2.74	0.69	2.88	0	0	0	13	2.84	6.90	5.45	5.80	1.34	0.37	4.07	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5: 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>-6</sup>(0.86<sup>log(hardness)</sup>-3.2)/1000
- d) Copper (Cu) mg/L: (e<sup>0.8545ln(hardness)</sup>-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>1.273ln(hardness)</sup>-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>0.76ln(hardness)</sup>+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

Highlighted cells indicate updates from Project Proposal

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guid
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available



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Parameters	CCME <sup>1</sup> Guideline	unit	W12										W8											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	16	0.000008	0.000096	0.000026	0.000020	0.000021	0.000005	1.24	2	0	0	13	0.000003	0.000063	0.000009	0.000003	0.000017	0.000005	0.52	10	0	0
Total Sodium	-	mg/L	16	1.24	10.40	5.61	5.43	2.64	0.66	2.12	0	0	0	13	1.01	4.88	3.33	3.53	1.18	0.33	2.82	0	0	0
Total Strontium	-	mg/L	16	0.051	0.457	0.252	0.266	0.118	0.030	2.14	0	0	0	13	0.059	0.361	0.220	0.217	0.091	0.025	2.41	0	0	0
Total Sulphur	-	mg/L	5	27.00	280.00	162.00	183.00	97.74	43.71	1.66	0	0	0	6	5.00	45.00	29.00	32.00	14.46	5.90	2.01	1	0	0
Total Thallium	0.0008	mg/L	16	0.0000226	0.0001200	0.0000652	0.0000665	0.0000267	0.0000067	2.44	0	0	0	13	0.0000040	0.0000100	0.0000071	0.0000070	0.0000020	0.0000006	3.54	0	0	0
Total Tin	-	mg/L	16	0.000005	0.000500	0.000047	0.000005	0.000124	0.000031	0.38	15	0	0	13	0.000005	0.000100	0.000027	0.000005	0.000039	0.000011	0.71	11	0	0
Total Titanium	-	mg/L	16	0.00025	0.01050	0.00269	0.00145	0.00343	0.00086	0.78	7	0	0	13	0.00025	0.01260	0.00223	0.00025	0.00365	0.00101	0.61	8	0	0
Total Uranium	0.015	mg/L	16	0.00276	0.02280	0.01110	0.01140	0.00534	0.00134	2.08	0	0	0	13	0.00098	0.00429	0.00224	0.00193	0.00100	0.00028	2.24	0	0	0
Total Vanadium	-	mg/L	16	0.00010	0.00160	0.00045	0.00035	0.00044	0.00011	1.03	8	0	0	13	0.00010	0.00094	0.00022	0.00010	0.00024	0.00007	0.91	9	0	0
Total Zinc	0.03	mg/L	16	0.04120	0.37700	0.17698	0.17500	0.09062	0.02266	1.95	0	16	100	13	0.01240	0.03160	0.01880	0.01830	0.00530	0.00147	3.55	0	1	8
Total Zirconium	-	mg/L	16	0.00005	0.00050	0.00020	0.00020	0.00014	0.00004	1.41	8	0	0	13	0.00005	0.00042	0.00013	0.00005	0.00012	0.00003	1.08	7	0	0
Dissolved Aluminum	0.1	mg/L	16	1.78	18.80	8.52	7.36	5.15	1.29	1.65	0	16	100	13	0.0275	0.4340	0.1125	0.0569	0.1208	0.0335	0.93	0	3	23
Dissolved Antimony	-	mg/L	16	0.00004	0.00020	0.00012	0.00011	0.00006	0.00014	2.00	3	0	0	13	0.00005	0.00011	0.00008	0.00008	0.00002	0.00005	4.96	0	0	0
Dissolved Arsenic	-	mg/L	16	0.00010	0.00060	0.00034	0.00031	0.00012	0.00030	2.80	0	0	0	13	0.00007	0.00035	0.00021	0.00018	0.00008	0.00023	2.52	0	0	0
Dissolved Barium	-	mg/L	16	0.007900	0.043600	0.020372	0.022600	0.011002	0.002750	1.85	0	0	0	13	0.030500	0.067800	0.051415	0.049800	0.011700	0.003245	4.39	0	0	0
Dissolved Beryllium	-	mg/L	16	0.000025	0.000880	0.000414	0.000440	0.000237	0.000059	1.75	1	0	0	13	0.000005	0.000030	0.000012	0.000010	0.000008	0.000002	1.38	6	0	0
Dissolved Bismuth	-	mg/L	16	0.0000025	0.0000150	0.0000064	0.0000025	0.0000056	0.0000014	1.16	14	0	0	13	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	13	0	0
Dissolved Boron	-	mg/L	16	0.025	0.150	0.056	0.025	0.056	0.014	1.01	16	0	0	13	0.025	0.025	0.025	0.025	0	-	-	13	0	0
Dissolved Cadmium	-	mg/L	16	0.000050	0.004620	0.002167	0.002090	0.001270	0.000317	1.71	0	0	0	13	0.000117	0.000316	0.000200	0.000190	0.000058	0.000016	3.42	0	0	0
Dissolved Calcium	-	mg/L	16	17.00	175.00	87.88	85.20	43.51	10.88	2.02	0	0	0	13	9.38	49.50	32.22	34.00	12.48	3.46	2.58	0	0	0
Dissolved Chromium	-	mg/L	16	0.00024	0.00080	0.00046	0.00045	0.00018	0.00004	2.56	3	0	0	13	0.00005	0.00030	0.00010	0.00005	0.00008	0.00002	1.30	7	0	0
Dissolved Cobalt	-	mg/L	16	0.000630	0.076100	0.033396	0.030000	0.020648	0.005162	1.62	0	0	0	13	0.000914	0.004760	0.002251	0.002270	0.001020	0.000283	2.21	0	0	0
Dissolved Copper	-	mg/L	16	0.0162	1.3400	0.7236	0.7295	0.4078	0.1019	1.77	0	0	0	13	0.0097	0.0493	0.0272	0.0278	0.0100	0.0028	2.73	0	0	0
Dissolved Iron	-	mg/L	16	0.355	35.100	16.522	15.300	12.214	3.053	1.35	0	0	0	13	0.001	0.423	0.219	0.203	0.150	0.042	1.46	0	0	0
Dissolved Lead	-	mg/L	16	0.000050	0.001900	0.001162	0.001185	0.000497	0.000124	2.34	0	0	0	13	0.000003	0.000712	0.000136	0.000092	0.000180	0.000050	0.76	1	0	0
Dissolved Lithium	-	mg/L	16	0.00089	0.00800	0.00459	0.00520	0.00202	0.00050	2.27	0	0	0	13	0.00025	0.00150	0.00091	0.00100	0.00032	0.00009	2.83	1	0	0
Dissolved Magnesium	-	mg/L	16	0.34	37.20	17.83	15.90	10.70	2.67	1.67	0	0	0	13	1.74	10.10	6.77	7.47	2.66	0.74	2.54	0	0	0
Dissolved Manganese	-	mg/L	16	0.0154	1.8800	0.9172	0.8595	0.5196	0.1299	1.77	0	0	0	13	0.0374	0.1510	0.0738	0.0683	0.0295	0.0082	2.50	0	0	0
Dissolved Mercury	-	mg/L	13	0.0000050	0.0000250	0.0000096	0.0000050	0.0000088	0.0000024	1.10	13	0	0	9	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	9	0	0
Dissolved Molybdenum	-	mg/L	16	0.00003	0.00031	0.00014	0.00013	0.00009	0.00002	1.46	7	0	0	13	0.00014	0.00028	0.00022	0.00021	0.00004	0.00001	5.36	0	0	0
Dissolved Nickel	-	mg/L	16	0.00020	0.01160	0.00566	0.00520	0.00300	0.00075	1.88	0	0	0	13	0.00072	0.00110	0.00088	0.00081	0.00013	0.00004	6.92	0	0	0
Dissolved Phosphorus	-	mg/L	13	0.0010	0.0160	0.0066	0.0050	0.0039	0.0011	1.67	4	0	0	9	0.0010	0.0115	0.0046	0.0020	0.0047	0.0016	0.98	4	0	0
Dissolved Potassium	-	mg/L	16	0.99	2.60	1.76	1.80	0.50	0.13	3.51	0	0	0	13	0.66	1.20	0.89	0.88	0.14	0.04	6.17	0	0	0
Dissolved Selenium	-	mg/L	16	0.00007	0.00050	0.00022	0.00019	0.00011	0.00003	2.01	1	0	0	13	0.00002	0.00009	0.00006	0.00006	0.00002	0.00001	2.67	2	0	0
Dissolved Silicon	-	mg/L	16	2.60	14.10	7.96	8.90	3.21	0.80	2.47	0	0	0	13	2.69	7.30	5.55	5.90	1.49	0.41	3.73	0	0	0
Dissolved Silver	-	mg/L	16	0.000003	0.000030	0.000016	0.000016	0.000007	0.000002	2.26	4	0	0	13	0.000003	0.000018	0.000004	0.000003	0.000005	0.000001	0.93	11	0	0
Dissolved Sodium	-	mg/L	15	1.19	10.30	5.76	6.10	2.79	0.72	2.06	0	0	0	13	0.99	4.89	3.40	3.72	1.21	0.34	2.82	0	0	0
Dissolved Strontium	-	mg/L	16	0.050	0.444	0.248	0.257	0.113	0.028	2.20	0	0	0	13	0.056	0.350	0.219	0.210	0.091	0.025	2.40	0	0	0
Dissolved Sulphur	-	mg/L	5	26.00	278.00	164.20	199.00	98.13	43.88	1.67	0	0	0	6	5.00	44.00	29.00	32.00	14.81	6.04	1.96	1	0	0
Dissolved Thallium	-	mg/L	16	0.0000164	0.0001000	0.0000643	0.0000700	0.0000266	0.0000067	2.42	0	0	0	13	0.0000030	0.0000090	0.0000061	0.0000060	0.0000018	0.0000005	3.48	0	0	0
Dissolved Tin	-	mg/L	16	0.000005	0.000500	0.000057	0.000005	0.000124	0.000031	0.46	13	0	0	13	0.000005	0.000100	0.000025	0.000005	0.000039	0.000011	0.65	12	0	0
Dissolved Titanium	-	mg/L	16	0.00025	0.00250	0.00107	0.00110	0.00072	0.00018	1.48	9	0	0	13	0.00025	0.00140	0.00057	0.00025	0.00044	0.00012	1.28	8	0	0
Dissolved Uranium	-	mg/L	16	0.00033	0.02090	0.01008	0.00996	0.00592	0.00148	1.70	0	0	0	13	0.00064	0.00220	0.00150	0.00135	0.00054	0.00015	2.75	0	0	0
Dissolved Vanadium	-	mg/L	16	0.00010	0.00060	0.00027	0.00015	0.00020	0.00005	1.37	12	0	0	13	0.00010	0.00035	0.00013	0.00010	0.00007	0.00002	1.75	11	0	0
Dissolved Zinc	-	mg/L	16	0.00340	0.32800	0.16683	0.15200	0.09664	0.02416	1.73	0	0	0	13	0.00630	0.02180	0.01349	0.01300	0.00448	0.00124	3.01	0	0	0
Dissolved Zirconium	-	mg/L	16	0.00005	0.00030	0.00018	0.00021	0.00010	0.00002	1.85	8	0	0	13	0.00005	0.00030	0.00010	0.00005	0.00008	0.00002	1.22	8	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH3) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L:  $10^{(0.86 \cdot (\log(\text{hardness}))-3.2)} / 1000$
- d) Copper (Cu) mg/L:  $(e^{0.8545 \cdot [\ln(\text{hardness})]} - 1.465) \cdot 0.2 / 1000$ ; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L:  $(e^{1.273 \cdot [\ln(\text{hardness})]} - 4.705) / 1000$ ; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L:  $(e^{0.76 \cdot [\ln(\text{hardness})]} + 1.06) / 1000$ ; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guic
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Highlighted cells indicate updates from Project Proposal

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W43										W13											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	10	6.90	7.64	7.40	7.48	0.22	0.07	34.21	0	0	0	12	7.46	8.20	7.89	8.00	0.25	0.07	31.22	0	0	0
Conductivity	-	µS/cm	10	208	300	236	222	30	9	7.93	0	0	0	12	76	444	253	259	104	30	2.44	0	0	0
Total Hardness CaCO3	-	mg/L	11	80	141	104	100	18	5	5.86	0	0	0	12	41	214	123	125	49	14	2.52	0	0	0
Dissolved Hardness CaCO3	-	mg/L	2	90	100	95	95	7	5	13.44	0	0	0	5	38	223	126	115	72	32	1.76	0	0	0
Ion Balance	-	no unit	2	1.00	1.10	1.05	1.05	0.07	0.05	14.85	0	0	0	4	0.87	1.00	0.94	0.94	0.06	0.03	15.51	0	0	0
Total Dissolved Solids	-	mg/L	10	110	210	151	150	29	9	5.20	0	0	0	12	70	260	154	145	57	17	2.68	0	0	0
Total Suspended Solids	-	mg/L	8	0.5	4.0	1.1	0.5	1.3	0.5	0.88	6	0	0	12	0.5	91.5	15.0	5.8	25.3	7.3	0.59	3	0	0
Turbidity	-	NTU	10	0.2	3.7	0.8	0.4	1.0	0.3	0.78	0	0	0	12	0.1	13.3	2.1	0.5	4.0	1.1	0.54	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	8	0.003	0.016	0.009	0.005	0.006	0.002	1.51	5	0	0	12	0.003	0.047	0.017	0.009	0.016	0.005	1.04	3	0	0
Alkalinity, Total (as CaCO3)	-	mg/L	10	59.0	93.0	73.88	70.0	11.11	3.51	6.65	0	0	0	12	28.8	141.0	96.48	105.0	34.78	10.04	2.77	0	0	0
Acidity (pH 4.5) as CaCO3	-	mg/L	4	0.25	0.25	0.25	0.25	0	-	-	4	0	0	5	0.25	0.25	0.25	0.25	0	-	-	5	0	0
Acidity (pH8.3) as CaCO3	-	mg/L	8	4.60	22.10	11.16	10.74	5.97	2.11	1.87	0	0	0	7	0.25	5.70	2.43	1.90	2.25	0.85	1.08	2	0	0
Bromide (Br)	-	mg/L	6	0.01	0.20	0.14	0.20	0.10	0.04	1.34	6	0	0	9	0.01	0.20	0.16	0.20	0.09	0.03	1.82	9	0	0
Chloride (Cl)	120	mg/L	10	0.25	5.00	0.85	0.25	1.47	0.47	0.58	6	0	0	12	0.25	1.10	0.56	0.43	0.35	0.10	1.60	6	0	0
Fluoride (F)	0.12	mg/L	6	0.080	0.092	0.087	0.090	0.005	0.002	16.13	0	0	0	9	0.034	0.110	0.065	0.060	0.022	0.007	2.99	0	0	0
Sulphate (SO4)	-	mg/L	10	34.00	54.00	40.95	38.50	6.62	2.09	6.19	0	0	0	12	0.25	110.00	33.50	28.00	30.04	8.67	1.12	1	0	0
Total Nitrogen (N)	-	mg/L	4	0.18	0.58	0.31	0.24	0.18	0.09	1.67	0	0	0	5	0.30	0.74	0.53	0.53	0.16	0.07	3.25	0	0	0
Nitrate (as N)	13	mg/L	10	0.128	0.479	0.236	0.173	0.128	0.041	1.84	0	0	0	12	0.082	0.419	0.272	0.291	0.103	0.030	2.65	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	4	0.138	0.479	0.238	0.168	0.162	0.081	1.47	0	0	0	5	0.084	0.419	0.277	0.297	0.130	0.058	2.13	0	0	0
Nitrite (as N)	0.06	mg/L	10	0.001	0.002	0.001	0.001	0.000	0.000	2.69	7	0	0	12	0.001	0.003	0.001	0.001	0.001	0.000	1.93	10	0	0
Total Kjeldahl Nitrogen	-	mg/L	10	0.01	0.10	0.06	0.06400	0.0258	0.0082	2.16	1	0	0	12	0.03	0.66	0.18	0.13500	0.1691	0.0488	1.09	0	0	0
Ortho Phosphate as P	-	mg/L	10	0.0005	0.0630	0.0086	0.0020	0.0192	0.0061	0.45	1	0	0	12	0.0005	0.0040	0.0015	0.0012	0.0010	0.0003	1.48	4	0	0
Cyanide, Total	0.005	mg/L	8	0.00025	0.00025	0.00025	0.00025	0	-	-	8	0	0	12	0.00025	0.00150	0.00057	0.00025	0.00047	0.00014	1.22	7	0	0
Cyanide, Weak Acid Diss	-	mg/L	8	0.00025	0.00025	0.00025	0.00025	0	-	-	8	0	0	12	0.00025	0.00130	0.00045	0.00025	0.00038	0.00011	1.17	9	0	0
Dissolved Organic Carbon	-	mg/L	2	1.00	2.00	1.50	1.50	0.71	0.50	2.12	0	0	0	6	1.31	11.50	4.30	3.15	3.68	1.50	1.17	0	0	0
Total Organic Carbon	-	mg/L	5	0.90	2.00	1.26	1.00	0.46	0.20	2.76	0	0	0	9	1.20	10.80	4.01	3.00	2.92	0.97	1.37	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	11	0.0023	0.0269	0.0126	0.0139	0.0097	0.0029	1.30	0	0	0	12	0.0132	0.7190	0.1577	0.0743	0.2058	0.0594	0.77	0	5	42
Total Antimony	-	mg/L	11	0.00201	0.00366	0.00286	0.00294	0.00049	0.0001	5.88	0	0	0	12	0.00010	0.00033	0.00023	0.00023	0.00006	0.00002	3.87	0	0	0
Total Arsenic	0.005	mg/L	11	0.00043	0.00152	0.00069	0.00068	0.00031	0.0001	2.25	0	0	0	12	0.00047	0.00190	0.00132	0.00136	0.00043	0.00012	3.09	0	0	0
Total Barium	-	mg/L	11	0.04	0.07	0.05	0.04750	0.0090	0.0027	5.75	0	0	0	12	0.05	0.11	0.09	0.08955	0.0153	0.0044	5.65	0	0	0
Total Beryllium	-	mg/L	11	0.000005	0.000005	0.000005	0.000005	0.000000	-	-	11	0	0	12	0.000005	0.000047	0.000012	0.000005	0.000013	0.000004	0.96	8	0	0
Total Bismuth	-	mg/L	11	0.0000025	0.0000100	0.0000032	0.0000025	0.0000023	0.0000007	1.41	10	0	0	12	0.0000025	0.0000140	0.0000050	0.0000025	0.0000043	0.0000012	1.17	8	0	0
Total Boron	1.5	mg/L	11	0.03	0.03	0.03	0.02500	0	-	-	11	0	0	12	0.025	0.025	0.025	0.025	0.000	-	-	12	0	0
Total Cadmium	0.00032 <sup>c</sup>	mg/L	11	0.039600	0.068000	0.047400	0.045800	0.008143	0.002455	5.82	0	11	100	12	0.000026	0.000519	0.000124	0.000087	0.000134	0.000039	0.93	0	10	83
Total Calcium	-	mg/L	11	21.40	38.90	28.50	27.40	5.08	1.53	5.61	0	0	0	12	11.40	56.60	33.05	33.60	12.47	3.60	2.65	0	0	0
Total Chromium	0.001	mg/L	11	0.00005	0.00005	0.00005	0.00005	0	-	-	11	0	0	12	0.00005	0.00190	0.00042	0.00015	0.00061	0.00018	0.69	4	2	17
Total Cobalt	-	mg/L	11	0.000162	0.000524	0.000254	0.000221	0.000110	0.000033	2.30	0	0	0	12	0.000018	0.000645	0.000161	0.000074	0.000195	0.000056	0.83	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	11	0.0463	0.0909	0.0671	0.0686	0.0128	0.0039	5.25	0	11	100	12	0.0005	0.0092	0.0024	0.0011	0.0028	0.0008	0.88	0	4	33
Total Iron	0.3	mg/L	11	0.021	0.112	0.050	0.047	0.028	0.008	1.80	0	0	0	12	0.021	0.906	0.206	0.071	0.272	0.079	0.76	0	3	25
Total Lead	0.003 <sup>e</sup>	mg/L	11	0.004290	0.018300	0.011422	0.009910	0.005099	0.001537	2.24	0	11	100	12	0.000025	0.073000	0.010740	0.003560	0.020573	0.005939	0.52	0	5	42
Total Lithium	-	mg/L	11	0.00160	0.00300	0.00222	0.00220	0.00041	0.00012	5.45	0	0	0	12	0.00070	0.00270	0.00153	0.00150	0.00064	0.00019	2.39	0	0	0
Total Magnesium	-	mg/L	11	6.38	10.70	7.89	7.57	1.24	0.37	6.37	0	0	0	12	3.07	17.60	9.80	9.67	4.35	1.26	2.25	0	0	0
Total Manganese	-	mg/L	11	0.2470	1.0700	0.4135	0.3510	0.2336	0.0704	1.77	0	0	0	12	0.0045	0.1730	0.0517	0.0401	0.0518	0.0149	1.00	0	0	0
Total Mercury	0.000026	mg/L	10	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	10	0	0	10	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	10	0	0
Total Molybdenum	0.073	mg/L	11	0.00003	0.00003	0.00003	0.00003	0	-	-	11	0	0	12	0.00034	0.00088	0.00058	0.00053	0.00019	0.00005	3.07	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	11	0.00039	0.00062	0.00050	0.00049	0.00007	0.00002	6.98	0	0	0	12	0.00016	0.00146	0.00056	0.00036	0.00042	0.00012	1.33	0	0	0
Total Phosphorus	-	mg/L	10	0.0010	0.0050	0.0028	0.0030	0.0013	0.0004	2.16	2	0	0	10	0.0020	0.0647	0.0132	0.0070	0.0189	0.0060	0.70	0	0	0
Total Potassium	-	mg/L	11	1.10	1.62	1.34	1.35	0.13	0.04	10.03	0	0	0	12	0.89	1.41	1.09	1.08	0.14	0.04	7.54	0	0	0
Total Selenium	0.001	mg/L	11	0.00002	0.00002	0.00002	0.00002	0	-	-	11	0	0	12	0.00002	0.00028	0.00006	0.00005	0.00007	0.00002	0.86	4	0	0
Total Silicon	-	mg/L	11	4.60	6.60	5.65	5.80	0.51	0.15	11.12	0	0	0	12	3.02	6.00	5.06	5.35	1.01	0.29	5.00	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5: 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10^(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e^0.8545[ln(hardness)]-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e^1.273[ln(hardness)]-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e^0.76[ln(hardness)]+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
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- "-" No Data Available

Highlighted cells indicate updates from Project Proposal

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W43											W13										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	11	0.000045	0.000215	0.000118	0.000105	0.000053	0.000016	2.24	0	6	55	12	0.000003	0.000152	0.000027	0.000016	0.000042	0.000012	0.63	5	1	8
Total Sodium	-	mg/L	11	2.74	3.75	3.26	3.28	0.30	0.09	10.96	0	0	0	12	1.17	5.59	3.71	3.85	1.32	0.38	2.80	0	0	0
Total Strontium	-	mg/L	11	0.195	0.342	0.255	0.245	0.044	0.013	5.77	0	0	0	12	0.072	0.380	0.214	0.222	0.087	0.025	2.47	0	0	0
Total Sulphur	-	mg/L	5	11.00	16.00	13.40	14.00	2.30	1.03	5.82	0	0	0	5	5.00	39.00	15.40	5.00	15.32	6.85	1.01	3	0	0
Total Thallium	0.0008	mg/L	11	0.0000220	0.0000293	0.0000256	0.0000250	0.0000023	0.0000007	10.92	0	0	0	12	0.0000010	0.0000249	0.0000064	0.0000030	0.0000076	0.0000022	0.84	2	0	0
Total Tin	-	mg/L	11	0.000005	0.000120	0.000033	0.000005	0.000048	0.000014	0.69	10	0	0	12	0.000005	0.000300	0.000038	0.000005	0.000087	0.000025	0.43	11	0	0
Total Titanium	-	mg/L	11	0.00025	0.00060	0.00031	0.00025	0.00014	0.00004	2.22	9	0	0	12	0.00025	0.02890	0.00723	0.00195	0.01034	0.00299	0.70	3	0	0
Total Uranium	0.015	mg/L	11	0.00077	0.00238	0.00136	0.00126	0.00051	0.00015	2.68	0	0	0	12	0.00369	0.02440	0.01217	0.01195	0.00685	0.00198	1.78	0	0	0
Total Vanadium	-	mg/L	11	0.00010	0.00030	0.00012	0.00010	0.00006	0.00002	1.96	10	0	0	12	0.00010	0.00231	0.00058	0.00035	0.00068	0.00020	0.85	5	0	0
Total Zinc	0.03	mg/L	11	2.22000	3.62000	2.62909	2.55000	0.39513	0.11914	6.65	0	11	100	12	0.00140	0.03290	0.00770	0.00610	0.00864	0.00249	0.89	0	1	8
Total Zirconium	-	mg/L	11	0.00005	0.00005	0.00005	0.00005	0	-	-	11	0	0	12	0.00005	0.00030	0.00011	0.00005	0.00010	0.00003	1.10	8	0	0
Dissolved Aluminum	0.1	mg/L	8	0.0013	0.0062	0.0034	0.0031	0.0021	0.0007	1.64	0	0	0	12	0.0023	0.1390	0.0348	0.0153	0.0484	0.0140	0.72	0	2	17
Dissolved Antimony	-	mg/L	8	0.00180	0.00360	0.00278	0.00270	0.00060	0.000214	4.60	0	0	0	12	0.00009	0.00026	0.00020	0.00021	0.00005	0.000014	4.18	0	0	0
Dissolved Arsenic	-	mg/L	8	0.00028	0.00047	0.00033	0.00031	0.00006	0.000022	5.30	0	0	0	12	0.00045	0.00178	0.00112	0.00111	0.00044	0.000128	2.53	0	0	0
Dissolved Barium	-	mg/L	8	0.045100	0.063100	0.053550	0.052250	0.006799	0.002404	7.88	0	0	0	12	0.039800	0.107000	0.078408	0.084350	0.018685	0.005394	4.20	0	0	0
Dissolved Beryllium	-	mg/L	8	0.000005	0.000005	0.000005	0.000005	0	-	-	8	0	0	12	0.000005	0.000020	0.000007	0.000005	0.000004	0.000001	1.50	10	0	0
Dissolved Bismuth	-	mg/L	8	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	8	0	0	12	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	12	0	0
Dissolved Boron	-	mg/L	8	0.025	0.025	0.025	0.025	0	-	-	8	0	0	12	0.025	0.025	0.025	0.025	0	-	-	12	0	0
Dissolved Cadmium	-	mg/L	8	0.041100	0.070500	0.048175	0.045100	0.009808	0.003467	4.91	0	0	0	12	0.000023	0.000120	0.000062	0.000049	0.000037	0.000011	1.67	0	0	0
Dissolved Calcium	-	mg/L	8	24.70	40.40	30.20	28.70	5.39	1.91	5.60	0	0	0	12	10.60	58.60	32.81	33.30	12.94	3.74	2.53	0	0	0
Dissolved Chromium	-	mg/L	8	0.00005	0.00030	0.00008	0.00005	0.00009	0.00003	0.92	7	0	0	12	0.00005	0.00030	0.00010	0.00005	0.00009	0.00002	1.17	8	0	0
Dissolved Cobalt	-	mg/L	8	0.000157	0.000488	0.000264	0.000236	0.000111	0.000039	2.37	0	0	0	12	0.000010	0.000253	0.000041	0.000018	0.000068	0.000020	0.60	0	0	0
Dissolved Copper	-	mg/L	8	0.0447	0.0709	0.0589	0.0589	0.0097	0.0034	6.10	0	0	0	12	0.0003	0.0069	0.0015	0.0008	0.0018	0.0005	0.81	0	0	0
Dissolved Iron	-	mg/L	8	0.007	0.034	0.017	0.013	0.010	0.004	1.74	0	0	0	12	0.001	0.108	0.028	0.012	0.034	0.010	0.81	0	0	0
Dissolved Lead	-	mg/L	8	0.002050	0.012600	0.006218	0.005205	0.004047	0.001431	1.54	0	0	0	12	0.000007	0.002730	0.000580	0.000122	0.000878	0.000253	0.66	0	0	0
Dissolved Lithium	-	mg/L	8	0.00180	0.00320	0.00231	0.00215	0.00045	0.00016	5.15	0	0	0	12	0.00025	0.00270	0.00140	0.00135	0.00071	0.00021	1.96	1	0	0
Dissolved Magnesium	-	mg/L	8	6.81	11.00	8.18	7.97	1.41	0.50	5.79	0	0	0	12	2.80	18.60	9.86	9.89	4.47	1.29	2.20	0	0	0
Dissolved Manganese	-	mg/L	8	0.2490	1.0800	0.4458	0.3645	0.2738	0.0968	1.63	0	0	0	12	0.0015	0.0939	0.0214	0.0117	0.0279	0.0080	0.77	0	0	0
Dissolved Mercury	-	mg/L	6	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	6	0	0	9	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	9	0	0
Dissolved Molybdenum	-	mg/L	8	0.00003	0.00035	0.00008	0.00003	0.00011	0.00004	0.72	5	0	0	12	0.00018	0.00099	0.00060	0.00056	0.00022	0.00006	2.71	0	0	0
Dissolved Nickel	-	mg/L	8	0.00039	0.00061	0.00051	0.00050	0.00008	0.00003	6.49	0	0	0	12	0.00015	0.00097	0.00040	0.00031	0.00025	0.00007	1.57	0	0	0
Dissolved Phosphorus	-	mg/L	6	0.0010	0.0050	0.0018	0.0010	0.0016	0.0007	1.14	4	0	0	9	0.0010	0.0110	0.0038	0.0030	0.0039	0.0013	0.96	4	0	0
Dissolved Potassium	-	mg/L	8	1.18	1.68	1.40	1.38	0.14	0.05	9.81	0	0	0	12	0.80	1.38	1.09	1.15	0.15	0.04	7.21	0	0	0
Dissolved Selenium	-	mg/L	8	0.00002	0.00002	0.00002	0.00002	0	-	-	8	0	0	12	0.00002	0.00031	0.00007	0.00005	0.00008	0.00002	0.79	5	0	0
Dissolved Silicon	-	mg/L	8	5.20	6.60	5.70	5.65	0.47	0.17	12.15	0	0	0	12	2.49	6.50	4.96	5.20	1.15	0.33	4.31	0	0	0
Dissolved Silver	-	mg/L	8	0.000008	0.000090	0.000029	0.000023	0.000025	0.000009	1.16	0	0	0	12	0.000003	0.000020	0.000005	0.000003	0.000005	0.000002	0.92	9	0	0
Dissolved Sodium	-	mg/L	8	2.89	3.95	3.32	3.35	0.35	0.12	9.59	0	0	0	12	1.16	5.39	3.77	3.99	1.35	0.39	2.80	0	0	0
Dissolved Strontium	-	mg/L	8	0.226	0.362	0.266	0.251	0.048	0.017	5.48	0	0	0	12	0.065	0.366	0.210	0.217	0.085	0.024	2.48	0	0	0
Dissolved Sulphur	-	mg/L	2	16.00	17.00	16.50	16.50	0.71	0.50	23.33	0	0	0	5	5.00	42.00	17.00	10.00	15.80	7.06	1.08	2	0	0
Dissolved Thallium	-	mg/L	8	0.0000210	0.0000270	0.0000244	0.0000250	0.0000020	0.0000007	12.21	0	0	0	12	0.0000010	0.0000030	0.0000014	0.0000010	0.0000008	0.0000002	1.79	9	0	0
Dissolved Tin	-	mg/L	8	0.000005	0.000080	0.000014	0.000005	0.000027	0.000009	0.54	7	0	0	12	0.000005	0.000100	0.000022	0.000005	0.000037	0.000011	0.60	11	0	0
Dissolved Titanium	-	mg/L	8	0.00025	0.00100	0.00034	0.00025	0.00027	0.00009	1.30	7	0	0	12	0.00025	0.00144	0.00049	0.00025	0.00046	0.00013	1.06	9	0	0
Dissolved Uranium	-	mg/L	8	0.00081	0.00229	0.00145	0.00128	0.00051	0.00018	2.85	0	0	0	12	0.00243	0.02390	0.01188	0.01182	0.00690	0.00199	1.72	0	0	0
Dissolved Vanadium	-	mg/L	8	0.00010	0.00010	0.00010	0.00010	0	-	-	8	0	0	12	0.00010	0.00035	0.00015	0.00010	0.00009	0.00003	1.64	9	0	0
Dissolved Zinc	-	mg/L	8	2.26000	3.73000	2.65000	2.52000	0.47401	0.16759	5.59	0	0	0	12	0.00110	0.00840	0.00379	0.00280	0.00247	0.00071	1.53	0	0	0
Dissolved Zirconium	-	mg/L	8	0.00005	0.00005	0.00005	0.00005	0	-	-	8	0	0	12	0.00005	0.00020	0.00008	0.00005	0.00005	0.00001	1.59	8	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L:  $10^{0.86 * (\log(\text{hardness})) - 3.2} / 1000$
- d) Copper (Cu) mg/L:  $(e^{0.8545 \ln(\text{hardness})} - 1.465) * 0.2 / 1000$ ; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L:  $(e^{1.273 \ln(\text{hardness})} - 4.705) / 1000$ ; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L:  $(e^{0.76 \ln(\text{hardness})} + 1.06) / 1000$ ; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guidelin
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Highlighted cells indicate updates from Project Proposal

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W11											W18										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	24	7.20	8.12	7.86	7.90	0.24	0.05	33.30	0	0	0	22	7.20	8.20	7.79	7.82	0.23	0.05	34.37	0	0	0
Conductivity	-	µS/cm	24	85	450	262	275	95	19	2.76	0	0	0	22	53	267	168	162	66	14	2.56	0	0	0
Total Hardness CaCO3	-	mg/L	24	45	204	129	137	46	9	2.80	0	0	0	22	25	124	78	74	29	6	2.66	0	0	0
Dissolved Hardness CaCO3	-	mg/L	6	47	207	140	147	58	24	2.41	0	0	0	6	26	124	90	100	37	15	2.41	0	0	0
Ion Balance	-	no unit	4	0.84	1.00	0.96	0.99	0.08	0.04	12.43	0	0	0	4	0.79	1.10	0.97	0.99	0.13	0.06	7.47	0	0	0
Total Dissolved Solids	-	mg/L	24	78	278	174	195	50	10	3.51	0	0	0	22	54	170	108	105	37	8	2.95	0	0	0
Total Suspended Solids	-	mg/L	24	0.5	53.0	9.4	2.5	15.0	3.1	0.62	6	0	0	22	0.5	46.0	6.4	1.0	11.8	2.5	0.55	10	0	0
Turbidity	-	NTU	24	0.4	22.5	3.1	1.6	4.8	1.0	0.65	0	0	0	22	0.1	4.6	0.8	0.3	1.2	0.2	0.65	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	24	0.003	0.260	0.029	0.006	0.053	0.011	0.54	12	0	0	22	0.003	0.190	0.029	0.010	0.042	0.009	0.68	8	0	0
Alkalinity, Total (as CaCO3)	-	mg/L	24	25.0	127.0	76.86	82.0	28.89	5.90	2.66	0	0	0	22	15.5	98.0	61.75	62.5	23.50	5.01	2.63	0	0	0
Acidity (pH 4.5) as CaCO3	-	mg/L	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0
Acidity (pH8.3) as CaCO3	-	mg/L	13	0.25	3.90	1.56	1.60	1.11	0.31	1.40	3	0	0	13	0.25	4.30	1.58	1.40	1.19	0.33	1.33	3	0	0
Bromide (Br)	-	mg/L	20	0.01	0.20	0.17	0.20	0.07	0.01	2.60	20	0	0	20	0.01	0.20	0.17	0.20	0.07	0.01	2.60	20	0	0
Chloride (Cl)	120	mg/L	23	0.25	1.40	0.50	0.25	0.37	0.08	1.36	14	0	0	22	0.25	2.50	0.61	0.25	0.60	0.13	1.03	12	0	0
Fluoride (F)	0.12	mg/L	20	0.055	0.100	0.082	0.080	0.013	0.003	6.52	0	0	0	20	0.028	0.060	0.044	0.040	0.009	0.002	5.11	0	0	0
Sulphate (SO4)	-	mg/L	24	9.30	107.00	57.15	62.00	22.05	4.50	2.59	0	0	0	22	0.25	49.00	23.23	23.00	13.04	2.78	1.78	2	0	0
Total Nitrogen (N)	-	mg/L	6	0.21	0.57	0.38	0.38	0.12	0.05	3.22	0	0	0	6	0.18	0.62	0.40	0.39	0.14	0.06	2.75	0	0	0
Nitrate (as N)	13	mg/L	24	0.031	0.289	0.169	0.180	0.083	0.017	2.03	0	0	0	22	0.037	0.333	0.191	0.181	0.092	0.020	2.07	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	6	0.062	0.289	0.213	0.247	0.089	0.036	2.39	0	0	0	6	0.105	0.320	0.200	0.179	0.084	0.034	2.38	0	0	0
Nitrite (as N)	0.06	mg/L	24	0.001	0.010	0.002	0.001	0.002	0.000	0.99	17	0	0	22	0.001	0.010	0.002	0.001	0.002	0.000	0.90	18	0	0
Total Kjeldahl Nitrogen	-	mg/L	24	0.01	0.51	0.20	0.16000	0.1402	0.0286	1.44	1	0	0	22	0.01	0.52	0.20	0.17000	0.1408	0.0300	1.41	2	0	0
Ortho Phosphate as P	-	mg/L	24	0.0005	0.0420	0.0037	0.0010	0.0087	0.0018	0.42	8	0	0	22	0.0005	0.0420	0.0033	0.0010	0.0087	0.0019	0.38	6	0	0
Cyanide, Total	0.005	mg/L	24	0.00025	0.00160	0.00045	0.00025	0.00035	0.00007	1.27	17	0	0	22	0.00025	0.00150	0.00050	0.00025	0.00038	0.00008	1.34	13	0	0
Cyanide, Weak Acid Diss	-	mg/L	24	0.00025	0.00110	0.00039	0.00025	0.00025	0.00005	1.56	17	0	0	22	0.00025	0.00120	0.00044	0.00025	0.00029	0.00006	1.53	14	0	0
Dissolved Organic Carbon	-	mg/L	12	1.44	13.60	6.30	5.30	3.82	1.10	1.65	0	0	0	12	1.84	21.00	8.03	6.70	5.77	1.67	1.39	0	0	0
Total Organic Carbon	-	mg/L	20	1.72	19.90	6.58	5.20	5.01	1.12	1.31	0	0	0	20	1.80	21.80	7.84	5.40	5.87	1.31	1.34	0	0	0
Total Aluminium	0.1 <sup>b</sup>	mg/L	24	0.0417	0.6300	0.2154	0.1680	0.1685	0.0344	1.28	0	16	67	22	0.0060	0.7090	0.1323	0.0694	0.1777	0.0379	0.74	0	9	41
Total Antimony	-	mg/L	24	0.000110	0.000390	0.000152	0.000145	0.000054	0.000011	2.82	0	0	0	22	0.000068	0.000180	0.000139	0.000140	0.000026	0.000006	5.33	0	0	0
Total Arsenic	0.005	mg/L	24	0.000540	0.001520	0.000772	0.000690	0.000252	0.000051	3.07	0	0	0	22	0.000300	0.001100	0.000458	0.000390	0.000183	0.000039	2.51	0	0	0
Total Barium	-	mg/L	24	0.04	0.09	0.06	0.06220	0.0126	0.0026	5.03	0	0	0	22	0.03	0.06	0.05	0.04355	0.0095	0.0020	4.80	0	0	0
Total Beryllium	-	mg/L	24	0.0000050	0.0000500	0.0000168	0.0000100	0.0000150	0.0000031	1.13	9	0	0	22	0.0000050	0.0000300	0.0000100	0.0000050	0.0000083	0.0000018	1.20	14	0	0
Total Bismuth	-	mg/L	24	0.0000025	0.0000310	0.0000053	0.0000025	0.0000077	0.0000016	0.68	20	0	0	22	0.0000025	0.0000140	0.0000030	0.0000025	0.0000025	0.0000005	1.23	21	0	0
Total Boron	1.5	mg/L	24	0.03	0.03	0.03	0.02500	0	-	-	24	0	0	22	0.03	0.03	0.03	0.02500	0	-	-	22	0	0
Total Cadmium	0.00032 <sup>c</sup>	mg/L	24	0.000041	0.000278	0.000094	0.000085	0.000050	0.000010	1.90	0	21	88	22	0.000003	0.000064	0.000021	0.000013	0.000018	0.000004	1.19	2	9	41
Total Calcium	-	mg/L	24	12.50	54.60	34.80	36.45	11.99	2.45	2.90	0	0	0	22	6.71	34.00	21.19	20.05	7.77	1.66	2.73	0	0	0
Total Chromium	0.001	mg/L	24	0.00005	0.00100	0.00024	0.00010	0.00027	0.00005	0.88	9	0	0	22	0.00005	0.00070	0.00021	0.00015	0.00019	0.00004	1.07	8	0	0
Total Cobalt	-	mg/L	24	0.000045	0.000973	0.000394	0.000330	0.000289	0.000059	1.37	0	0	0	22	0.000009	0.000421	0.000098	0.000054	0.000118	0.000025	0.83	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	24	0.0044	0.0328	0.0161	0.0161	0.0085	0.0017	1.90	0	24	100	22	0.0004	0.0079	0.0019	0.0012	0.0020	0.0004	0.92	0	5	23
Total Iron	0.3	mg/L	24	0.032	1.040	0.339	0.307	0.256	0.052	1.32	0	13	54	22	0.004	0.617	0.139	0.053	0.192	0.041	0.73	0	4	18
Total Lead	0.003 <sup>e</sup>	mg/L	23	0.000041	0.01000	0.001363	0.000671	0.002075	0.000433	0.66	0	2	9	22	0.000003	0.000711	0.000154	0.000061	0.000205	0.000044	0.75	4	0	0
Total Lithium	-	mg/L	24	0.00060	0.00260	0.00133	0.00130	0.00045	0.00009	2.95	0	0	0	22	0.00025	0.00200	0.00077	0.00070	0.00037	0.00008	2.06	2	0	0
Total Magnesium	-	mg/L	24	3.28	18.60	10.28	10.80	4.01	0.82	2.56	0	0	0	22	1.95	9.96	6.20	5.82	2.48	0.53	2.50	0	0	0
Total Manganese	-	mg/L	24	0.0145	0.1340	0.0468	0.0331	0.0307	0.0063	1.53	0	0	0	22	0.0015	0.0330	0.0091	0.0037	0.0099	0.0021	0.92	0	0	0
Total Mercury	0.000026	mg/L	21	0.0000050	0.0000100	0.0000057	0.0000050	0.0000018	0.000004	3.19	18	0	0	19	0.0000050	0.0000100	0.0000053	0.0000050	0.0000011	0.0000003	4.59	18	0	0
Total Molybdenum	0.073	mg/L	24	0.00025	0.00101	0.00065	0.00066	0.00023	0.00005	2.86	0	0	0	22	0.00045	0.00239	0.00127	0.00119	0.00053	0.00011	2.41	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	24	0.00024	0.00167	0.00062	0.00052	0.00039	0.00008	1.61	0	0	0	22	0.00011	0.00109	0.00041	0.00030	0.00030	0.00006	1.38	0	0	0
Total Phosphorus	-	mg/L	21	0.0010	0.0310	0.0097	0.0050	0.0099	0.0022	0.98	5	0	0	19	0.0010	0.0320	0.0079	0.0030	0.0088	0.0020	0.90	5	0	0
Total Potassium	-	mg/L	24	0.50	1.41	0.98	0.96	0.21	0.04	4.65	0	0	0	22	0.64	1.50	1.06	1.02	0.25	0.05	4.24	0	0	0
Total Selenium	0.001	mg/L	24	0.00002	0.00028	0.00012	0.00012	0.00005	0.00001	2.26	1	0	0	22	0.00002	0.00009	0.00004	0.00004	0.00002	0.00000	1.83	10	0	0
Total Silicon	-	mg/L	24	2.83	6.50	5.06	5.25	0.98	0.20	5.17	0	0	0	22	2.30	5.90	4.97	5.30	0.90	0.19	5.51	0	0	0

Note:

1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007

a) Ammonia (NH3) guideline based on pH=8 and temp=20

b) Aluminium (AL-T)= 0.005 mg/L at pH < 6.5: 0.1 mg/L at pH ≥ 6.5

c) Cadmium (Cd) mg/L: 10<sup>-4</sup>(0.86<sup>log(hardness)</sup>)-3.2/1000

d) Copper (Cu) mg/L: (e<sup>-0.8545ln(hardness)</sup>-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness

e) Lead (Pb) mg/L: (e<sup>-1.273ln(hardness)</sup>-4.705)/1000; minimum is 0.001mg/L regardless of water hardness

f) Nickel (Ni) mg/L: (e<sup>-0.76ln(hardness)</sup>+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

Highlighted cells indicate updates from Project Proposal

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guid
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W11											W18										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	24	0.000003	0.000091	0.000010	0.000003	0.000019	0.000004	0.51	15	0	0	22	0.000003	0.000010	0.000003	0.000003	0.000002	0.000000	1.73	19	0	0
Total Sodium	-	mg/L	24	1.33	5.53	3.54	3.73	1.12	0.23	3.15	0	0	0	22	1.07	6.42	3.37	3.26	1.24	0.26	2.72	0	0	0
Total Strontium	-	mg/L	24	0.073	0.367	0.220	0.232	0.076	0.015	2.90	0	0	0	22	0.041	0.231	0.118	0.112	0.049	0.010	2.42	0	0	0
Total Sulphur	-	mg/L	6	5.00	39.00	23.17	24.00	11.81	4.82	1.96	1	0	0	6	5.00	17.00	11.00	12.00	5.06	2.07	2.17	2	0	0
Total Thallium	0.0008	mg/L	24	0.000010	0.0000220	0.0000047	0.0000030	0.0000043	0.0000009	1.08	3	0	0	22	0.000010	0.0000100	0.0000035	0.0000030	0.0000026	0.0000006	1.37	6	0	0
Total Tin	-	mg/L	24	0.000005	0.000100	0.000013	0.000005	0.000027	0.000005	0.48	24	0	0	22	0.000005	0.000500	0.000041	0.000005	0.000118	0.000025	0.35	19	0	0
Total Titanium	-	mg/L	24	0.00025	0.02050	0.00406	0.00110	0.00574	0.00117	0.71	7	0	0	22	0.00025	0.02040	0.00375	0.00065	0.00591	0.00126	0.64	10	0	0
Total Uranium	0.015	mg/L	24	0.00209	0.02400	0.00975	0.00970	0.00565	0.00115	1.73	0	0	0	22	0.00121	0.00826	0.00399	0.00336	0.00228	0.00049	1.75	0	0	0
Total Vanadium	-	mg/L	24	0.00010	0.00260	0.00050	0.00020	0.00064	0.00013	0.78	11	0	0	22	0.00010	0.00210	0.00059	0.00035	0.00059	0.00013	0.99	4	0	0
Total Zinc	0.03	mg/L	24	0.00180	0.02110	0.00648	0.00550	0.00406	0.00083	1.60	0	0	0	22	0.00020	0.00770	0.00204	0.00140	0.00212	0.00045	0.96	0	0	0
Total Zirconium	-	mg/L	24	0.00005	0.00070	0.00016	0.00015	0.00014	0.00003	1.14	9	0	0	22	0.00005	0.00060	0.00017	0.00015	0.00014	0.00003	1.21	8	0	0
Dissolved Aluminum	0.1	mg/L	24	0.0093	0.2680	0.0696	0.0339	0.0787	0.0161	0.88	0	5	21	22	0.0048	0.3460	0.0729	0.0356	0.0877	0.0187	0.83	0	6	27
Dissolved Antimony	-	mg/L	24	0.00009	0.00019	0.00014	0.00014	0.00002	0.00005	5.95	0	0	0	22	0.00006	0.00021	0.00014	0.00014	0.00003	0.00007	4.27	0	0	0
Dissolved Arsenic	-	mg/L	24	0.00035	0.00091	0.00058	0.00054	0.00014	0.000028	4.22	0	0	0	22	0.00027	0.00069	0.00039	0.00037	0.00010	0.000020	4.07	0	0	0
Dissolved Barium	-	mg/L	24	0.032900	0.091700	0.059238	0.060150	0.014441	0.002948	4.10	0	0	0	22	0.025200	0.061900	0.043814	0.041100	0.011115	0.002370	3.94	0	0	0
Dissolved Beryllium	-	mg/L	24	0.000005	0.000030	0.000010	0.000005	0.000009	0.000002	1.10	17	0	0	22	0.000005	0.000020	0.000007	0.000005	0.000004	0.000001	1.82	16	0	0
Dissolved Bismuth	-	mg/L	24	0.0000025	0.0000150	0.0000033	0.0000025	0.0000028	0.0000006	1.17	22	0	0	22	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	22	0	0
Dissolved Boron	-	mg/L	24	0.025	0.025	0.025	0.025	0	-	-	24	0	0	22	0.025	0.025	0.025	0.025	0	-	-	22	0	0
Dissolved Cadmium	-	mg/L	24	0.000023	0.000130	0.000069	0.000068	0.000027	0.000005	2.57	0	0	0	22	0.000003	0.000063	0.000015	0.000011	0.000016	0.000003	0.98	4	0	0
Dissolved Calcium	-	mg/L	24	12.50	55.20	34.33	37.20	11.52	2.35	2.98	0	0	0	22	7.21	32.90	21.11	19.45	7.89	1.68	2.68	0	0	0
Dissolved Chromium	-	mg/L	24	0.00005	0.00030	0.00011	0.00010	0.00008	0.00002	1.41	10	0	0	22	0.00005	0.00050	0.00016	0.00010	0.00012	0.00003	1.30	7	0	0
Dissolved Cobalt	-	mg/L	24	0.000033	0.000572	0.000260	0.000248	0.000160	0.000033	1.63	0	0	0	22	0.000010	0.000131	0.000041	0.000032	0.000031	0.000007	1.35	0	0	0
Dissolved Copper	-	mg/L	24	0.0034	0.0292	0.0116	0.0085	0.0076	0.0016	1.52	0	0	0	22	0.0004	0.0078	0.0016	0.0010	0.0018	0.0004	0.91	0	0	0
Dissolved Iron	-	mg/L	24	0.002	0.376	0.106	0.065	0.099	0.020	1.07	0	0	0	22	0.002	0.192	0.049	0.028	0.053	0.011	0.91	0	0	0
Dissolved Lead	-	mg/L	23	0.000009	0.000703	0.000175	0.000114	0.000185	0.000039	0.94	0	0	0	22	0.000003	0.000388	0.000063	0.000018	0.000106	0.000023	0.60	1	0	0
Dissolved Lithium	-	mg/L	24	0.00025	0.00240	0.00125	0.00130	0.00048	0.00010	2.62	1	0	0	22	0.00025	0.00220	0.00064	0.00060	0.00046	0.00010	1.40	8	0	0
Dissolved Magnesium	-	mg/L	24	3.23	17.60	10.01	10.55	3.75	0.77	2.67	0	0	0	22	1.89	10.20	6.09	5.68	2.44	0.52	2.49	0	0	0
Dissolved Manganese	-	mg/L	24	0.0136	0.1110	0.0346	0.0269	0.0230	0.0047	1.50	0	0	0	22	0.0011	0.0266	0.0050	0.0027	0.0067	0.0014	0.74	0	0	0
Dissolved Mercury	-	mg/L	20	0.0000050	0.0000200	0.0000063	0.0000050	0.0000036	0.0000008	1.74	17	0	0	18	0.0000050	0.0000100	0.0000053	0.0000050	0.0000012	0.0000003	4.48	17	0	0
Dissolved Molybdenum	-	mg/L	24	0.00025	0.00099	0.00064	0.00063	0.00021	0.00004	3.01	0	0	0	22	0.00045	0.00239	0.00126	0.00116	0.00054	0.00011	2.34	0	0	0
Dissolved Nickel	-	mg/L	24	0.00019	0.00112	0.00050	0.00045	0.00024	0.00005	2.12	0	0	0	22	0.00010	0.00076	0.00033	0.00025	0.00021	0.00004	1.61	0	0	0
Dissolved Phosphorus	-	mg/L	20	0.0010	0.0100	0.0033	0.0010	0.0033	0.0007	1.01	11	0	0	17	0.0010	0.0094	0.0030	0.0010	0.0028	0.0007	1.04	9	0	0
Dissolved Potassium	-	mg/L	24	0.45	1.47	0.96	0.94	0.22	0.05	4.35	0	0	0	22	0.63	1.53	1.05	1.05	0.24	0.05	4.28	0	0	0
Dissolved Selenium	-	mg/L	24	0.00007	0.00028	0.00012	0.00012	0.00005	0.00001	2.55	0	0	0	22	0.00002	0.00012	0.00004	0.00002	0.00003	0.00001	1.42	12	0	0
Dissolved Silicon	-	mg/L	24	2.74	6.40	4.97	5.20	0.92	0.19	5.38	0	0	0	22	2.34	6.10	4.87	5.00	0.94	0.20	5.21	0	0	0
Dissolved Silver	-	mg/L	24	0.000003	0.000013	0.000005	0.000003	0.000004	0.000001	1.29	17	0	0	22	0.000003	0.000007	0.000003	0.000003	0.000001	0.000000	2.58	20	0	0
Dissolved Sodium	-	mg/L	24	1.37	5.33	3.47	3.66	1.06	0.22	3.28	0	0	0	22	1.10	6.46	3.31	3.20	1.19	0.25	2.77	0	0	0
Dissolved Strontium	-	mg/L	24	0.072	0.365	0.217	0.228	0.074	0.015	2.92	0	0	0	22	0.041	0.250	0.117	0.113	0.051	0.011	2.29	0	0	0
Dissolved Sulphur	-	mg/L	6	5.00	40.00	23.67	24.00	12.40	5.06	1.91	1	0	0	6	5.00	16.00	10.50	12.00	4.55	1.86	2.31	2	0	0
Dissolved Thallium	-	mg/L	24	0.000010	0.0000050	0.0000030	0.0000030	0.0000012	0.0000002	2.44	4	0	0	22	0.000010	0.0000050	0.0000024	0.0000030	0.0000011	0.0000002	2.08	7	0	0
Dissolved Tin	-	mg/L	24	0.000005	0.000100	0.000013	0.000005	0.000027	0.000005	0.48	24	0	0	22	0.000005	0.000100	0.000014	0.000005	0.000028	0.000006	0.51	20	0	0
Dissolved Titanium	-	mg/L	24	0.00025	0.00210	0.00060	0.00025	0.00061	0.00013	0.97	16	0	0	22	0.00025	0.00260	0.00062	0.00025	0.00065	0.00014	0.95	15	0	0
Dissolved Uranium	-	mg/L	24	0.00144	0.02370	0.00946	0.00934	0.00556	0.00113	1.70	0	0	0	22	0.00102	0.00863	0.00393	0.00324	0.00238	0.00051	1.65	0	0	0
Dissolved Vanadium	-	mg/L	24	0.00010	0.00060	0.00018	0.00010	0.00014	0.00003	1.29	16	0	0	22	0.00010	0.00100	0.00034	0.00030	0.00021	0.00005	1.58	4	0	0
Dissolved Zinc	-	mg/L	24	0.00110	0.00980	0.00420	0.00430	0.00190	0.00039	2.21	0	0	0	22	0.00020	0.00520	0.00112	0.00060	0.00120	0.00026	0.93	0	0	0
Dissolved Zirconium	-	mg/L	24	0.00005	0.00050	0.00012	0.00010	0.00011	0.00002	1.14	11	0	0	22	0.00005	0.00050	0.00017	0.00020	0.00013	0.00003	1.35	8	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH3) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5: 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10^(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e^0.8545[ln(hardness)]-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e^1.273[ln(hardness)]-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e^0.76[ln(hardness)]+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

Highlighted cells indicate updates from Project Proposal

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guic
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "." No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W4											W24										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	24	7.30	8.20	7.84	7.90	0.24	0.05	32.03	0	0	0	1	7.69	7.69	7.69	7.69	0	-	-	0	0	0
Conductivity	-	µS/cm	24	71	387	234	236	82	17	2.85	0	0	0	1	132	132	132	132	0	-	-	0	0	0
Total Hardness CaCO <sub>3</sub>	-	mg/L	24	37	176	111	111	39	8	2.87	0	0	0	1	62	62	62	62	0	-	-	0	0	0
Dissolved Hardness CaCO <sub>3</sub>	-	mg/L	6	33	176	123	129	52	21	2.36	0	0	0	1	58	58	58	58	0	-	-	0	0	0
Moisture	-	%	-	-	-	-	-	-	-	-	-	-	-	1	75	75	75	75	0	-	-	0	0	0
Ion Balance	-	no unit	4	0.93	1.00	0.98	1.00	0.03	0.02	28.07	0	0	0	1	0.97	0.97	0.97	0.97	0	-	-	0	0	0
Total Dissolved Solids	-	mg/L	24	72	232	154	150	44	9	3.52	0	0	0	1	74	74	74	74	0	-	-	0	0	0
Total Suspended Solids	-	mg/L	24	0.5	130.0	13.9	2.0	32.8	6.7	0.43	7	0	0	1	0.5	0.5	0.5	0.5	0	-	-	1	0	0
Turbidity	-	NTU	24	0.2	51.0	3.5	0.8	10.4	2.1	0.33	0	0	0	1	0.4	0.4	0.4	0.4	0	-	-	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	24	0.003	0.250	0.033	0.010	0.053	0.011	0.62	10	0	0	1	0.043	0.043	0.043	0.043	0	-	-	0	0	0
Alkalinity, Total (as CaCO <sub>3</sub> )	-	mg/L	24	22.0	125.0	78.04	79.0	27.81	5.68	2.81	0	0	0	1	40.0	40.0	40.0	40.0	0	-	-	0	0	0
Acidity (pH 4.5) as CaCO <sub>3</sub>	-	mg/L	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0	1	0.25	0.25	0.25	0.25	0	-	-	1	0	0
Acidity (pH8.3) as CaCO <sub>3</sub>	-	mg/L	13	0.25	4.50	1.64	1.40	1.29	0.36	1.27	3	0	0	1	1.80	1.80	1.80	1.80	0	-	-	0	0	0
Bromide (Br)	-	mg/L	20	0.01	0.20	0.17	0.20	0.07	0.01	2.60	20	0	0	1	0.20	0.20	0.20	0.20	0	-	-	1	0	0
Chloride (Cl)	120	mg/L	24	0.25	6.40	0.83	0.25	1.27	0.26	0.65	13	0	0	1	0.25	0.25	0.25	0.25	0	-	-	1	0	0
Fluoride (F)	0.12	mg/L	20	0.040	0.100	0.068	0.070	0.013	0.003	5.19	0	0	0	1	0.060	0.060	0.060	0.060	0	-	-	0	0	0
Sulphate (SO <sub>4</sub> )	-	mg/L	24	7.16	70.50	39.02	41.00	16.68	3.40	2.34	0	0	0	1	21.00	21.00	21.00	21.00	0	-	-	0	0	0
Total Nitrogen (N)	-	mg/L	6	0.16	0.74	0.39	0.36	0.19	0.08	2.08	0	0	0	1	0.24	0.24	0.24	0.24	0	-	-	0	0	0
Nitrate (as N)	13	mg/L	24	0.022	0.264	0.145	0.158	0.080	0.016	1.81	0	0	0	1	0.205	0.205	0.205	0.205	0	-	-	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	6	0.052	0.264	0.174	0.182	0.082	0.034	2.11	0	0	0	1	0.205	0.205	0.205	0.205	0	-	-	0	0	0
Nitrite (as N)	0.06	mg/L	24	0.001	0.004	0.001	0.001	0.001	0.000	1.72	18	0	0	1	0.001	0.001	0.001	0.001	0	-	-	1	0	0
Total Kjeldahl Nitrogen	-	mg/L	23	0.01	0.69	0.21	0.17000	0.1604	0.0334	1.30	1	0	0	1	0.03	0.03	0.03	0.03000	0	-	-	0	0	0
Ortho Phosphate as P	-	mg/L	24	0.0005	0.0480	0.0036	0.0010	0.0097	0.0020	0.37	7	0	0	1	0.0010	0.0010	0.0010	0.0010	0	-	-	0	0	0
Cyanide, Total	0.005	mg/L	23	0.00025	0.00210	0.00053	0.00025	0.00044	0.00009	1.20	13	1	4	1	0.00025	0.00025	0.00025	0.00025	0	-	-	1	0	0
Cyanide, Weak Acid Diss	-	mg/L	24	0.00025	0.00170	0.00049	0.00025	0.00036	0.00007	1.36	14	0	0	1	0.00025	0.00025	0.00025	0.00025	0	-	-	1	0	0
Dissolved Organic Carbon	-	mg/L	12	2.10	13.40	6.76	7.00	3.63	1.05	1.86	0	0	0	1	8.80	8.80	8.80	8.80	0	-	-	0	0	0
Total Organic Carbon	-	mg/L	20	1.80	19.80	7.18	5.65	4.80	1.07	1.50	0	0	0	1	9.20	9.20	9.20	9.20	0	-	-	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	24	0.0120	0.9450	0.1589	0.0811	0.2397	0.0489	0.66	0	9	38	1	0.0436	0.0436	0.0436	0.0436	0	-	-	0	0	0
Total Antimony	-	mg/L	24	0.000100	0.000460	0.000146	0.000131	0.000069	0.000014	2.12	0	0	0	1	0.00030	0.00030	0.00030	0.00030	0	-	-	0	0	0
Total Arsenic	0.005	mg/L	24	0.000290	0.002430	0.000587	0.000430	0.000466	0.000095	1.26	0	0	0	1	0.00063	0.00063	0.00063	0.00063	0	-	-	0	0	0
Total Barium	-	mg/L	24	0.04	0.10	0.06	0.05850	0.0151	0.0031	4.07	0	0	0	1	0.04	0.04	0.04	0.03960	0	-	-	0	0	0
Total Beryllium	-	mg/L	24	0.000005	0.000073	0.000013	0.000005	0.000019	0.000004	0.71	16	0	0	1	0.000010	0.000010	0.000010	0.000010	0	-	-	0	0	0
Total Bismuth	-	mg/L	24	0.0000025	0.0000177	0.0000044	0.0000025	0.0000048	0.0000010	0.92	20	0	0	1	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	1	0	0
Total Boron	1.5	mg/L	24	0.03	0.03	0.03	0.02500	0	-	-	24	0	0	1	0.03	0.03	0.03	0.02500	0	-	-	1	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	24	0.000012	0.000271	0.000048	0.000027	0.000067	0.000014	0.73	0	8	33	1	0.000013	0.000013	0.000013	0.000013	0	-	-	0	0	0
Total Calcium	-	mg/L	24	10.10	47.20	29.55	29.40	10.02	2.05	2.95	0	0	0	1	16.30	16.30	16.30	16.30	0	-	-	0	0	0
Total Chromium	0.001	mg/L	24	0.00005	0.00126	0.00023	0.00010	0.00027	0.00006	0.83	9	1	4	1	0.00030	0.00030	0.00030	0.00030	0	-	-	0	0	0
Total Cobalt	-	mg/L	24	0.000017	0.001700	0.000227	0.000079	0.000403	0.000082	0.56	0	0	0	1	0.000043	0.000043	0.000043	0.000043	0	-	-	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	24	0.0015	0.0278	0.0079	0.0059	0.0070	0.0014	1.13	0	18	75	1	0.0014	0.0014	0.0014	0.0014	0	-	-	0	0	0
Total Iron	0.3	mg/L	24	0.011	1.930	0.258	0.126	0.422	0.086	0.61	0	4	17	1	0.039	0.039	0.039	0.039	0	-	-	0	0	0
Total Lead	0.003 <sup>e</sup>	mg/L	23	0.000028	0.010700	0.000751	0.000182	0.002194	0.000457	0.34	0	2	9	1	0.000081	0.000081	0.000081	0.000081	0	-	-	0	0	0
Total Lithium	-	mg/L	24	0.00060	0.00160	0.00109	0.00100	0.00026	0.00005	4.19	0	0	0	1	0.00025	0.00025	0.00025	0.00025	0	-	-	1	0	0
Total Magnesium	-	mg/L	24	2.85	15.10	9.13	9.03	3.37	0.69	2.71	0	0	0	1	5.19	5.19	5.19	5.19	0	-	-	0	0	0
Total Manganese	-	mg/L	24	0.0038	0.2150	0.0275	0.0115	0.0474	0.0097	0.58	0	0	0	1	0.0006	0.0006	0.0006	0.0006	0	-	-	0	0	0
Total Mercury	0.000026	mg/L	21	0.0000050	0.0000100	0.0000055	0.0000050	0.0000015	0.0000003	3.64	19	0	0	1	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	1	0	0
Total Molybdenum	0.073	mg/L	24	0.00037	0.00138	0.00103	0.00113	0.00030	0.00006	3.50	0	0	0	1	0.00028	0.00028	0.00028	0.00028	0	-	-	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	24	0.00016	0.00171	0.00047	0.00037	0.00039	0.00008	1.21	0	0	0	1	0.00064	0.00064	0.00064	0.00064	0	-	-	0	0	0
Total Phosphorus	-	mg/L	21	0.0010	0.0910	0.0136	0.0060	0.0234	0.0051	0.58	2	0	0	1	0.0040	0.0040	0.0040	0.0040	0	-	-	0	0	0
Total Potassium	-	mg/L	24	0.59	1.54	1.04	1.01	0.23	0.05	4.52	0	0	0	1	0.43	0.43	0.43	0.43	0	-	-	0	0	0
Total Selenium	0.001	mg/L	24	0.00002	0.00015	0.00007	0.00007	0.00002	0.00000	2.98	1	0	0	1	0.00043	0.00043	0.00043	0.00043	0	-	-	0	0	0

Note:

1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007

a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20

b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5: 0.1 mg/L at pH ≥ 6.5

c) Cadmium (Cd) mg/L: 10<sup>-5</sup>(0.86\*(log(hardness))-3.2)/1000

d) Copper (Cu) mg/L: (e<sup>0.8545[ln(hardness)]-1.465</sup>)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness

e) Lead (Pb) mg/L: (e<sup>1.273[ln(hardness)]-4.705</sup>)/1000; minimum is 0.001mg/L regardless of water hardness

f) Nickel (Ni) mg/L: (e<sup>0.76[ln(hardness)]+1.06</sup>)/1000; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guid
- "%>GL" % of Parameters that Exceed CCME Guideline
- "-" No Data Available

Highlighted cells indicate updates from Project Proposal

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W4											W24										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silicon	-	mg/L	24	3.07	6.10	4.97	5.10	0.82	0.17	6.04	0	0	0	1	2.80	2.80	2.80	2.80	0	-	-	0	0	0
Total Silver	0.0001	mg/L	24	0.000003	0.000090	0.000009	0.000003	0.000021	0.000004	0.43	21	0	0	1	0.000003	0.000003	0.000003	0.000003	0	-	-	1	0	0
Total Sodium	-	mg/L	24	1.22	6.02	4.00	4.08	1.33	0.27	2.99	0	0	0	1	0.90	0.90	0.90	0.90	0	-	-	0	0	0
Total Strontium	-	mg/L	24	0.065	0.309	0.184	0.179	0.065	0.013	2.83	0	0	0	1	0.044	0.044	0.044	0.044	0	-	-	0	0	0
Total Sulphur	-	mg/L	6	5.00	26.00	16.83	17.00	7.47	3.05	2.25	1	0	0	1	5.00	5.00	5.00	5.00	0	-	-	1	0	0
Total Thallium	0.0008	mg/L	24	0.000010	0.000300	0.000040	0.000020	0.000066	0.000013	0.61	11	0	0	1	0.000040	0.000040	0.000040	0.000040	0	-	-	0	0	0
Total Tin	-	mg/L	24	0.000005	0.000100	0.000013	0.000005	0.000027	0.000005	0.48	24	0	0	1	0.000005	0.000005	0.000005	0.000005	0	-	-	1	0	0
Total Titanium	-	mg/L	24	0.00025	0.03130	0.00394	0.00145	0.00702	0.00143	0.56	7	0	0	1	0.00110	0.00110	0.00110	0.00110	0	-	-	0	0	0
Total Uranium	0.015	mg/L	24	0.00222	0.01850	0.00746	0.00663	0.00428	0.00087	1.74	0	0	0	1	0.00031	0.00031	0.00031	0.00031	0	-	-	0	0	0
Total Vanadium	-	mg/L	24	0.00010	0.00389	0.00067	0.00040	0.00097	0.00020	0.69	8	0	0	1	0.00010	0.00010	0.00010	0.00010	0	-	-	1	0	0
Total Zinc	0.03	mg/L	24	0.00050	0.02380	0.00379	0.00180	0.00553	0.00113	0.69	0	0	0	1	0.00310	0.00310	0.00310	0.00310	0	-	-	0	0	0
Total Zirconium	-	mg/L	24	0.00005	0.00070	0.00018	0.00015	0.00016	0.00003	1.11	9	0	0	1	0.00020	0.00020	0.00020	0.00020	0	-	-	0	0	0
Dissolved Aluminum	0.1	mg/L	24	0.0060	0.2470	0.0569	0.0270	0.0655	0.0134	0.87	0	4	17	1	0.0395	0.0395	0.0395	0.0395	0	-	-	0	0	0
Dissolved Antimony	-	mg/L	24	0.00007	0.00022	0.00013	0.00013	0.00003	0.00006	4.79	0	0	0	1	0.00030	0.00030	0.00030	0.00030	0	-	-	0	0	0
Dissolved Arsenic	-	mg/L	24	0.00030	0.00075	0.00041	0.00039	0.00010	0.00020	4.24	0	0	0	1	0.00060	0.00060	0.00060	0.00060	0	-	-	0	0	0
Dissolved Barium	-	mg/L	24	0.027	0.099	0.057	0.054	0.017	0.004	3.28	0	0	0	1	0.039	0.039	0.039	0.039	0	-	-	0	0	0
Dissolved Beryllium	-	mg/L	24	0.000005	0.000020	0.000007	0.000005	0.000004	0.000001	1.64	17	0	0	1	0.000005	0.000005	0.000005	0.000005	0	-	-	1	0	0
Dissolved Bismuth	-	mg/L	24	0.000025	0.000050	0.000026	0.000025	0.000005	0.000001	5.10	23	0	0	1	0.000025	0.000025	0.000025	0.000025	0	-	-	1	0	0
Dissolved Boron	-	mg/L	24	0.025	0.025	0.025	0.025	0	-	-	24	0	0	1	0.025	0.025	0.025	0.025	0	-	-	1	0	0
Dissolved Cadmium	-	mg/L	24	0.000006	0.000047	0.000023	0.000021	0.000010	0.000002	2.23	0	0	0	1	0.000003	0.000003	0.000003	0.000003	0	-	-	1	0	0
Dissolved Calcium	-	mg/L	24	8.91	46.60	29.06	28.45	9.94	2.03	2.92	0	0	0	1	14.40	14.40	14.40	14.40	0	-	-	0	0	0
Dissolved Chromium	-	mg/L	24	0.00005	0.00030	0.00012	0.00008	0.00009	0.00002	1.33	12	0	0	1	0.00030	0.00030	0.00030	0.00030	0	-	-	0	0	0
Dissolved Cobalt	-	mg/L	24	0.000014	0.000174	0.000071	0.000062	0.000048	0.000010	1.50	0	0	0	1	0.000029	0.000029	0.000029	0.000029	0	-	-	0	0	0
Dissolved Copper	-	mg/L	24	0.0014	0.0147	0.0056	0.0041	0.0040	0.0008	1.41	0	0	0	1	0.0013	0.0013	0.0013	0.0013	0	-	-	0	0	0
Dissolved Iron	-	mg/L	24	0.003	0.201	0.066	0.043	0.060	0.012	1.09	0	0	0	1	0.026	0.026	0.026	0.026	0	-	-	0	0	0
Dissolved Lead	-	mg/L	23	0.000006	0.000495	0.000077	0.000029	0.000106	0.000022	0.73	0	0	0	1	0.000012	0.000012	0.000012	0.000012	0	-	-	0	0	0
Dissolved Lithium	-	mg/L	24	0.00025	0.00150	0.00102	0.00100	0.00032	0.00007	3.14	1	0	0	1	0.00025	0.00025	0.00025	0.00025	0	-	-	1	0	0
Dissolved Magnesium	-	mg/L	24	2.54	15.30	9.08	8.52	3.33	0.68	2.73	0	0	0	1	5.41	5.41	5.41	5.41	0	-	-	0	0	0
Dissolved Manganese	-	mg/L	24	0.0034	0.0233	0.0093	0.0076	0.0054	0.0011	1.73	0	0	0	1	0.0002	0.0002	0.0002	0.0002	0	-	-	0	0	0
Dissolved Mercury	-	mg/L	20	0.0000050	0.0000100	0.0000053	0.0000050	0.0000011	0.0000003	4.70	19	0	0	-	-	-	-	-	-	-	-	-	-	-
Dissolved Molybdenum	-	mg/L	24	0.00033	0.00141	0.00106	0.00110	0.00029	0.00006	3.68	0	0	0	1	0.00030	0.00030	0.00030	0.00030	0	-	-	0	0	0
Dissolved Nickel	-	mg/L	24	0.00015	0.00089	0.00037	0.00032	0.00021	0.00004	1.75	0	0	0	1	0.00054	0.00054	0.00054	0.00054	0	-	-	0	0	0
Dissolved Phosphorus	-	mg/L	20	0.0010	0.0120	0.0040	0.0030	0.0034	0.0008	1.17	6	0	0	-	-	-	-	-	-	-	-	-	-	-
Dissolved Potassium	-	mg/L	24	0.59	1.57	1.03	1.02	0.23	0.05	4.50	0	0	0	1	0.45	0.45	0.45	0.45	0	-	-	0	0	0
Dissolved Selenium	-	mg/L	24	0.00002	0.00015	0.00007	0.00007	0.00003	0.00001	2.52	1	0	0	1	0.00036	0.00036	0.00036	0.00036	0	-	-	0	0	0
Dissolved Silicon	-	mg/L	24	2.24	6.40	4.90	5.10	0.97	0.20	5.03	0	0	0	1	2.60	2.60	2.60	2.60	0	-	-	0	0	0
Dissolved Silver	-	mg/L	24	0.000003	0.000028	0.000004	0.000003	0.000005	0.000001	0.73	21	0	0	1	0.000003	0.000003	0.000003	0.000003	0	-	-	1	0	0
Dissolved Sodium	-	mg/L	24	1.19	6.16	3.99	3.82	1.29	0.26	3.08	0	0	0	1	0.90	0.90	0.90	0.90	0	-	-	0	0	0
Dissolved Strontium	-	mg/L	24	0.057	0.299	0.183	0.179	0.064	0.013	2.83	0	0	0	1	0.044	0.044	0.044	0.044	0	-	-	0	0	0
Dissolved Sulphur	-	mg/L	6	5.00	27.00	17.17	17.00	8.26	3.37	2.08	1	0	0	1	5.00	5.00	5.00	5.00	0	-	-	1	0	0
Dissolved Thallium	-	mg/L	24	0.0000010	0.0000050	0.0000019	0.0000010	0.0000011	0.0000002	1.66	13	0	0	1	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	0	0	0
Dissolved Tin	-	mg/L	24	0.000005	0.000100	0.000014	0.000005	0.000027	0.000006	0.52	23	0	0	1	0.000005	0.000005	0.000005	0.000005	0	-	-	1	0	0
Dissolved Titanium	-	mg/L	24	0.00025	0.00230	0.00060	0.00025	0.00062	0.00013	0.96	16	0	0	1	0.00110	0.00110	0.00110	0.00110	0	-	-	0	0	0
Dissolved Uranium	-	mg/L	24	0.00150	0.01820	0.00734	0.00639	0.00440	0.00090	1.67	0	0	0	1	0.00028	0.00028	0.00028	0.00028	0	-	-	0	0	0
Dissolved Vanadium	-	mg/L	24	0.00010	0.00080	0.00027	0.00025	0.00018	0.00004	1.48	9	0	0	1	0.00040	0.00040	0.00040	0.00040	0	-	-	0	0	0
Dissolved Zinc	-	mg/L	24	0.00050	0.00690	0.00212	0.00155	0.00173	0.00035	1.23	0	0	0	1	0.00040	0.00040	0.00040	0.00040	0	-	-	0	0	0
Dissolved Zirconium	-	mg/L	24	0.00005	0.00050	0.00014	0.00010	0.00011	0.00002	1.28	9	0	0	1	0.00020	0.00020	0.00020	0.00020	0	-	-	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH3) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10^(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e^0.8545[ln(hardness)]-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e^1.273[ln(hardness)]-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e^0.76[ln(hardness)]+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guic
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Highlighted cells indicate updates from Project Proposal



Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W22										R2											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	5	7.26	8.00	7.71	7.92	0.34	0.15	22.83	0	0	0	19	7.37	7.90	7.70	7.70	0.15	0.03	50.81	0	0	0
Conductivity	-	µS/cm	5	69	289	179	220	100	45	1.80	0	0	0	19	51	263	159	163	50	11	3.18	0	0	0
Total Hardness CaCO <sub>3</sub>	-	mg/L	5	28	132	75	71	43	19	1.73	0	0	0	5	26	125	83	93	37	16	2.26	0	0	0
Dissolved Hardness CaCO <sub>3</sub>	-	mg/L	5	30	128	74	70	41	19	1.79	0	0	0	19	27	118	75	76	22	5	3.45	0	0	0
Ion Balance	-	no unit	3	0.92	1.00	0.97	0.99	0.04	0.03	22.25	0	0	0	3	0.91	1.00	0.96	0.98	0.05	0.03	20.38	0	0	0
Total Dissolved Solids	-	mg/L	5	54	164	100	82	46	20	2.19	0	0	0	19	70	150	102	100	24	6	4.20	0	0	0
Total Suspended Solids	-	mg/L	5	0.5	10.0	4.1	0.5	4.9	2.2	0.83	3	0	0	19	0.5	31.1	3.2	0.5	7.1	1.6	0.45	11	0	0
Turbidity	-	NTU	5	0.2	2.2	1.1	1.1	0.9	0.4	1.21	0	0	0	19	0.1	3.1	0.5	0.2	0.7	0.2	0.68	1	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	5	0.010	0.046	0.022	0.020	0.014	0.006	1.58	0	0	0	19	0.003	0.070	0.013	0.005	0.016	0.004	0.80	11	0	0
Alkalinity, Total (as CaCO <sub>3</sub> )	-	mg/L	5	16.0	137.0	70.68	65.0	48.80	21.82	1.45	0	0	0	19	21.3	88.0	63.70	67.0	17.08	3.92	3.73	0	0	0
Acidity (pH 4.5) as CaCO <sub>3</sub>	-	mg/L	5	0.25	0.25	0.25	0.25	0	-	-	5	0	0	5	0.25	0.25	0.25	0.25	0	-	-	5	0	0
Acidity (pH8.3) as CaCO <sub>3</sub>	-	mg/L	5	0.25	7.50	2.47	2.10	2.97	1.33	0.83	2	0	0	13	0.70	7.30	2.48	1.60	1.88	0.52	1.32	0	0	0
Bromide (Br)	-	mg/L	5	0.01	0.20	0.12	0.20	0.11	0.05	1.14	5	0	0	19	0.01	0.20	0.18	0.20	0.06	0.01	2.92	19	0	0
Chloride (Cl)	120	mg/L	5	0.25	0.80	0.47	0.25	0.30	0.13	1.56	3	0	0	19	0.25	1.10	0.36	0.25	0.22	0.05	1.63	14	0	0
Fluoride (F)	0.12	mg/L	5	0.038	0.062	0.046	0.040	0.010	0.005	4.55	0	0	0	19	0.037	0.080	0.053	0.050	0.009	0.002	5.86	0	0	0
Sulphate (SO <sub>4</sub> )	-	mg/L	5	8.10	15.00	11.11	9.86	2.94	1.32	3.78	0	0	0	19	0.25	43.00	17.31	17.00	9.14	2.10	1.89	1	0	0
Total Nitrogen (N)	-	mg/L	5	0.22	0.54	0.38	0.38	0.12	0.05	3.30	0	0	0	5	0.37	0.61	0.44	0.41	0.10	0.04	4.62	0	0	0
Nitrate (as N)	13	mg/L	5	0.092	0.296	0.188	0.196	0.090	0.040	2.08	0	0	0	19	0.009	0.403	0.207	0.199	0.133	0.030	1.56	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	5	0.092	0.296	0.189	0.199	0.090	0.040	2.10	0	0	0	5	0.011	0.359	0.229	0.268	0.142	0.063	1.61	0	0	0
Nitrite (as N)	0.06	mg/L	5	0.001	0.002	0.001	0.001	0.001	0.000	2.20	3	0	0	19	0.001	0.005	0.002	0.001	0.001	0.000	1.32	14	0	0
Total Kjeldahl Nitrogen	-	mg/L	5	0.02	0.44	0.19	0.16000	0.1628	0.0728	1.18	0	0	0	18	0.0200	0.5940	0.1869	0.1700	0.1311	0.0309	1.43	0	0	0
Ortho Phosphate as P	-	mg/L	5	0.0005	0.0030	0.0015	0.0010	0.0010	0.0004	1.50	1	0	0	19	0.0005	0.0310	0.0029	0.0010	0.0068	0.0016	0.42	4	0	0
Cyanide, Total	0.005	mg/L	5	0.00025	0.00135	0.00047	0.00025	0.00049	0.00022	0.96	4	0	0	19	0.00025	0.00150	0.00040	0.00025	0.00034	0.00008	1.18	15	0	0
Cyanide, Weak Acid Diss	-	mg/L	5	0.00025	0.00070	0.00043	0.00025	0.00025	0.00011	1.74	3	0	0	19	0.00025	0.00110	0.00040	0.00025	0.00028	0.00006	1.45	14	0	0
Dissolved Organic Carbon	-	mg/L	5	2.04	7.40	5.21	6.30	2.51	1.12	2.07	0	0	0	12	2.24	15.70	8.04	6.55	4.91	1.42	1.64	0	0	0
Total Organic Carbon	-	mg/L	5	2.00	7.40	4.38	4.10	2.28	1.02	1.93	1	0	0	19	2.40	19.50	7.34	6.10	4.71	1.08	1.56	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	5	0.0098	0.1980	0.0841	0.0874	0.0771	0.0345	1.09	0	2	40	19	0.0093	0.3700	0.0658	0.0238	0.1007	0.0231	0.65	0	3	16
Total Antimony	-	mg/L	5	0.000050	0.000080	0.000063	0.000060	0.000011	0.000005	5.75	0	0	0	19	0.000020	0.000060	0.000035	0.000032	0.000010	0.000002	3.69	0	0	0
Total Arsenic	0.005	mg/L	5	0.000260	0.000542	0.000332	0.000290	0.000119	0.000053	2.79	0	0	0	19	0.000100	0.000475	0.000216	0.000200	0.000087	0.000020	2.47	0	0	0
Total Barium	-	mg/L	5	0.01	0.10	0.06	0.06380	0.0350	0.0156	1.69	0	0	0	19	0.04	0.07	0.05	0.04980	0.0105	0.0024	4.82	0	0	0
Total Beryllium	-	mg/L	5	0.000050	0.0000170	0.0000084	0.0000050	0.0000053	0.0000024	1.59	3	0	0	19	0.0000050	0.0000320	0.0000085	0.0000050	0.0000074	0.0000017	1.15	14	0	0
Total Bismuth	-	mg/L	5	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	5	0	0	19	0.0000025	0.0000077	0.0000028	0.0000025	0.0000012	0.0000003	2.33	18	0	0
Total Boron	1.5	mg/L	5	0.03	0.03	0.03	0.02500	0	-	-	5	0	0	19	0.03	0.03	0.03	0.02500	0	-	-	19	0	0
Total Cadmium	0.00032 <sup>c</sup>	mg/L	5	0.000003	0.000022	0.000013	0.000014	0.000007	0.000003	1.82	1	2	40	19	0.000003	0.000038	0.000007	0.000005	0.000008	0.000002	0.87	8	1	5
Total Calcium	-	mg/L	5	8.29	34.50	20.00	19.00	10.90	4.87	1.84	0	0	0	19	6.74	26.20	18.08	18.20	4.90	1.12	3.69	0	0	0
Total Chromium	0.001	mg/L	5	0.00005	0.00029	0.00016	0.00020	0.00011	0.00005	1.50	2	0	0	19	0.00005	0.00060	0.00018	0.00010	0.00017	0.00004	1.07	7	0	0
Total Cobalt	-	mg/L	5	0.000041	0.000149	0.000091	0.000071	0.000045	0.000020	2.00	0	0	0	19	0.000013	0.000319	0.000057	0.000030	0.000073	0.000017	0.77	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	5	0.0003	0.0017	0.0010	0.0009	0.0006	0.0003	1.71	0	0	0	19	0.0005	0.0026	0.0011	0.0009	0.0006	0.0001	1.86	0	2	11
Total Iron	0.3	mg/L	5	0.056	0.371	0.161	0.094	0.131	0.059	1.23	0	1	20	19	0.006	0.625	0.088	0.029	0.153	0.035	0.58	0	2	11
Total Lead	0.003 <sup>e</sup>	mg/L	5	0.000012	0.000438	0.000146	0.000121	0.000172	0.000077	0.85	0	0	0	19	0.000003	0.000232	0.000047	0.000018	0.000063	0.000015	0.75	1	0	0
Total Lithium	-	mg/L	5	0.00107	0.00470	0.00263	0.00240	0.00145	0.00065	1.81	0	0	0	19	0.00060	0.00130	0.00099	0.00100	0.00021	0.00005	4.81	0	0	0
Total Magnesium	-	mg/L	5	1.71	11.30	6.03	5.74	3.91	1.75	1.54	0	0	0	19	2.43	12.70	7.35	7.35	2.37	0.54	3.09	0	0	0
Total Manganese	-	mg/L	5	0.0011	0.0771	0.0419	0.0419	0.0277	0.0124	1.52	0	0	0	19	0.0032	0.0371	0.0068	0.0049	0.0075	0.0017	0.90	0	0	0
Total Mercury	0.000026	mg/L	4	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	4	0	0	16	0.0000050	0.0000100	0.0000053	0.0000050	0.0000013	0.0000003	4.25	15	0	0
Total Molybdenum	0.073	mg/L	5	0.00023	0.00052	0.00038	0.00037	0.00011	0.00005	3.41	0	0	0	19	0.00029	0.00098	0.00075	0.00076	0.00017	0.00004	4.48	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	5	0.00021	0.00057	0.00032	0.00027	0.00014	0.00006	2.25	0	0	0	19	0.00020	0.00108	0.00041	0.00031	0.00023	0.00005	1.78	0	0	0
Total Phosphorus	-	mg/L	4	0.0030	0.0208	0.0087	0.0055	0.0084	0.0042	1.04	0	0	0	16	0.0010	0.0400	0.0062	0.0040	0.0093	0.0023	0.66	2	0	0
Total Potassium	-	mg/L	5	0.36	1.16	0.75	0.69	0.29	0.13	2.57	0	0	0	19	0.41	0.85	0.64	0.66	0.11	0.03	5.56	0	0	0
Total Selenium	0.001	mg/L	5	0.00002	0.00004	0.00002	0.00002	0.00001	0.00000	2.68	4	0	0	19	0.00002	0.00010	0.00006	0.00006	0.00002	0.00000	3.03	2	0	0
Total Silicon	-	mg/L	5	3.09	5.80	4.88	5.10	1.10	0.49	4.45	0	0	0	19	2.20	5.00	4.42	4.60	0.71	0.16	6.26	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5: 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>0.86</sup>\*(log(hardness))-3.2/1000
- d) Copper (Cu) mg/L: (e<sup>0.8545</sup>ln(hardness))-1.465/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>1.273</sup>ln(hardness))-4.705/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>0.76</sup>ln(hardness))+1.06/1000; minimum is 0.025mg/L regardless of water hardness

Highlighted cells indicate updates from Project Proposal

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guid
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W22											R2										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	5	0.000003	0.000007	0.000003	0.000003	0.000002	0.000001	1.84	4	0	0	19	0.000003	0.000007	0.000003	0.000003	0.000001	0.000000	2.65	18	0	0
Total Sodium	-	mg/L	5	1.56	5.07	3.04	2.82	1.45	0.65	2.10	0	0	0	19	0.89	4.04	2.88	3.00	0.80	0.18	3.59	0	0	0
Total Strontium	-	mg/L	5	0.052	0.339	0.175	0.153	0.116	0.052	1.50	0	0	0	19	0.052	0.229	0.151	0.155	0.043	0.010	3.49	0	0	0
Total Sulphur	-	mg/L	5	5.00	5.00	5.00	5.00	0	-	-	5	0	0	5	5.00	16.00	7.20	5.00	4.92	2.20	1.46	4	0	0
Total Thallium	0.0008	mg/L	5	0.000010	0.000038	0.000024	0.000020	0.000011	0.000005	2.20	1	0	0	19	0.000010	0.000058	0.000015	0.000010	0.000013	0.000003	1.19	15	0	0
Total Tin	-	mg/L	5	0.000005	0.000300	0.000092	0.000050	0.000123	0.000055	0.75	3	0	0	19	0.000005	0.000100	0.000015	0.000005	0.000030	0.000007	0.50	19	0	0
Total Titanium	-	mg/L	5	0.00025	0.00692	0.00228	0.00090	0.00284	0.00127	0.80	2	0	0	19	0.00025	0.01120	0.00165	0.00025	0.00324	0.00074	0.51	10	0	0
Total Uranium	0.015	mg/L	5	0.00163	0.01440	0.00608	0.00371	0.00536	0.00240	1.13	0	0	0	19	0.00111	0.00569	0.00236	0.00227	0.00123	0.00028	1.92	0	0	0
Total Vanadium	-	mg/L	5	0.00010	0.00078	0.00036	0.00020	0.00028	0.00013	1.27	1	0	0	19	0.00010	0.00131	0.00030	0.00010	0.00034	0.00008	0.86	11	0	0
Total Zinc	0.03	mg/L	5	0.00030	0.00360	0.00139	0.00096	0.00128	0.00057	1.09	0	0	0	19	0.00020	0.00244	0.00065	0.00050	0.00055	0.00013	1.18	0	0	0
Total Zirconium	-	mg/L	5	0.00005	0.00021	0.00010	0.00010	0.00007	0.00003	1.56	2	0	0	19	0.00005	0.00040	0.00016	0.00010	0.00012	0.00003	1.40	5	0	0
Dissolved Aluminum	0.1	mg/L	5	0.0035	0.1140	0.0532	0.0256	0.0552	0.0247	0.96	0	2	40	19	0.0079	0.1660	0.0373	0.0225	0.0394	0.0090	0.95	0	1	5
Dissolved Antimony	-	mg/L	5	0.00005	0.00007	0.00006	0.00006	0.00001	0.00003	8.42	0	0	0	19	0.00001	0.00005	0.00003	0.00003	0.00001	0.00002	3.13	1	0	0
Dissolved Arsenic	-	mg/L	5	0.00020	0.00034	0.00027	0.00025	0.00006	0.00028	4.37	0	0	0	19	0.00014	0.00029	0.00020	0.00020	0.00004	0.00009	4.89	0	0	0
Dissolved Barium	-	mg/L	5	0.0101	0.1040	0.0589	0.0586	0.0365	0.0163	1.61	0	0	0	19	0.0264	0.0687	0.0496	0.0495	0.0122	0.0028	4.07	0	0	0
Dissolved Beryllium	-	mg/L	5	0.000005	0.000013	0.000008	0.000005	0.000004	0.000002	2.05	3	0	0	19	0.000005	0.000020	0.000007	0.000005	0.000004	0.000001	1.58	15	0	0
Dissolved Bismuth	-	mg/L	5	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	5	0	0	19	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	19	0	0
Dissolved Boron	-	mg/L	5	0.025	0.025	0.025	0.025	0	-	-	5	0	0	19	0.025	0.025	0.025	0.025	0	-	-	19	0	0
Dissolved Cadmium	-	mg/L	5	0.000003	0.000019	0.000010	0.000010	0.000007	0.000003	1.51	1	0	0	19	0.000003	0.000024	0.000006	0.000003	0.000006	0.000001	1.04	11	0	0
Dissolved Calcium	-	mg/L	5	9.05	32.80	19.51	18.60	10.15	4.54	1.92	0	0	0	19	6.24	29.00	17.92	18.20	5.48	1.26	3.27	0	0	0
Dissolved Chromium	-	mg/L	5	0.00005	0.00020	0.00012	0.00010	0.00007	0.00003	1.64	2	0	0	19	0.00005	0.00050	0.00016	0.00010	0.00012	0.00003	1.33	5	0	0
Dissolved Cobalt	-	mg/L	5	0.000035	0.000061	0.000048	0.000047	0.000012	0.000005	4.15	0	0	0	19	0.000015	0.000129	0.000037	0.000030	0.000026	0.000006	1.42	0	0	0
Dissolved Copper	-	mg/L	5	0.0002	0.0017	0.0008	0.0007	0.0006	0.0003	1.36	0	0	0	19	0.0004	0.0019	0.0010	0.0009	0.0004	0.0001	2.35	0	0	0
Dissolved Iron	-	mg/L	5	0.013	0.122	0.060	0.058	0.039	0.018	1.53	0	0	0	19	0.004	0.213	0.041	0.024	0.049	0.011	0.84	0	0	0
Dissolved Lead	-	mg/L	5	0.000003	0.000124	0.000034	0.000015	0.000051	0.000023	0.67	1	0	0	19	0.000003	0.000133	0.000025	0.000010	0.000036	0.000008	0.70	6	0	0
Dissolved Lithium	-	mg/L	5	0.00108	0.00470	0.00266	0.00270	0.00152	0.00068	1.75	0	0	0	19	0.00058	0.00120	0.00094	0.00100	0.00019	0.00004	4.89	0	0	0
Dissolved Magnesium	-	mg/L	5	1.84	11.20	6.17	5.68	3.93	1.76	1.57	0	0	0	19	2.46	12.70	7.32	7.49	2.30	0.53	3.19	0	0	0
Dissolved Manganese	-	mg/L	5	0.0010	0.0704	0.0293	0.0120	0.0309	0.0138	0.95	0	0	0	19	0.0025	0.0107	0.0047	0.0046	0.0018	0.0004	2.61	0	0	0
Dissolved Mercury	-	mg/L	2	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	2	0	0	16	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	16	0	0
Dissolved Molybdenum	-	mg/L	5	0.00033	0.00049	0.00042	0.00042	0.00007	0.00003	5.68	0	0	0	19	0.00028	0.00101	0.00075	0.00077	0.00018	0.00004	4.23	0	0	0
Dissolved Nickel	-	mg/L	5	0.00019	0.00047	0.00028	0.00024	0.00011	0.00005	2.51	0	0	0	19	0.00020	0.00090	0.00041	0.00033	0.00017	0.00004	2.35	0	0	0
Dissolved Phosphorus	-	mg/L	2	0.0020	0.0090	0.0055	0.0055	0.0049	0.0035	1.11	0	0	0	16	0.0010	0.0099	0.0031	0.0030	0.0024	0.0006	1.29	6	0	0
Dissolved Potassium	-	mg/L	5	0.38	1.11	0.77	0.70	0.28	0.13	2.70	0	0	0	19	0.44	0.84	0.64	0.64	0.11	0.03	5.75	0	0	0
Dissolved Selenium	-	mg/L	5	0.00002	0.00004	0.00002	0.00002	0.00001	0.00000	2.68	4	0	0	19	0.00002	0.00012	0.00006	0.00006	0.00002	0.00001	2.65	1	0	0
Dissolved Silicon	-	mg/L	5	2.98	5.70	4.86	5.10	1.09	0.49	4.47	0	0	0	19	1.98	5.70	4.31	4.40	0.86	0.20	5.01	0	0	0
Dissolved Silver	-	mg/L	5	0.000003	0.000003	0.000003	0.000003	0	-	-	5	0	0	19	0.000003	0.000003	0.000003	0.000003	0	-	-	19	0	0
Dissolved Sodium	-	mg/L	5	1.57	5.01	3.08	2.82	1.42	0.64	2.17	0	0	0	19	0.96	4.90	3.00	3.01	0.88	0.20	3.42	0	0	0
Dissolved Strontium	-	mg/L	5	0.055	0.330	0.175	0.155	0.113	0.051	1.54	0	0	0	19	0.051	0.233	0.151	0.159	0.045	0.010	3.33	0	0	0
Dissolved Sulphur	-	mg/L	5	5.00	5.00	5.00	5.00	0	-	-	5	0	0	5	5.00	14.00	6.80	5.00	4.02	1.80	1.69	4	0	0
Dissolved Thallium	-	mg/L	5	0.000010	0.000030	0.000014	0.000010	0.000009	0.000004	1.57	4	0	0	19	0.000010	0.000010	0.000010	0.000010	0	-	-	19	0	0
Dissolved Tin	-	mg/L	5	0.000005	0.000100	0.000043	0.000005	0.000052	0.000023	0.83	5	0	0	19	0.000005	0.000100	0.000016	0.000005	0.000030	0.000007	0.53	18	0	0
Dissolved Titanium	-	mg/L	5	0.00025	0.00122	0.00051	0.00025	0.00042	0.00019	1.22	3	0	0	19	0.00025	0.00164	0.00044	0.00025	0.00038	0.00009	1.15	14	0	0
Dissolved Uranium	-	mg/L	5	0.00170	0.01460	0.00619	0.00398	0.00547	0.00244	1.13	0	0	0	19	0.00104	0.00601	0.00235	0.00219	0.00132	0.00030	1.79	0	0	0
Dissolved Vanadium	-	mg/L	5	0.00010	0.00060	0.00033	0.00030	0.00020	0.00009	1.66	1	0	0	19	0.00010	0.00063	0.00024	0.00020	0.00017	0.00004	1.42	9	0	0
Dissolved Zinc	-	mg/L	5	0.00040	0.00120	0.00084	0.00090	0.00037	0.00017	2.26	0	0	0	19	0.00010	0.00296	0.00056	0.00050	0.00062	0.00014	0.91	0	0	0
Dissolved Zirconium	-	mg/L	5	0.00005	0.00020	0.00011	0.00010	0.00007	0.00003	1.68	2	0	0	19	0.00005	0.00030	0.00015	0.00010	0.00008	0.00002	1.83	3	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>-4</sup>(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e<sup>-0.8545[ln(hardness)]-1.465</sup>)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>-1.273[ln(hardness)]-4.705</sup>)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>-0.76[ln(hardness)]+1.06</sup>)/1000; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guic
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Highlighted cells indicate updates from Project Proposal

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W9										W5											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	27	7.20	8.30	7.78	7.80	0.22	0.04	35.72	0	0	0	22	7.30	8.20	7.81	7.87	0.22	0.05	35.74	0	0	0
Conductivity	-	µS/cm	27	65	265	176	172	62	12	2.81	0	0	0	22	68	305	189	194	70	15	2.72	0	0	0
Total Hardness CaCO <sub>3</sub>	-	mg/L	27	33	128	84	81	29	6	2.93	0	0	0	22	33	140	91	90	32	7	2.81	0	0	0
Dissolved Hardness CaCO <sub>3</sub>	-	mg/L	6	31	118	88	99	34	14	2.57	0	0	0	6	33	134	100	112	38	16	2.61	0	0	0
Ion Balance	-	no unit	4	0.88	1.00	0.96	0.98	0.05	0.03	17.73	0	0	0	4	0.91	1.10	1.00	0.99	0.08	0.04	12.54	0	0	0
Total Dissolved Solids	-	mg/L	27	56	180	110	110	30	6	3.66	0	0	0	22	68	180	120	115	30	6	4.04	0	0	0
Total Suspended Solids	-	mg/L	27	0.5	160.0	17.7	3.0	35.3	6.8	0.50	9	0	0	22	0.5	96.0	15.3	3.5	25.7	5.5	0.59	9	0	0
Turbidity	-	NTU	27	0.2	29.0	2.7	0.6	5.8	1.1	0.46	0	0	0	22	0.2	7.8	1.7	1.1	2.1	0.5	0.79	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	27	0.003	0.083	0.016	0.005	0.022	0.004	0.74	15	0	0	22	0.003	0.260	0.030	0.005	0.058	0.012	0.51	12	0	0
Alkalinity, Total (as CaCO <sub>3</sub> )	-	mg/L	27	22.0	113.0	74.73	74.0	26.95	5.19	2.77	0	0	0	22	24.0	115.0	73.28	74.5	26.66	5.68	2.75	0	0	0
Acidity (pH 4.5) as CaCO <sub>3</sub>	-	mg/L	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0
Acidity (pH8.3) as CaCO <sub>3</sub>	-	mg/L	15	0.25	11.10	2.84	1.60	2.89	0.75	0.98	3	0	0	11	0.25	4.90	2.28	2.50	1.64	0.49	1.40	3	0	0
Bromide (Br)	-	mg/L	23	0.01	0.20	0.18	0.20	0.06	0.01	2.83	23	0	0	18	0.01	0.20	0.17	0.20	0.07	0.02	2.44	18	0	0
Chloride (Cl)	120	mg/L	27	0.25	1.60	0.59	0.50	0.42	0.08	1.42	13	0	0	22	0.25	2.50	0.68	0.65	0.52	0.11	1.31	9	0	0
Fluoride (F)	0.12	mg/L	23	0.041	0.060	0.053	0.050	0.005	0.001	9.78	0	0	0	18	0.040	0.070	0.059	0.060	0.008	0.002	7.76	0	0	0
Sulphate (SO <sub>4</sub> )	-	mg/L	27	0.25	33.00	14.62	15.00	7.88	1.52	1.86	2	0	0	22	0.25	45.00	22.05	23.50	11.26	2.40	1.96	2	0	0
Total Nitrogen (N)	-	mg/L	6	0.16	0.61	0.40	0.41	0.15	0.06	2.72	0	0	0	6	0.16	0.56	0.36	0.37	0.13	0.05	2.89	0	0	0
Nitrate (as N)	13	mg/L	27	0.016	0.317	0.137	0.130	0.092	0.018	1.49	0	0	0	22	0.006	0.300	0.142	0.143	0.085	0.018	1.67	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	6	0.037	0.317	0.197	0.198	0.105	0.043	1.88	0	0	0	6	0.046	0.300	0.191	0.186	0.096	0.039	2.00	0	0	0
Nitrite (as N)	0.06	mg/L	27	0.001	0.005	0.002	0.001	0.001	0.000	1.52	20	0	0	22	0.001	0.004	0.001	0.001	0.001	0.000	1.81	17	0	0
Total Kjeldahl Nitrogen	-	mg/L	26	0.01	0.58	0.20	0.16500	0.1266	0.0248	1.54	1	0	0	21	0.02	0.51	0.21	0.18000	0.1369	0.0299	1.53	0	0	0
Ortho Phosphate as P	-	mg/L	27	0.0005	0.0070	0.0019	0.0020	0.0014	0.0003	1.35	4	0	0	22	0.0005	0.0030	0.0017	0.0020	0.0008	0.0002	2.17	5	0	0
Cyanide, Total	0.005	mg/L	27	0.00025	0.00130	0.00053	0.00025	0.00037	0.00007	1.44	15	0	0	22	0.00025	0.00150	0.00054	0.00025	0.00037	0.00008	1.45	12	0	0
Cyanide, Weak Acid Diss	-	mg/L	27	0.00025	0.00110	0.00045	0.00025	0.00028	0.00005	1.60	17	0	0	22	0.00025	0.00130	0.00045	0.00025	0.00029	0.00006	1.57	13	0	0
Dissolved Organic Carbon	-	mg/L	14	2.62	14.10	6.64	5.15	3.58	0.96	1.85	0	0	0	10	2.50	14.10	6.71	5.65	3.95	1.25	1.70	0	0	0
Total Organic Carbon	-	mg/L	23	2.92	17.30	6.94	5.20	3.84	0.80	1.81	0	0	0	18	2.70	16.40	6.83	5.45	4.18	0.99	1.63	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	27	0.0073	0.7770	0.1439	0.0349	0.2047	0.0394	0.70	0	11	41	22	0.0105	0.5690	0.1452	0.0368	0.1751	0.0373	0.83	0	9	41
Total Antimony	-	mg/L	27	0.0000500	0.0001200	0.0000777	0.0000800	0.0000140	0.0000027	5.56	0	0	0	22	0.0000700	0.0001400	0.0000967	0.0001000	0.0000162	0.0000035	5.97	0	0	0
Total Arsenic	0.005	mg/L	27	0.0001900	0.0014100	0.0004153	0.0003100	0.0002778	0.0000535	1.50	0	0	0	22	0.0002600	0.0010600	0.0004545	0.0003550	0.0002148	0.0000458	2.12	0	0	0
Total Barium	-	mg/L	27	0.04	0.09	0.06	0.05260	0.0142	0.0027	4.14	0	0	0	22	0.04	0.09	0.06	0.05315	0.0134	0.0029	4.27	0	0	0
Total Beryllium	-	mg/L	27	0.0000050	0.0000700	0.0000160	0.0000050	0.0000178	0.0000034	0.90	15	0	0	22	0.0000050	0.0000500	0.0000148	0.0000050	0.0000143	0.0000031	1.03	12	0	0
Total Bismuth	-	mg/L	27	0.0000025	0.0000120	0.0000041	0.0000025	0.0000029	0.0000006	1.42	19	0	0	22	0.0000025	0.0000123	0.0000039	0.0000025	0.0000026	0.0000006	1.47	16	0	0
Total Boron	1.5	mg/L	27	0.03	0.03	0.03	0.02500	0	-	-	27	0	0	22	0.03	0.03	0.03	0.02500	0	-	-	22	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	27	0.000003	0.000057	0.000016	0.000012	0.000016	0.000003	0.96	7	4	15	22	0.000003	0.000101	0.000024	0.000017	0.000023	0.000005	1.05	2	7	32
Total Calcium	-	mg/L	27	8.38	32.00	21.62	21.20	7.28	1.40	2.97	0	0	0	22	8.44	36.10	23.67	23.65	8.32	1.77	2.85	0	0	0
Total Chromium	0.001	mg/L	27	0.00005	0.00100	0.00025	0.00010	0.00026	0.00005	0.96	9	0	0	22	0.00005	0.00079	0.00025	0.00015	0.00024	0.00005	1.04	9	0	0
Total Cobalt	-	mg/L	27	0.000016	0.000825	0.000157	0.000071	0.000198	0.000038	0.79	0	0	0	22	0.000029	0.000645	0.000166	0.000093	0.000171	0.000036	0.97	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	27	0.0005	0.0053	0.0014	0.0009	0.0010	0.0002	1.33	0	4	15	22	0.0008	0.0093	0.0032	0.0023	0.0025	0.0005	1.31	0	12	55
Total Iron	0.3	mg/L	27	0.008	1.440	0.267	0.084	0.364	0.070	0.73	0	7	26	22	0.039	0.973	0.252	0.089	0.278	0.059	0.91	0	7	32
Total Lead	0.003 <sup>e</sup>	mg/L	27	0.000012	0.002130	0.000281	0.000084	0.000479	0.000092	0.59	0	1	4	22	0.000018	0.004120	0.000573	0.000124	0.001033	0.000220	0.55	0	3	14
Total Lithium	-	mg/L	27	0.00145	0.00310	0.00231	0.00230	0.00045	0.00009	5.18	0	0	0	22	0.00130	0.00250	0.00186	0.00190	0.00031	0.00007	6.03	0	0	0
Total Magnesium	-	mg/L	27	2.83	12.60	7.41	6.96	2.64	0.51	2.81	0	0	0	22	2.77	12.90	7.72	7.52	2.88	0.61	2.69	0	0	0
Total Manganese	-	mg/L	27	0.0025	0.1070	0.0307	0.0220	0.0243	0.0047	1.26	0	0	0	22	0.0104	0.0785	0.0287	0.0247	0.0186	0.0040	1.55	0	0	0
Total Mercury	0.000026	mg/L	23	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	23	0	0	19	0.0000050	0.0000100	0.0000053	0.0000050	0.000011	0.000003	4.59	18	0	0
Total Molybdenum	0.073	mg/L	27	0.00028	0.00081	0.00059	0.00059	0.00014	0.00003	4.28	0	0	0	22	0.00040	0.00099	0.00075	0.00081	0.00017	0.00004	4.53	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	27	0.00022	0.00210	0.00055	0.00034	0.00044	0.00009	1.25	0	0	0	22	0.00020	0.00122	0.00050	0.00032	0.00033	0.00007	1.52	0	0	0
Total Phosphorus	-	mg/L	24	0.0020	0.1260	0.0190	0.0055	0.0293	0.0060	0.65	0	0	0	19	0.0010	0.0530	0.0147	0.0090	0.0176	0.0040	0.84	2	0	0
Total Potassium	-	mg/L	27	0.51	1.30	0.76	0.71	0.20	0.04	3.87	0	0	0	22	0.57	1.37	0.84	0.77	0.22	0.05	3.75	0	0	0
Total Selenium	0.001	mg/L	27	0.00002	0.00007	0.00004	0.00004	0.00002	0.00000	2.14	12	0	0	22	0.00002	0.00009	0.00005	0.00005	0.00002	0.00000	3.02	3	0	0
Total Silicon	-	mg/L	27	2.58	5.60	4.73	5.00	0.81	0.16	5.83	0	0	0	22	2.63	5.90	4.81	5.15	0.86	0.18	5.61	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T) = 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>0.86\*(log(hardness))-3.2</sup>/1000
- d) Copper (Cu) mg/L: (e<sup>0.8545[ln(hardness)]-1.465</sup>)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>1.273[ln(hardness)]-4.705</sup>)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>0.76[ln(hardness)]+1.06</sup>)/1000; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guic
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Highlighted cells indicate updates from Project Proposal

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W9											W5										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	27	0.000003	0.000010	0.000003	0.000003	0.000002	0.000000	1.65	23	0	0	22	0.000003	0.000023	0.000005	0.000003	0.000005	0.000001	0.97	16	0	0
Total Sodium	-	mg/L	27	1.31	5.86	3.71	3.64	1.23	0.24	3.02	0	0	0	22	1.25	5.85	3.71	3.74	1.25	0.27	2.96	0	0	0
Total Strontium	-	mg/L	27	0.069	0.263	0.175	0.170	0.059	0.011	2.95	0	0	0	22	0.068	0.281	0.171	0.174	0.061	0.013	2.83	0	0	0
Total Sulphur	-	mg/L	6	5.00	5.00	5.00	5.00	0	-	-	6	0	0	6	5.00	14.00	10.00	11.50	4.10	1.67	2.44	2	0	0
Total Thallium	0.0008	mg/L	27	0.000010	0.000080	0.000026	0.000010	0.000024	0.000005	1.09	15	0	0	22	0.000010	0.000104	0.000031	0.000020	0.000028	0.000006	1.11	10	0	0
Total Tin	-	mg/L	27	0.000005	0.000100	0.000012	0.000005	0.000025	0.000005	4.47	27	0	0	22	0.000005	0.000200	0.000021	0.000005	0.000046	0.000010	0.45	20	0	0
Total Titanium	-	mg/L	27	0.00025	0.02710	0.00547	0.00150	0.00782	0.00151	0.70	10	0	0	22	0.00025	0.02190	0.00506	0.00170	0.00672	0.00143	0.75	8	0	0
Total Uranium	0.015	mg/L	27	0.00232	0.01140	0.00576	0.00529	0.00261	0.00050	2.21	0	0	0	22	0.00234	0.01320	0.00607	0.00556	0.00320	0.00068	1.89	0	0	0
Total Vanadium	-	mg/L	27	0.00010	0.00500	0.00078	0.00030	0.00108	0.00021	0.73	8	0	0	22	0.00010	0.00216	0.00068	0.00035	0.00067	0.00014	1.02	5	0	0
Total Zinc	0.03	mg/L	27	0.00030	0.00600	0.00141	0.00070	0.00150	0.00029	0.94	0	0	0	22	0.00030	0.00734	0.00201	0.00120	0.00188	0.00040	1.07	0	0	0
Total Zirconium	-	mg/L	27	0.00005	0.00080	0.00022	0.00020	0.00017	0.00003	1.26	5	0	0	22	0.00005	0.00050	0.00020	0.00020	0.00014	0.00003	1.44	6	0	0
Dissolved Aluminum	0.1	mg/L	27	0.0065	0.1820	0.0431	0.0239	0.0448	0.0086	0.96	0	4	15	22	0.0068	0.3550	0.0600	0.0206	0.0826	0.0176	0.73	0	5	23
Dissolved Antimony	-	mg/L	27	0.00005	0.00012	0.00007	0.00007	0.00002	0.00003	4.77	1	0	0	22	0.00006	0.00012	0.00009	0.00009	0.00002	0.00003	5.82	0	0	0
Dissolved Arsenic	-	mg/L	27	0.00019	0.00055	0.00030	0.00031	0.00008	0.00015	3.81	0	0	0	22	0.00022	0.00052	0.00033	0.00033	0.00007	0.00014	5.02	0	0	0
Dissolved Barium	-	mg/L	27	0.028	0.087	0.055	0.050	0.018	0.003	3.07	0	0	0	22	0.029	0.089	0.054	0.050	0.016	0.003	3.31	0	0	0
Dissolved Beryllium	-	mg/L	27	0.000005	0.000030	0.000010	0.000005	0.000008	0.00001	1.30	18	0	0	22	0.000005	0.000030	0.000009	0.000005	0.000006	0.000001	1.39	13	0	0
Dissolved Bismuth	-	mg/L	27	0.0000025	0.0000150	0.0000030	0.0000025	0.0000024	0.0000005	1.23	27	0	0	22	0.0000025	0.0000080	0.0000028	0.0000025	0.0000012	0.0000003	2.35	21	0	0
Dissolved Boron	-	mg/L	27	0.025	0.150	0.030	0.025	0.024	0.005	1.23	27	0	0	22	0.025	0.025	0.025	0.025	0	-	-	22	0	0
Dissolved Cadmium	-	mg/L	27	0.000003	0.000016	0.000007	0.000006	0.000005	0.000001	1.47	11	0	0	22	0.000003	0.000042	0.000013	0.000011	0.000009	0.000002	1.44	2	0	0
Dissolved Calcium	-	mg/L	27	7.81	34.10	21.37	20.20	7.36	1.42	2.90	0	0	0	22	8.82	35.00	23.09	23.00	7.78	1.66	2.97	0	0	0
Dissolved Chromium	-	mg/L	27	0.00005	0.00030	0.00014	0.00010	0.00009	0.00002	1.59	10	0	0	22	0.00005	0.00030	0.00015	0.00010	0.00011	0.00002	1.39	10	0	0
Dissolved Cobalt	-	mg/L	27	0.000017	0.000110	0.000054	0.000048	0.000024	0.000005	2.25	0	0	0	22	0.000037	0.000362	0.000071	0.000052	0.000068	0.000015	1.04	0	0	0
Dissolved Copper	-	mg/L	27	0.0005	0.0019	0.0010	0.0009	0.0004	0.0001	2.44	0	0	0	22	0.0007	0.0080	0.0025	0.0019	0.0017	0.0004	1.45	0	0	0
Dissolved Iron	-	mg/L	27	0.006	0.220	0.079	0.044	0.063	0.012	1.26	0	0	0	22	0.013	0.581	0.094	0.042	0.120	0.026	0.78	0	0	0
Dissolved Lead	-	mg/L	27	0.000003	0.000172	0.000042	0.000021	0.000046	0.000009	0.91	4	0	0	22	0.000003	0.000760	0.000079	0.000032	0.000161	0.000034	0.49	3	0	0
Dissolved Lithium	-	mg/L	27	0.00120	0.00310	0.00221	0.00210	0.00049	0.00009	4.52	0	0	0	22	0.00092	0.00250	0.00178	0.00185	0.00037	0.00008	4.77	0	0	0
Dissolved Magnesium	-	mg/L	27	2.75	12.80	7.32	6.81	2.63	0.51	2.78	0	0	0	22	2.77	12.80	7.64	7.27	2.79	0.60	2.74	0	0	0
Dissolved Manganese	-	mg/L	27	0.0015	0.0486	0.0175	0.0122	0.0128	0.0025	1.36	0	0	0	22	0.0014	0.0410	0.0161	0.0117	0.0100	0.0021	1.61	0	0	0
Dissolved Mercury	-	mg/L	23	0.0000050	0.0000250	0.0000059	0.0000050	0.0000042	0.0000009	1.41	23	0	0	18	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	18	0	0
Dissolved Molybdenum	-	mg/L	27	0.00029	0.00084	0.00062	0.00061	0.00014	0.00003	4.49	0	0	0	22	0.00033	0.00099	0.00076	0.00082	0.00017	0.00004	4.36	0	0	0
Dissolved Nickel	-	mg/L	27	0.00022	0.00073	0.00041	0.00037	0.00017	0.00003	2.39	0	0	0	22	0.00020	0.00087	0.00040	0.00033	0.00019	0.00004	2.06	0	0	0
Dissolved Phosphorus	-	mg/L	23	0.0010	0.0120	0.0042	0.0040	0.0027	0.0006	1.54	4	0	0	18	0.0010	0.0170	0.0048	0.0035	0.0045	0.0011	1.06	4	0	0
Dissolved Potassium	-	mg/L	27	0.50	1.27	0.75	0.71	0.20	0.04	3.78	0	0	0	22	0.55	1.34	0.83	0.77	0.21	0.05	3.93	0	0	0
Dissolved Selenium	-	mg/L	27	0.00002	0.00010	0.00004	0.00004	0.00002	0.00000	1.85	14	0	0	22	0.00002	0.00007	0.00005	0.00005	0.00001	0.00000	3.89	2	0	0
Dissolved Silicon	-	mg/L	27	2.22	6.20	4.54	4.70	0.83	0.16	5.44	0	0	0	22	2.34	5.70	4.67	4.90	0.87	0.19	5.35	0	0	0
Dissolved Silver	-	mg/L	27	0.000003	0.000015	0.000003	0.000003	0.000002	0.000000	1.23	27	0	0	22	0.000003	0.000009	0.000003	0.000003	0.000002	0.000000	1.73	19	0	0
Dissolved Sodium	-	mg/L	27	1.34	5.90	3.71	3.49	1.23	0.24	3.01	0	0	0	22	1.34	5.90	3.67	3.59	1.21	0.26	3.04	0	0	0
Dissolved Strontium	-	mg/L	27	0.066	0.270	0.175	0.172	0.062	0.012	2.83	0	0	0	22	0.065	0.270	0.171	0.176	0.060	0.013	2.87	0	0	0
Dissolved Sulphur	-	mg/L	6	5.00	5.00	5.00	5.00	0	-	-	6	0	0	6	5.00	13.00	9.50	11.00	3.56	1.45	2.67	2	0	0
Dissolved Thallium	-	mg/L	27	0.000010	0.000050	0.000013	0.000010	0.000009	0.000002	1.47	24	0	0	22	0.000010	0.000070	0.000017	0.000010	0.000014	0.000003	1.22	14	0	0
Dissolved Tin	-	mg/L	27	0.000005	0.000100	0.000013	0.000005	0.000025	0.000005	0.50	27	0	0	22	0.000005	0.000100	0.000021	0.000005	0.000034	0.000007	0.60	19	0	0
Dissolved Titanium	-	mg/L	27	0.00025	0.00230	0.00063	0.00025	0.00059	0.00011	1.07	18	0	0	21	0.00025	0.00220	0.00063	0.00025	0.00065	0.00014	0.98	14	0	0
Dissolved Uranium	-	mg/L	27	0.00161	0.01190	0.00561	0.00543	0.00280	0.00054	2.01	0	0	0	22	0.00163	0.01300	0.00595	0.00567	0.00327	0.00070	1.82	0	0	0
Dissolved Vanadium	-	mg/L	27	0.00010	0.00080	0.00032	0.00030	0.00020	0.00004	1.60	8	0	0	22	0.00010	0.00140	0.00036	0.00030	0.00030	0.00006	1.17	6	0	0
Dissolved Zinc	-	mg/L	27	0.00010	0.00590	0.00105	0.00050	0.00153	0.00029	0.69	0	0	0	22	0.00040	0.00530	0.00148	0.00070	0.00157	0.00034	0.94	0	0	0
Dissolved Zirconium	-	mg/L	27	0.00005	0.00040	0.00017	0.00020	0.00009	0.00002	1.89	4	0	0	22	0.00005	0.00040	0.00017	0.00020	0.00010	0.00002	1.73	4	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH3) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5: 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10^(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e^0.8545\*ln(hardness))-1.465\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e^1.273\*ln(hardness))-4.705/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e^0.76\*(ln(hardness))+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

Highlighted cells indicate updates from Project Proposal

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guid
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "." No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W16											W19										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	22	7.40	8.30	7.83	7.90	0.20	0.04	39.62	0	0	0	5	7.48	7.91	7.72	7.79	0.18	0.08	42.47	0	0	0
Conductivity	-	µS/cm	22	108	327	200	190	60	13	3.35	0	0	0	5	101	248	171	174	66	30	2.58	0	0	0
Total Hardness CaCO <sub>3</sub>	-	mg/L	22	57	154	96	93	28	6	3.39	0	0	0	5	53	105	80	80	25	11	3.12	0	0	0
Dissolved Hardness CaCO <sub>3</sub>	-	mg/L	5	54	136	102	112	35	16	2.93	0	0	0	5	50	105	78	78	27	12	2.92	0	0	0
Moisture	-	%	1	20	20	20	20	0	-	-	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Ion Balance	-	no unit	3	0.94	1.10	1.01	1.00	0.08	0.05	12.54	0	0	0	3	0.95	1.00	0.98	1.00	0.03	0.02	34.06	0	0	0
Total Dissolved Solids	-	mg/L	22	92	180	135	140	25	5	5.37	0	0	0	5	84	158	122	130	30	13	4.07	0	0	0
Total Suspended Solids	-	mg/L	22	0.5	74.0	11.4	3.5	17.4	3.7	0.65	4	0	0	5	1.1	123.0	41.2	12.0	53.4	23.9	0.77	0	0	0
Turbidity	-	NTU	22	0.3	12.6	2.7	0.9	3.6	0.8	0.75	0	0	0	5	1.1	16.5	8.7	5.4	6.8	3.0	1.28	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	22	0.003	0.260	0.029	0.016	0.054	0.011	0.54	9	0	0	5	0.014	0.059	0.031	0.027	0.018	0.008	1.72	0	0	0
Alkalinity, Total (as CaCO <sub>3</sub> )	-	mg/L	22	38.0	120.0	74.41	71.5	23.13	4.93	3.22	0	0	0	5	34.0	92.7	65.04	67.0	25.27	11.30	2.57	0	0	0
Acidity (pH 4.5) as CaCO <sub>3</sub>	-	mg/L	5	0.25	0.25	0.25	0.25	0	-	-	5	0	0	5	0.25	0.25	0.25	0.25	0	-	-	5	0	0
Acidity (pH8.3) as CaCO <sub>3</sub>	-	mg/L	12	0.25	6.00	1.55	0.90	1.75	0.51	0.88	5	0	0	5	0.25	12.10	3.19	1.60	5.03	2.25	0.63	2	0	0
Bromide (Br)	-	mg/L	19	0.05	0.20	0.19	0.20	0.03	0.01	5.58	19	0	0	5	0.01	0.20	0.12	0.20	0.11	0.05	1.14	5	0	0
Chloride (Cl)	120	mg/L	22	0.25	5.00	0.77	0.43	1.03	0.22	0.74	11	0	0	5	0.25	0.90	0.51	0.25	0.36	0.16	1.43	3	0	0
Fluoride (F)	0.12	mg/L	19	0.050	0.080	0.061	0.060	0.008	0.002	7.14	0	0	0	5	0.059	0.070	0.063	0.060	0.005	0.002	13.73	0	0	0
Sulphate (SO <sub>4</sub> )	-	mg/L	22	15.00	62.00	28.16	28.00	10.92	2.33	2.58	0	0	0	5	12.00	31.00	20.10	20.00	8.16	3.65	2.46	0	0	0
Total Nitrogen (N)	-	mg/L	5	0.15	0.51	0.35	0.38	0.14	0.06	2.48	0	0	0	5	0.19	0.74	0.41	0.31	0.22	0.10	1.89	0	0	0
Nitrate (as N)	13	mg/L	22	0.001	0.274	0.104	0.089	0.077	0.016	1.35	1	0	0	5	0.036	0.104	0.071	0.081	0.029	0.013	2.41	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	5	0.054	0.274	0.153	0.145	0.080	0.036	1.91	0	0	0	5	0.039	0.106	0.072	0.081	0.029	0.013	2.53	0	0	0
Nitrite (as N)	0.06	mg/L	22	0.001	0.008	0.002	0.001	0.002	0.000	1.19	12	0	0	5	0.001	0.003	0.002	0.002	0.001	0.000	2.16	2	0	0
Total Kjeldahl Nitrogen	-	mg/L	21	0.01	4.00	0.41	0.20000	0.8328	0.1817	0.49	1	0	0	5	0.08	0.69	0.34	0.22800	0.2412	0.1079	1.39	0	0	0
Ortho Phosphate as P	-	mg/L	22	0.0005	0.0110	0.0021	0.0020	0.0021	0.0005	0.99	3	0	0	5	0.0019	0.0110	0.0050	0.0050	0.0037	0.0017	1.35	0	0	0
Cyanide, Total	0.005	mg/L	22	0.00025	0.00170	0.00056	0.00025	0.00043	0.00009	1.30	12	0	0	5	0.00025	0.00055	0.00031	0.00025	0.00013	0.00006	2.31	4	0	0
Cyanide, Weak Acid Diss	-	mg/L	22	0.00025	0.00120	0.00055	0.00050	0.00033	0.00007	1.67	10	0	0	5	0.00025	0.00110	0.00049	0.00025	0.00037	0.00017	1.32	3	0	0
Dissolved Organic Carbon	-	mg/L	11	3.50	15.50	8.36	7.70	3.78	1.14	2.21	0	0	0	5	5.44	17.80	10.89	10.20	5.21	2.33	2.09	0	0	0
Total Organic Carbon	-	mg/L	18	3.60	15.50	8.20	7.20	3.58	0.84	2.29	0	0	0	5	5.58	17.80	11.42	11.10	5.41	2.42	2.11	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	22	0.0102	0.4670	0.1418	0.0828	0.1422	0.0303	1.00	0	10	45	5	0.0111	0.7810	0.3424	0.2260	0.3500	0.1565	0.98	0	3	60
Total Antimony	-	mg/L	22	0.000060	0.000160	0.000093	0.000090	0.000019	0.000004	4.81	0	0	0	5	0.000050	0.000090	0.000077	0.000080	0.000016	0.000007	4.89	0	0	0
Total Arsenic	0.005	mg/L	22	0.000310	0.001230	0.000586	0.000535	0.000217	0.000046	2.69	0	0	0	5	0.000900	0.002300	0.001330	0.001120	0.000578	0.000258	2.30	0	0	0
Total Barium	-	mg/L	22	0.04	0.08	0.06	0.05390	0.0124	0.0026	4.59	0	0	0	5	0.05	0.09	0.06	0.06420	0.0160	0.0072	4.02	0	0	0
Total Beryllium	-	mg/L	22	0.0000050	0.0000400	0.0000132	0.0000100	0.0000108	0.0000023	1.23	10	0	0	5	0.0000050	0.0000520	0.0000274	0.0000200	0.0000222	0.0000099	1.23	1	0	0
Total Bismuth	-	mg/L	22	0.0000025	0.0000100	0.0000035	0.0000025	0.0000021	0.0000005	1.66	17	0	0	5	0.0000025	0.0000103	0.0000056	0.0000025	0.0000042	0.0000019	1.33	3	0	0
Total Boron	1.5	mg/L	22	0.03	0.03	0.03	0.02500	0	-	-	22	0	0	5	0.03	0.03	0.03	0.02500	0	-	-	5	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	22	0.000003	0.000073	0.000021	0.000017	0.000017	0.000004	1.21	2	4	18	5	0.000013	0.000091	0.000036	0.000018	0.000033	0.000015	1.09	0	2	40
Total Calcium	-	mg/L	22	14.20	36.40	23.86	23.95	6.88	1.47	3.47	0	0	0	5	13.10	25.90	19.90	20.70	5.99	2.68	3.32	0	0	0
Total Chromium	0.001	mg/L	22	0.00005	0.00070	0.00031	0.00025	0.00023	0.00005	1.35	3	0	0	5	0.00010	0.00120	0.00065	0.00060	0.00052	0.00023	1.26	0	2	40
Total Cobalt	-	mg/L	22	0.000063	0.000575	0.000191	0.000131	0.000142	0.000030	1.35	0	0	0	5	0.000207	0.001000	0.000514	0.000411	0.000327	0.000146	1.57	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	22	0.0008	0.0089	0.0028	0.0022	0.0019	0.0004	1.48	0	10	45	5	0.0008	0.0083	0.0038	0.0031	0.0030	0.0013	1.26	0	3	60
Total Iron	0.3	mg/L	22	0.078	1.090	0.353	0.265	0.266	0.057	1.33	0	10	45	5	0.748	2.680	1.377	1.210	0.794	0.355	1.73	0	5	100
Total Lead	0.003 <sup>e</sup>	mg/L	22	0.000015	0.003010	0.000363	0.000128	0.000652	0.000139	0.56	0	1	5	5	0.000015	0.002220	0.000741	0.000375	0.000918	0.000411	0.81	0	1	20
Total Lithium	-	mg/L	22	0.00110	0.00190	0.00140	0.00140	0.00017	0.00004	8.47	0	0	0	5	0.00060	0.00130	0.00107	0.00110	0.00028	0.00012	3.84	0	0	0
Total Magnesium	-	mg/L	22	5.15	15.40	8.72	8.17	2.75	0.59	3.17	0	0	0	5	4.71	10.10	7.29	7.01	2.57	1.15	2.84	0	0	0
Total Manganese	-	mg/L	22	0.0204	0.1330	0.0410	0.0329	0.0240	0.0051	1.70	0	0	0	5	0.0474	0.2750	0.1428	0.0965	0.0976	0.0437	1.46	0	0	0
Total Mercury	0.000026	mg/L	19	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	19	0	0	4	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	4	0	0
Total Molybdenum	0.073	mg/L	22	0.00049	0.00104	0.00079	0.00083	0.00017	0.00004	4.53	0	0	0	5	0.00048	0.00101	0.00069	0.00065	0.00021	0.00009	3.32	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	22	0.00032	0.00151	0.00075	0.00065	0.00038	0.00008	1.97	0	0	0	5	0.00060	0.00207	0.00124	0.00105	0.00068	0.00030	1.83	0	0	0
Total Phosphorus	-	mg/L	19	0.0030	0.0520	0.0133	0.0090	0.0119	0.0027	1.11	0	0	0	4	0.0120	0.0817	0.0409	0.0350	0.0324	0.0162	1.26	0	0	0
Total Potassium	-	mg/L	22	0.60	1.52	0.90	0.86	0.23	0.05	3.89	0	0	0	5	0.65	1.22	0.91	0.82	0.23	0.10	4.01	0	0	0
Total Selenium	0.001	mg/L																						

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W16										W19											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silicon	-	mg/L	22	3.50	5.70	4.64	4.65	0.67	0.14	6.94	0	0	0	5	3.80	5.40	4.68	4.80	0.64	0.29	7.34	0	0	0
Total Silver	0.0001	mg/L	22	0.000003	0.000010	0.000003	0.000003	0.000002	0.000000	1.57	19	0	0	5	0.000003	0.000023	0.000009	0.000007	0.000008	0.000004	1.04	2	0	0
Total Sodium	-	mg/L	22	2.30	6.72	3.95	3.79	1.18	0.25	3.34	0	0	0	5	2.19	5.19	3.71	3.76	1.44	0.64	2.58	0	0	0
Total Strontium	-	mg/L	22	0.091	0.245	0.161	0.151	0.047	0.010	3.41	0	0	0	5	0.082	0.190	0.136	0.135	0.049	0.022	2.75	0	0	0
Total Sulphur	-	mg/L	5	5.00	18.00	10.40	11.00	5.55	2.48	1.87	2	0	0	5	5.00	12.00	7.60	5.00	3.58	1.60	2.12	3	0	0
Total Thallium	0.0008	mg/L	22	0.000010	0.000090	0.000025	0.000010	0.000022	0.000005	1.14	12	0	0	5	0.000010	0.000090	0.000045	0.000030	0.000039	0.000018	1.14	2	0	0
Total Tin	-	mg/L	22	0.000005	0.000005	0.000005	0.000005	0	-	-	22	0	0	5	0.000005	0.000100	0.000043	0.000005	0.000052	0.000023	0.83	5	0	0
Total Titanium	-	mg/L	22	0.00025	0.01830	0.00499	0.00260	0.00557	0.00119	0.90	4	0	0	5	0.00025	0.02800	0.01325	0.01080	0.01277	0.00571	1.04	1	0	0
Total Uranium	0.015	mg/L	22	0.00178	0.00971	0.00456	0.00438	0.00224	0.00048	2.03	0	0	0	5	0.00161	0.00580	0.00315	0.00265	0.00162	0.00072	1.95	0	0	0
Total Vanadium	-	mg/L	22	0.00010	0.00250	0.00090	0.00070	0.00074	0.00016	1.23	3	0	0	5	0.00060	0.00437	0.00221	0.00160	0.00160	0.00072	1.38	0	0	0
Total Zinc	0.03	mg/L	22	0.00040	0.00580	0.00171	0.00125	0.00140	0.00030	1.22	0	0	0	5	0.00050	0.00640	0.00300	0.00290	0.00260	0.00116	1.16	0	0	0
Total Zirconium	-	mg/L	22	0.00005	0.00050	0.00028	0.00020	0.00015	0.00003	1.78	1	0	0	5	0.00020	0.00060	0.00042	0.00040	0.00018	0.00008	2.37	0	0	0
Dissolved Aluminum	0.1	mg/L	22	0.0062	0.1170	0.0444	0.0384	0.0358	0.0076	1.24	0	16	73	5	0.0078	0.1210	0.0538	0.0389	0.0471	0.0211	1.14	0	1	20
Dissolved Antimony	-	mg/L	22	0.00005	0.00013	0.00009	0.00009	0.00002	0.000003	5.50	0	0	0	5	0.00005	0.00008	0.00007	0.00008	0.00001	0.000006	5.49	0	0	0
Dissolved Arsenic	-	mg/L	22	0.00030	0.00053	0.00044	0.00045	0.00007	0.000014	6.74	0	0	0	5	0.00052	0.00082	0.00066	0.00063	0.00013	0.000056	5.21	0	0	0
Dissolved Barium	-	mg/L	22	0.031	0.082	0.053	0.051	0.014	0.003	3.80	0	0	0	5	0.031	0.088	0.052	0.042	0.023	0.010	2.26	0	0	0
Dissolved Beryllium	-	mg/L	22	0.000005	0.000030	0.000008	0.000005	0.000006	0.000001	1.30	15	0	0	5	0.000005	0.000020	0.000010	0.000010	0.000006	0.000003	1.66	2	0	0
Dissolved Bismuth	-	mg/L	22	0.0000025	0.0000050	0.0000026	0.0000025	0.0000005	0.0000001	4.90	21	0	0	5	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	5	0	0
Dissolved Boron	-	mg/L	22	0.025	0.025	0.025	0.025	0	-	-	22	0	0	5	0.025	0.025	0.025	0.025	0	-	-	5	0	0
Dissolved Cadmium	-	mg/L	22	0.000003	0.000022	0.000010	0.000010	0.000006	0.000001	1.72	5	0	0	5	0.000007	0.000015	0.000012	0.000013	0.000003	0.000001	3.54	0	0	0
Dissolved Calcium	-	mg/L	22	13.40	36.00	23.39	21.90	6.59	1.41	3.55	0	0	0	5	12.90	25.80	19.42	20.00	6.33	2.83	3.07	0	0	0
Dissolved Chromium	-	mg/L	22	0.00005	0.00040	0.00018	0.00015	0.00013	0.00003	1.43	6	0	0	5	0.00020	0.00040	0.00027	0.00025	0.00008	0.00004	3.23	0	0	0
Dissolved Cobalt	-	mg/L	22	0.000043	0.000133	0.000085	0.000084	0.000024	0.000005	3.56	0	0	0	5	0.000044	0.000414	0.000171	0.000123	0.000142	0.000064	1.20	0	0	0
Dissolved Copper	-	mg/L	22	0.0008	0.0062	0.0022	0.0020	0.0012	0.0003	1.81	0	0	0	5	0.0006	0.0039	0.0023	0.0022	0.0013	0.0006	1.72	0	0	0
Dissolved Iron	-	mg/L	22	0.063	0.240	0.144	0.143	0.053	0.011	2.71	0	0	0	5	0.241	0.585	0.416	0.345	0.158	0.071	2.64	0	0	0
Dissolved Lead	-	mg/L	22	0.000003	0.000399	0.000051	0.000030	0.000081	0.000017	0.63	1	0	0	5	0.000012	0.000126	0.000059	0.000057	0.000046	0.000021	1.28	0	0	0
Dissolved Lithium	-	mg/L	22	0.00090	0.00200	0.00135	0.00130	0.00020	0.00004	6.61	0	0	0	5	0.00060	0.00120	0.00087	0.00080	0.00023	0.00010	3.78	0	0	0
Dissolved Magnesium	-	mg/L	22	5.03	14.90	8.68	8.18	2.59	0.55	3.36	0	0	0	5	4.34	9.75	7.06	6.86	2.60	1.16	2.71	0	0	0
Dissolved Manganese	-	mg/L	22	0.0008	0.0529	0.0268	0.0207	0.0148	0.0032	1.81	0	0	0	5	0.0024	0.2650	0.0798	0.0295	0.1078	0.0482	0.74	0	0	0
Dissolved Mercury	-	mg/L	17	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	17	0	0	2	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	2	0	0
Dissolved Molybdenum	-	mg/L	22	0.00056	0.00104	0.00081	0.00077	0.00014	0.00003	5.59	0	0	0	5	0.00062	0.00104	0.00085	0.00095	0.00020	0.00009	4.20	0	0	0
Dissolved Nickel	-	mg/L	22	0.00030	0.00116	0.00057	0.00051	0.00023	0.00005	2.47	0	0	0	5	0.00056	0.00120	0.00081	0.00074	0.00024	0.00011	3.35	0	0	0
Dissolved Phosphorus	-	mg/L	17	0.0020	0.0070	0.0046	0.0050	0.0017	0.0004	2.65	0	0	0	2	0.0060	0.0121	0.0091	0.0091	0.0043	0.0031	2.10	0	0	0
Dissolved Potassium	-	mg/L	22	0.57	1.49	0.89	0.86	0.23	0.05	3.92	0	0	0	5	0.60	1.16	0.87	0.77	0.23	0.10	3.76	0	0	0
Dissolved Selenium	-	mg/L	22	0.00002	0.00009	0.00006	0.00006	0.00002	0.00000	2.86	3	0	0	5	0.00002	0.00009	0.00005	0.00005	0.00003	0.00001	1.58	2	0	0
Dissolved Silicon	-	mg/L	22	3.30	5.50	4.59	4.75	0.62	0.13	7.36	0	0	0	5	2.93	4.90	4.27	4.90	0.91	0.41	4.69	0	0	0
Dissolved Silver	-	mg/L	22	0.000003	0.000003	0.000003	0.000003	0	-	-	22	0	0	5	0.000003	0.000003	0.000003	0.000003	0	-	-	5	0	0
Dissolved Sodium	-	mg/L	22	2.32	6.44	3.93	3.80	1.08	0.23	3.63	0	0	0	5	2.14	5.14	3.67	3.67	1.40	0.62	2.63	0	0	0
Dissolved Strontium	-	mg/L	22	0.089	0.248	0.162	0.153	0.047	0.010	3.46	0	0	0	5	0.081	0.185	0.133	0.132	0.051	0.023	2.61	0	0	0
Dissolved Sulphur	-	mg/L	5	5.00	19.00	10.80	12.00	5.93	2.65	1.82	2	0	0	5	5.00	11.00	6.20	5.00	2.68	1.20	2.31	4	0	0
Dissolved Thallium	-	mg/L	22	0.0000010	0.0000020	0.0000012	0.0000010	0.0000004	0.0000001	2.99	18	0	0	5	0.0000010	0.0000010	0.0000010	0.0000010	0	-	-	5	0	0
Dissolved Tin	-	mg/L	22	0.000005	0.000005	0.000005	0.000005	0	-	-	22	0	0	5	0.000005	0.000100	0.000043	0.000005	0.000052	0.000023	0.83	5	0	0
Dissolved Titanium	-	mg/L	22	0.00025	0.00170	0.00070	0.00060	0.00050	0.00011	1.39	10	0	0	5	0.00025	0.00200	0.00111	0.00137	0.00082	0.00037	1.36	2	0	0
Dissolved Uranium	-	mg/L	22	0.00162	0.00998	0.00447	0.00459	0.00229	0.00049	1.95	0	0	0	5	0.00114	0.00580	0.00281	0.00226	0.00189	0.00085	1.48	0	0	0
Dissolved Vanadium	-	mg/L	22	0.00010	0.00120	0.00044	0.00040	0.00027	0.00006	1.63	4	0	0	5	0.00050	0.00110	0.00080	0.00080	0.00022	0.00010	3.60	0	0	0
Dissolved Zinc	-	mg/L	22	0.00020	0.00640	0.00105	0.00050	0.00142	0.00030	0.74	0	0	0	5	0.00030	0.00080	0.00064	0.00070	0.00021	0.00009	3.10	0	0	0
Dissolved Zirconium	-	mg/L	22	0.00005	0.00040	0.00023	0.00020	0.00012	0.00003	1.90	3	0	0	5	0.00020	0.00040	0.00029	0.00025	0.00010	0.00005	2.83	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH3) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>-6</sup>\*(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e<sup>-0.8545ln(hardness)</sup>-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>-1.273ln(hardness)</sup>-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>-0.76ln(hardness)</sup>+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

"n" Count  
 "min" Minimum Value  
 "max" Maximum Value  
 "sd" Standard Deviation  
 "se" Standard Error  
 "cov" Covariance  
 "<DL" # of Non-detectable Values  
 ">GL" # of Exceedances of CCME Guic  
 "%>GL" % of Parameters that Exceed CCME Guidelin  
 "-" No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W20											W21										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	19	7.25	8.10	7.76	7.74	0.19	0.04	41.44	0	0	0	17	7.31	8.10	7.76	7.79	0.20	0.05	38.68	0	0	0
Conductivity	-	µS/cm	19	106	201	159	165	24	5	6.68	0	0	0	17	131	242	173	171	27	7	6.34	0	0	0
Total Hardness CaCO3	-	mg/L	19	54	86	74	75	10	2	7.12	0	0	0	17	57	108	80	82	13	3	6.26	0	0	0
Dissolved Hardness CaCO3	-	mg/L	6	51	88	71	74	15	6	4.79	0	0	0	4	63	95	80	82	13	7	5.95	0	0	0
Moisture	-	%	-	-	-	-	-	-	-	-	-	-	-	1	18	18	18	18	0	-	-	0	0	0
Ion Balance	-	no unit	4	0.94	1.00	0.98	0.99	0.03	0.01	34.65	0	0	0	3	0.99	1.10	1.03	1.00	0.06	0.04	16.93	0	0	0
Total Dissolved Solids	-	mg/L	19	76	130	100	100	16	4	6.32	0	0	0	17	84	160	111	110	19	4	5.96	0	0	0
Total Suspended Solids	-	mg/L	19	0.5	59.5	5.3	1.0	13.4	3.1	0.39	6	0	0	17	0.5	9.0	3.1	1.0	3.0	0.7	1.02	4	0	0
Turbidity	-	NTU	19	0.3	6.6	2.1	1.2	2.0	0.5	1.03	0	0	0	17	0.4	6.2	2.5	1.8	2.0	0.5	1.28	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	19	0.003	0.170	0.030	0.021	0.038	0.009	0.79	5	0	0	17	0.003	0.200	0.034	0.025	0.046	0.011	0.73	6	0	0
Alkalinity, Total (as CaCO3)	-	mg/L	19	42.7	74.0	64.13	66.0	7.63	1.75	8.40	0	0	0	17	53.0	91.0	69.0	69.0	8.98	2.18	7.68	0	0	0
Acidity (pH 4.5) as CaCO3	-	mg/L	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0	4	0.25	0.25	0.25	0.25	0	-	-	4	0	0
Acidity (pH8.3) as CaCO3	-	mg/L	14	0.25	4.90	1.73	1.45	1.30	0.35	1.33	2	0	0	11	0.25	4.40	1.50	1.60	1.21	0.37	1.24	3	0	0
Bromide (Br)	-	mg/L	19	0.01	0.20	0.18	0.20	0.06	0.01	2.92	19	0	0	17	0.20	0.20	0.20	0.20	0	-	-	17	0	0
Chloride (Cl)	120	mg/L	19	0.25	1.00	0.34	0.25	0.21	0.05	1.66	15	0	0	16	0.25	1.40	0.44	0.25	0.37	0.09	1.19	12	0	0
Fluoride (F)	0.12	mg/L	19	0.120	0.160	0.132	0.130	0.013	0.003	10.04	0	11	58	17	0.100	0.140	0.118	0.120	0.011	0.003	10.25	0	5	29
Sulphate (SO4)	-	mg/L	19	8.01	28.00	17.28	17.00	5.40	1.24	3.20	0	0	0	17	11.00	39.00	20.29	18.00	6.80	1.65	2.99	0	0	0
Total Nitrogen (N)	-	mg/L	6	0.09	0.56	0.31	0.29	0.15	0.06	2.00	0	0	0	4	0.11	0.27	0.21	0.24	0.07	0.04	3.02	0	0	0
Nitrate (as N)	13	mg/L	19	0.008	0.154	0.083	0.083	0.039	0.009	2.11	0	0	0	17	0.001	0.135	0.073	0.081	0.034	0.008	2.14	1	0	0
Nitrate plus Nitrite (N)	-	mg/L	6	0.008	0.154	0.094	0.104	0.059	0.024	1.60	0	0	0	4	0.001	0.121	0.067	0.073	0.050	0.025	1.33	1	0	0
Nitrite (as N)	0.06	mg/L	19	0.001	0.006	0.002	0.001	0.001	0.000	1.23	15	0	0	17	0.001	0.003	0.001	0.001	0.001	0.000	2.06	15	0	0
Total Kjeldahl Nitrogen	-	mg/L	19	0.04	0.49	0.17	0.15000	0.1089	0.0250	1.56	0	0	0	17	0.05	0.47	0.18	0.15000	0.1091	0.0265	1.63	0	0	0
Ortho Phosphate as P	-	mg/L	19	0.0005	0.0080	0.0022	0.0012	0.0020	0.0005	1.06	2	0	0	17	0.0005	0.0070	0.0019	0.0020	0.0015	0.0004	1.27	2	0	0
Cyanide, Total	0.005	mg/L	19	0.00025	0.00150	0.00041	0.00025	0.00031	0.00007	1.32	13	0	0	17	0.00025	0.00150	0.00042	0.00025	0.00033	0.00008	1.27	12	0	0
Cyanide, Weak Acid Diss	-	mg/L	19	0.00025	0.00110	0.00036	0.00025	0.00026	0.00006	1.37	16	0	0	17	0.00025	0.00120	0.00041	0.00025	0.00032	0.00008	1.30	13	0	0
Dissolved Organic Carbon	-	mg/L	14	3.00	8.90	5.53	5.10	2.19	0.58	2.53	0	0	11	3.40	9.80	5.85	4.90	2.19	0.66	2.67	0	0	0	0
Total Organic Carbon	-	mg/L	19	2.50	9.70	5.06	4.40	1.99	0.46	2.54	1	0	0	17	3.20	10.10	6.12	5.70	2.08	0.50	2.94	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	19	0.0049	0.4870	0.0636	0.0214	0.1116	0.0256	0.57	0	3	16	17	0.0048	0.2220	0.0470	0.0204	0.0596	0.0144	0.79	0	3	18
Total Antimony	-	mg/L	19	0.000020	0.000050	0.000037	0.000040	0.000009	0.000002	4.28	0	0	0	17	0.00003	0.00006	0.00004	0.00004	0.00001	0.00000	3.98	0	0	0
Total Arsenic	0.005	mg/L	19	0.000290	0.001920	0.000658	0.000440	0.000450	0.000103	1.46	0	0	0	17	0.00039	0.00117	0.00062	0.00053	0.00023	0.00006	2.64	0	0	0
Total Barium	-	mg/L	19	0.03	0.06	0.04	0.04010	0.0072	0.0017	5.96	0	0	0	17	0.04	0.06	0.05	0.04590	0.0078	0.0019	6.01	0	0	0
Total Beryllium	-	mg/L	19	0.000005	0.000045	0.000010	0.000005	0.000010	0.000002	1.02	12	0	0	17	0.000005	0.000020	0.000009	0.000005	0.000006	0.000002	1.42	11	0	0
Total Bismuth	-	mg/L	19	0.000025	0.000050	0.000026	0.000025	0.000006	0.000001	4.59	18	0	0	17	0.000025	0.000070	0.000028	0.000025	0.000011	0.000003	2.53	16	0	0
Total Boron	1.5	mg/L	19	0.03	0.03	0.03	0.03	0	-	-	19	0	0	17	0.03	0.03	0.03	0.03	0	-	-	17	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	19	0.000003	0.000054	0.000012	0.000011	0.000011	0.000003	1.09	4	1	5	17	0.000003	0.000026	0.000011	0.000009	0.000006	0.000002	1.68	1	0	0
Total Calcium	-	mg/L	19	13.10	20.60	17.74	18.40	2.48	0.57	7.15	0	0	0	17	13.40	26.00	19.52	20.20	3.13	0.76	6.24	0	0	0
Total Chromium	0.001	mg/L	19	0.00005	0.00150	0.00029	0.00020	0.00033	0.00007	0.91	2	1	5	17	0.00010	0.00070	0.00025	0.00020	0.00015	0.00004	1.64	0	0	0
Total Cobalt	-	mg/L	19	0.000058	0.000604	0.000152	0.000126	0.000117	0.000027	1.30	0	0	0	17	0.000073	0.000256	0.000162	0.000158	0.000056	0.000013	2.91	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	19	0.0006	0.0028	0.0012	0.0010	0.0006	0.0001	1.94	0	1	5	17	0.0006	0.0024	0.0012	0.0010	0.0006	0.0001	2.08	0	3	18
Total Iron	0.3	mg/L	19	0.150	1.900	0.550	0.348	0.478	0.110	1.15	0	10	53	17	0.226	1.180	0.491	0.393	0.272	0.066	1.81	0	13	76
Total Lead	0.003 <sup>e</sup>	mg/L	19	0.000006	0.000430	0.000077	0.000061	0.000095	0.000022	0.82	0	0	0	17	0.000011	0.000178	0.000064	0.000040	0.000054	0.000013	1.18	0	0	0
Total Lithium	-	mg/L	19	0.00025	0.00060	0.00030	0.00025	0.00012	0.00003	2.54	16	0	0	17	0.00025	0.00090	0.00045	0.00050	0.00022	0.00005	2.10	8	0	0
Total Magnesium	-	mg/L	19	4.78	8.87	7.09	7.34	1.08	0.25	6.55	0	0	0	17	5.37	10.50	7.57	7.68	1.26	0.31	6.00	0	0	0
Total Manganese	-	mg/L	19	0.0198	0.1530	0.0627	0.0563	0.0438	0.0101	1.43	0	0	0	17	0.0254	0.1540	0.0787	0.0530	0.0515	0.0125	1.53	0	0	0
Total Mercury	0.000026	mg/L	16	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	16	0	14	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	14	0	0	
Total Molybdenum	0.073	mg/L	19	0.00043	0.00064	0.00056	0.00058	0.00007	0.00002	8.60	0	0	0	17	0.00048	0.00108	0.00067	0.00067	0.00013	0.00003	5.27	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	19	0.00043	0.00183	0.00068	0.00053	0.00034	0.00008	1.99	0	0	0	17	0.00047	0.00120	0.00067	0.00057	0.00024	0.00006	2.75	0	0	0
Total Phosphorus	-	mg/L	16	0.0030	0.0573	0.0136	0.0100	0.0127	0.0032	1.07	0	0	0	14	0.0030	0.0180	0.0096	0.0090	0.0047	0.0012	2.07	0	0	0
Total Potassium	-	mg/L	19	0.58	0.85	0.74	0.73	0.07	0.02	10.09	0	0	0	17	0.58	1.33	0.83	0.79	0.18	0.04	4.67	0	0	0
Total Selenium	0.001	mg/L	19	0.00008	0.00029	0.00014	0.00012	0.00005																

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W20											W21										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silicon	-	mg/L	19	3.50	5.60	4.66	4.80	0.50	0.12	9.23	0	0	0	17	3.50	5.40	4.76	4.80	0.54	0.13	8.78	0	0	0
Total Silver	0.0001	mg/L	19	0.000003	0.000011	0.000003	0.000003	0.000002	0.000000	1.51	18	0	0	17	0.000003	0.000003	0.000003	0.000003	0	-	-	17	0	0
Total Sodium	-	mg/L	19	2.43	4.01	3.44	3.56	0.40	0.09	8.54	0	0	0	17	2.86	6.22	3.87	3.77	0.77	0.19	5.04	0	0	0
Total Strontium	-	mg/L	19	0.104	0.173	0.146	0.148	0.017	0.004	8.41	0	0	0	17	0.123	0.187	0.150	0.153	0.018	0.004	8.55	0	0	0
Total Sulphur	-	mg/L	6	5.00	5.00	5.00	5.00	0	-	-	6	0	0	4	5.00	11.00	6.50	5.00	3.00	1.50	2.17	3	0	0
Total Thallium	0.0008	mg/L	19	0.000010	0.000033	0.000011	0.000010	0.000005	0.000001	2.12	18	0	0	17	0.000010	0.000020	0.000011	0.000010	0.000002	0.000001	4.37	16	0	0
Total Tin	-	mg/L	19	0.000005	0.000100	0.000015	0.000005	0.000030	0.000007	0.50	19	0	0	17	0.000005	0.000010	0.000005	0.000005	0.000001	0.000000	4.37	16	0	0
Total Titanium	-	mg/L	19	0.00025	0.01770	0.00212	0.00070	0.00407	0.00093	0.52	8	0	0	17	0.00025	0.00970	0.00161	0.00060	0.00238	0.00058	0.68	7	0	0
Total Uranium	0.015	mg/L	19	0.00012	0.00050	0.00025	0.00024	0.00010	0.00002	2.62	0	0	0	17	0.00015	0.00340	0.00090	0.00081	0.00077	0.00019	1.16	0	0	0
Total Vanadium	-	mg/L	19	0.00010	0.00262	0.00056	0.00040	0.00056	0.00013	1.00	2	0	0	17	0.00010	0.00130	0.00044	0.00030	0.00035	0.00009	1.25	4	0	0
Total Zinc	0.03	mg/L	19	0.00020	0.00370	0.00094	0.00060	0.00098	0.00022	0.96	0	0	0	17	0.00030	0.00220	0.00084	0.00050	0.00058	0.00014	1.45	0	0	0
Total Zirconium	-	mg/L	19	0.00010	0.00049	0.00017	0.00010	0.00010	0.00002	1.68	0	0	0	17	0.00010	0.00040	0.00021	0.00020	0.00008	0.00002	2.71	0	0	0
Dissolved Aluminum	0.1	mg/L	19	0.0036	0.0475	0.0152	0.0099	0.0129	0.0030	1.18	0	0	0	17	0.0043	0.0419	0.0164	0.0124	0.0128	0.0031	1.28	0	0	0
Dissolved Antimony	-	mg/L	19	0.00001	0.00005	0.00003	0.00003	0.00001	0.00002	3.44	1	0	0	17	0.00002	0.00017	0.00005	0.00005	0.00003	0.00008	1.50	0	0	0
Dissolved Arsenic	-	mg/L	19	0.00027	0.00145	0.00052	0.00037	0.00036	0.000082	1.45	0	0	0	17	0.00035	0.00074	0.00049	0.00042	0.00013	0.00032	3.69	0	0	0
Dissolved Barium	-	mg/L	19	0.026300	0.056400	0.041274	0.039100	0.008816	0.002023	4.68	0	0	0	17	0.031900	0.061200	0.045982	0.047400	0.008188	0.001986	5.62	0	0	0
Dissolved Beryllium	-	mg/L	19	0.000005	0.000015	0.000007	0.000005	0.000003	0.000001	2.34	12	0	0	17	0.000005	0.000010	0.000006	0.000005	0.000002	0.000001	2.83	13	0	0
Dissolved Bismuth	-	mg/L	19	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	19	0	0	17	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	17	0	0
Dissolved Boron	-	mg/L	19	0.025	0.025	0.025	0.025	0	-	-	19	0	0	17	0.025	0.025	0.025	0.025	0	-	-	17	0	0
Dissolved Cadmium	-	mg/L	19	0.000003	0.000021	0.000007	0.000008	0.000005	0.000001	1.45	7	0	0	17	0.000003	0.000011	0.000007	0.000007	0.000003	0.000001	2.15	5	0	0
Dissolved Calcium	-	mg/L	19	12.80	20.50	17.53	17.80	2.31	0.53	7.57	0	0	0	17	14.70	27.40	19.81	19.80	3.16	0.77	6.27	0	0	0
Dissolved Chromium	-	mg/L	19	0.00005	0.00030	0.00017	0.00020	0.00008	0.00002	2.17	3	0	0	17	0.00005	0.00030	0.00019	0.00020	0.00009	0.00002	2.11	3	0	0
Dissolved Cobalt	-	mg/L	19	0.000025	0.000193	0.000095	0.000079	0.000049	0.000011	1.95	0	0	0	17	0.000027	0.000209	0.000121	0.000093	0.000058	0.000014	2.09	0	0	0
Dissolved Copper	-	mg/L	19	0.0005	0.0016	0.0010	0.0009	0.0004	0.0001	2.61	0	0	0	17	0.0005	0.0018	0.0011	0.0009	0.0005	0.0001	2.38	0	0	0
Dissolved Iron	-	mg/L	19	0.085	1.150	0.312	0.136	0.328	0.075	0.95	0	0	0	17	0.017	0.424	0.248	0.197	0.119	0.029	2.09	0	0	0
Dissolved Lead	-	mg/L	19	0.000003	0.000117	0.000026	0.000008	0.000034	0.000008	0.76	4	0	0	17	0.000003	0.000314	0.000042	0.000017	0.000075	0.000018	0.56	4	0	0
Dissolved Lithium	-	mg/L	19	0.00025	0.00050	0.00026	0.00025	0.00006	0.00001	4.59	18	0	0	17	0.00025	0.00090	0.00043	0.00050	0.00020	0.00005	2.15	8	0	0
Dissolved Magnesium	-	mg/L	19	4.53	9.09	7.06	7.18	1.16	0.27	6.09	0	0	0	17	5.63	10.90	7.58	7.57	1.29	0.31	5.88	0	0	0
Dissolved Manganese	-	mg/L	19	0.0008	0.1550	0.0564	0.0340	0.0475	0.0109	1.19	0	0	0	17	0.0025	0.1570	0.0735	0.0438	0.0573	0.0139	1.28	0	0	0
Dissolved Mercury	-	mg/L	15	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	15	0	0	13	0.0000050	0.0000100	0.0000054	0.0000050	0.0000014	0.0000004	3.88	12	0	0
Dissolved Molybdenum	-	mg/L	19	0.00046	0.00078	0.00057	0.00054	0.00008	0.00002	7.34	0	0	0	17	0.00052	0.00144	0.00072	0.00069	0.00023	0.00006	3.17	0	0	0
Dissolved Nickel	-	mg/L	19	0.00042	0.00083	0.00057	0.00052	0.00013	0.00003	4.54	0	0	0	17	0.00021	0.00084	0.00058	0.00055	0.00015	0.00004	3.89	0	0	0
Dissolved Phosphorus	-	mg/L	15	0.0010	0.0140	0.0059	0.0050	0.0039	0.0010	1.51	2	0	0	13	0.0020	0.0080	0.0048	0.0050	0.0018	0.0005	2.66	0	0	0
Dissolved Potassium	-	mg/L	19	0.55	0.86	0.74	0.75	0.08	0.02	8.75	0	0	0	17	0.60	1.39	0.86	0.82	0.20	0.05	4.33	0	0	0
Dissolved Selenium	-	mg/L	19	0.00008	0.00028	0.00014	0.00012	0.00005	0.00001	2.63	0	0	0	17	0.00002	0.00020	0.00011	0.00012	0.00004	0.00001	2.66	1	0	0
Dissolved Silicon	-	mg/L	19	3.41	5.40	4.46	4.40	0.53	0.12	8.45	0	0	0	17	3.30	5.70	4.71	4.90	0.60	0.15	7.79	0	0	0
Dissolved Silver	-	mg/L	19	0.000003	0.000003	0.000003	0.000003	0	-	-	19	0	0	17	0.000003	0.000003	0.000003	0.000003	0	-	-	17	0	0
Dissolved Sodium	-	mg/L	19	2.39	5.70	3.56	3.56	0.64	0.15	5.58	0	0	0	17	2.98	6.42	3.99	3.87	0.84	0.20	4.73	0	0	0
Dissolved Strontium	-	mg/L	19	0.101	0.170	0.145	0.149	0.018	0.004	7.92	0	0	0	17	0.119	0.190	0.149	0.151	0.020	0.005	7.37	0	0	0
Dissolved Sulphur	-	mg/L	6	5.00	5.00	5.00	5.00	0	-	-	6	0	0	4	5.00	10.00	6.25	5.00	2.50	1.25	2.50	3	0	0
Dissolved Thallium	-	mg/L	19	0.0000010	0.0000010	0.0000010	0.0000010	0	-	-	19	0	0	17	0.0000010	0.0000030	0.0000011	0.0000010	0.0000005	0.0000001	2.30	16	0	0
Dissolved Tin	-	mg/L	19	0.000005	0.000100	0.000015	0.000005	0.000030	0.000007	0.51	18	0	0	17	0.000005	0.000005	0.000005	0.000005	0	-	-	17	0	0
Dissolved Titanium	-	mg/L	19	0.00025	0.00110	0.00034	0.00025	0.00023	0.00005	1.49	16	0	0	17	0.00025	0.00090	0.00032	0.00025	0.00017	0.00004	1.85	14	0	0
Dissolved Uranium	-	mg/L	19	0.00012	0.00037	0.00023	0.00023	0.00007	0.00002	3.12	0	0	0	17	0.00016	0.00425	0.00108	0.00083	0.00114	0.00028	0.94	0	0	0
Dissolved Vanadium	-	mg/L	19	0.00010	0.00080	0.00036	0.00030	0.00022	0.00005	1.68	4	0	0	17	0.00010	0.00080	0.00034	0.00030	0.00021	0.00005	1.63	3	0	0
Dissolved Zinc	-	mg/L	19	0.00020	0.00110	0.00047	0.00040	0.00023	0.00005	2.01	0	0	0	17	0.00020	0.00070	0.00041	0.00040	0.00015	0.00004	2.67	0	0	0
Dissolved Zirconium	-	mg/L	19	0.00005	0.00020	0.00015	0.00015	0.00005	0.00001	2.73	1	0	0	17	0.00010	0.00030	0.00018	0.00020	0.00006	0.00002	2.87	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>-4</sup>\*(0.86<sup>ln(hardness)</sup>)-3.2/1000
- d) Copper (Cu) mg/L: (e<sup>-0.8545ln(hardness)</sup>-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>-1.273ln(hardness)</sup>-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>-0.76ln(hardness)</sup>+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guic
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available



Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W7											W3										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	18	5.50	8.00	6.87	6.89	0.51	0.12	13.58	0	3	17	27	7.40	8.21	7.83	7.89	0.20	0.04	38.61	0	0	0
Conductivity	-	µS/cm	18	34	217	121	125	44	10	2.75	0	0	0	27	89	435	276	263	92	18	3.01	0	0	0
Total Hardness CaCO3	-	mg/L	18	15	61	42	42	13	3	3.28	0	0	0	27	46	189	129	126	44	8	2.97	0	0	0
Dissolved Hardness CaCO3	-	mg/L	4	32	63	49	51	13	7	3.78	0	0	0	6	48	197	146	170	58	24	2.51	0	0	0
Ion Balance	-	no unit	3	0.93	1.10	1.01	1.00	0.09	0.05	11.82	0	0	0	4	0.62	1.10	0.90	0.95	0.21	0.10	4.36	0	0	0
Total Dissolved Solids	-	mg/L	17	32	130	90	98	30	7	3.04	0	0	0	27	74	306	184	180	59	11	3.10	0	0	0
Total Suspended Solids	-	mg/L	18	0.5	40.0	8.9	1.0	14.0	3.3	0.64	5	0	0	27	0.5	34.0	4.2	0.5	7.8	1.5	0.54	14	0	0
Turbidity	-	NTU	18	0.1	15.5	2.5	0.4	4.2	1.0	0.59	0	0	0	27	0.1	7.5	0.9	0.3	1.6	0.3	0.59	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	18	0.003	0.250	0.037	0.015	0.062	0.015	0.59	6	0	0	27	0.003	0.052	0.016	0.010	0.015	0.003	1.09	10	0	0
Alkalinity, Total (as CaCO3)	-	mg/L	18	0.6	15.0	7.23	7.05	3.40	0.80	2.13	0	0	0	27	22.0	130.0	75.18	72.0	26.26	5.05	2.86	0	0	0
Acidity (pH 4.5) as CaCO3	-	mg/L	4	0.25	0.25	0.25	0.25	0	-	-	4	0	0	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0
Acidity (pH8.3) as CaCO3	-	mg/L	11	0.25	7.60	2.78	1.30	2.86	0.86	0.97	2	0	0	15	0.25	5.00	1.79	1.39	1.51	0.39	1.19	3	0	0
Bromide (Br)	-	mg/L	14	0.20	0.20	0.20	0.20	0	-	-	14	0	0	23	0.01	0.20	0.18	0.20	0.06	0.01	2.83	23	0	0
Chloride (Cl)	120	mg/L	18	0.25	1.90	0.47	0.25	0.43	0.10	1.10	12	0	0	27	0.25	1.50	0.56	0.50	0.38	0.07	1.47	13	0	0
Fluoride (F)	0.12	mg/L	14	0.030	0.130	0.066	0.065	0.024	0.007	2.73	0	1	7	23	0.059	0.120	0.096	0.100	0.018	0.004	5.20	0	0	0
Sulphate (SO4)	-	mg/L	18	0.25	54.00	39.85	44.50	15.26	3.60	2.61	1	0	0	27	15.00	121.00	61.67	58.00	25.96	5.00	2.38	0	0	0
Total Nitrogen (N)	-	mg/L	4	0.07	0.64	0.24	0.13	0.27	0.13	0.91	0	0	0	6	0.37	0.68	0.53	0.54	0.12	0.05	4.25	0	0	0
Nitrate (as N)	13	mg/L	18	0.001	0.011	0.003	0.001	0.004	0.001	0.92	13	0	0	27	0.050	0.487	0.228	0.236	0.115	0.022	1.99	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	4	0.001	0.012	0.006	0.006	0.006	0.003	1.03	2	0	0	6	0.111	0.487	0.300	0.290	0.132	0.054	2.27	0	0	0
Nitrite (as N)	0.06	mg/L	18	0.001	0.010	0.002	0.001	0.002	0.001	0.90	15	0	0	27	0.001	0.004	0.002	0.001	0.001	0.000	1.69	19	0	0
Total Kjeldahl Nitrogen	-	mg/L	18	0.07	0.63	0.22	0.17000	0.1575	0.0371	1.40	0	0	0	27	0.08	0.56	0.22	0.21000	0.1117	0.0215	2.00	0	0	0
Ortho Phosphate as P	-	mg/L	18	0.0005	0.0040	0.0015	0.0010	0.0009	0.0002	1.68	4	0	0	27	0.0005	0.0460	0.0031	0.0010	0.0086	0.0017	0.36	6	0	0
Cyanide, Total	0.005	mg/L	18	0.00025	0.00150	0.00053	0.00025	0.00042	0.00010	1.25	11	0	0	27	0.00025	0.00150	0.00057	0.00025	0.00038	0.00007	1.48	14	0	0
Cyanide, Weak Acid Diss	-	mg/L	18	0.00025	0.00130	0.00049	0.00025	0.00038	0.00009	1.28	12	0	0	27	0.00025	0.00180	0.00054	0.00025	0.00042	0.00008	1.28	16	0	0
Dissolved Organic Carbon	-	mg/L	10	1.70	17.40	6.26	4.20	4.91	1.55	1.28	0	0	0	14	2.00	15.30	6.95	6.70	3.33	0.89	2.09	0	0	0
Total Organic Carbon	-	mg/L	15	1.90	18.50	5.96	4.00	4.67	1.21	1.28	0	0	0	23	1.50	17.40	7.22	6.40	3.48	0.73	2.08	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	18	0.0195	0.5890	0.1494	0.0619	0.1794	0.0423	0.83	0	7	39	27	0.0063	0.4150	0.0702	0.0237	0.1022	0.0197	0.69	0	5	19
Total Antimony	-	mg/L	18	0.000040	0.000110	0.000068	0.000070	0.000016	0.000004	4.32	0	0	0	27	0.000200	0.000490	0.000337	0.000320	0.000087	0.000017	3.86	0	0	0
Total Arsenic	0.005	mg/L	18	0.000150	0.000990	0.000371	0.000250	0.000272	0.000064	1.36	0	0	0	27	0.000380	0.001380	0.000692	0.000660	0.000269	0.000052	2.57	0	0	0
Total Barium	-	mg/L	18	0.03	0.07	0.05	0.04785	0.0097	0.0023	4.99	0	0	0	27	0.04	0.09	0.06	0.05440	0.0135	0.0026	4.23	0	0	0
Total Beryllium	-	mg/L	18	0.000005	0.000050	0.000018	0.000010	0.000015	0.000004	1.17	5	0	0	27	0.000005	0.000040	0.000009	0.000005	0.000009	0.000002	1.01	19	0	0
Total Bismuth	-	mg/L	18	0.0000025	0.0000400	0.0000105	0.0000025	0.0000123	0.0000029	0.85	11	0	0	27	0.0000025	0.0000130	0.0000038	0.0000025	0.0000030	0.0000006	1.29	22	0	0
Total Boron	1.5	mg/L	18	0.03	0.03	0.03	0.03	0	-	-	18	0	0	27	0.03	0.03	0.03	0.03	0	-	-	27	0	0
Total Cadmium	0.00032 <sup>c</sup>	mg/L	18	0.000087	0.000505	0.000213	0.000172	0.000114	0.000027	1.86	0	18	100	27	0.000008	0.000084	0.000029	0.000021	0.000020	0.000004	1.40	0	5	19
Total Calcium	-	mg/L	18	4.49	18.30	12.66	12.50	3.92	0.93	3.23	0	0	0	27	11.40	48.20	33.44	32.60	11.32	2.18	2.95	0	0	0
Total Chromium	0.001	mg/L	18	0.00005	0.00050	0.00019	0.00015	0.00015	0.00003	1.31	6	0	0	27	0.00005	0.00080	0.00021	0.00020	0.00019	0.00004	1.12	5	0	0
Total Cobalt	-	mg/L	18	0.000024	0.000793	0.000184	0.000079	0.000234	0.000055	0.79	0	0	0	27	0.000020	0.000545	0.000103	0.000045	0.000131	0.000025	0.78	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	18	0.0009	0.0107	0.0037	0.0025	0.0029	0.0007	1.26	0	14	78	27	0.0013	0.0081	0.0030	0.0024	0.0017	0.0003	1.69	0	11	41
Total Iron	0.3	mg/L	18	0.010	0.646	0.159	0.047	0.206	0.049	0.77	0	4	22	27	0.004	0.540	0.091	0.028	0.145	0.028	0.63	0	3	11
Total Lead	0.003 <sup>e</sup>	mg/L	18	0.000017	0.000856	0.000248	0.000076	0.000292	0.000069	0.85	0	0	0	27	0.000009	0.001470	0.000141	0.000040	0.000295	0.000057	0.48	0	0	0
Total Lithium	-	mg/L	18	0.00025	0.00130	0.00069	0.00070	0.00028	0.00007	2.46	3	0	0	27	0.00025	0.00080	0.00045	0.00050	0.00019	0.00004	2.39	11	0	0
Total Magnesium	-	mg/L	18	0.93	3.81	2.60	2.58	0.77	0.18	3.38	0	0	0	27	4.18	17.30	11.15	10.80	3.77	0.72	2.96	0	0	0
Total Manganese	-	mg/L	18	0.0008	0.0845	0.0157	0.0047	0.0247	0.0058	0.64	0	0	0	27	0.0002	0.0369	0.0091	0.0046	0.0115	0.0022	0.79	0	0	0
Total Mercury	0.000026	mg/L	15	0.0000050	0.0000100	0.0000053	0.0000050	0.0000013	0.0000003	4.13	14	0	0	24	0.0000050	0.0000100	0.0000052	0.0000050	0.0000010	0.0000002	5.10	23	0	0
Total Molybdenum	0.073	mg/L	18	0.00007	0.00049	0.00026	0.00026	0.00010	0.00002	2.71	0	0	0	27	0.00037	0.00143	0.00089	0.00088	0.00028	0.00005	3.13	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	18	0.00063	0.00217	0.00107	0.00097	0.00044	0.00010	2.41	0	0	0	27	0.00045	0.00211	0.00085	0.00069	0.00038	0.00007	2.21	0	0	0
Total Phosphorus	-	mg/L	15	0.0010	0.0480	0.0121	0.0050	0.0158	0.0041	0.76	2	0	0	24	0.0010	0.0300	0.0071	0.0035	0.0089	0.0018	0.80	7	0	0
Total Potassium	-	mg/L	18	0.34	2.53	0.76	0.55	0.54	0.13	1.42	0	0	0	27	1.03	2.44	1.81	1.77	0.44	0.08	4.15	0	0	0
Total Selenium	0.001	mg/L	18	0.00002	0.00015	0.00007	0.00006	0.00003	0.00001	1.93	2	0	0	27	0.00002	0.00019	0.00008</							

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W7											W3										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	18	0.000003	0.000026	0.000006	0.000003	0.000006	0.000001	0.92	12	0	0	27	0.000003	0.000014	0.000003	0.000003	0.000003	0.000001	1.17	24	0	0
Total Sodium	-	mg/L	18	0.92	5.27	3.52	3.71	1.32	0.31	2.67	0	0	0	27	1.40	5.90	3.93	3.98	1.23	0.24	3.20	0	0	0
Total Strontium	-	mg/L	18	0.031	0.141	0.085	0.089	0.027	0.006	3.11	0	0	0	27	0.071	0.345	0.209	0.204	0.072	0.014	2.91	0	0	0
Total Sulphur	-	mg/L	4	5.00	21.00	15.25	17.50	7.04	3.52	2.17	1	0	0	6	5.00	40.00	26.50	30.50	13.40	5.47	1.98	1	0	0
Total Thallium	0.0008	mg/L	18	0.000010	0.0000110	0.0000035	0.0000030	0.0000027	0.0000006	1.27	3	0	0	27	0.000010	0.0000080	0.0000026	0.0000020	0.0000019	0.0000004	1.34	11	0	0
Total Tin	-	mg/L	18	0.000005	0.000040	0.000008	0.000005	0.000008	0.000002	0.91	15	0	0	27	0.000005	0.000100	0.000014	0.000005	0.000026	0.000005	0.53	24	0	0
Total Titanium	-	mg/L	18	0.00025	0.01620	0.00348	0.00115	0.00498	0.00117	0.70	5	0	0	27	0.00025	0.01280	0.00190	0.00050	0.00315	0.00061	0.60	13	0	0
Total Uranium	0.015	mg/L	18	0.00004	0.00038	0.00013	0.00008	0.00010	0.00002	1.28	0	0	0	27	0.00339	0.03510	0.01226	0.00992	0.00801	0.00154	1.53	0	0	0
Total Vanadium	-	mg/L	18	0.00010	0.00120	0.00041	0.00025	0.00035	0.00008	1.16	4	0	0	27	0.00010	0.00085	0.00023	0.00010	0.00024	0.00005	0.96	18	0	0
Total Zinc	0.03	mg/L	18	0.00610	0.02800	0.01561	0.01410	0.00621	0.00146	2.51	0	0	0	27	0.00050	0.01330	0.00202	0.00110	0.00272	0.00052	0.74	0	0	0
Total Zirconium	-	mg/L	18	0.00005	0.00050	0.00015	0.00005	0.00014	0.00003	1.06	10	0	0	27	0.00005	0.00040	0.00017	0.00010	0.00011	0.00002	1.57	5	0	0
Dissolved Aluminum	0.1	mg/L	18	0.0092	0.3910	0.0899	0.0329	0.1163	0.0274	0.77	0	4	22	26	0.0056	0.2330	0.0377	0.0140	0.0540	0.0106	0.70	0	3	12
Dissolved Antimony	-	mg/L	18	0.00004	0.00009	0.00006	0.00006	0.00001	0.00003	4.60	0	0	0	26	0.00018	0.00049	0.00032	0.00031	0.00009	0.00017	3.62	0	0	0
Dissolved Arsenic	-	mg/L	18	0.00012	0.00064	0.00024	0.00021	0.00012	0.000028	2.03	0	0	0	26	0.00033	0.00083	0.00059	0.00058	0.00015	0.00029	3.97	0	0	0
Dissolved Barium	-	mg/L	18	0.028	0.061	0.046	0.047	0.009	0.002	4.93	0	0	0	26	0.031	0.090	0.056	0.054	0.015	0.003	3.78	0	0	0
Dissolved Beryllium	-	mg/L	18	0.000005	0.000050	0.000015	0.000008	0.000014	0.000003	1.09	9	0	0	26	0.000005	0.000020	0.000007	0.000005	0.000005	0.000001	1.38	22	0	0
Dissolved Bismuth	-	mg/L	18	0.000025	0.0000150	0.0000032	0.0000025	0.0000029	0.0000007	1.08	17	0	0	26	0.000025	0.0000025	0.0000025	0.0000025	0	-	-	26	0	0
Dissolved Boron	-	mg/L	18	0.025	0.025	0.025	0.025	0	-	-	18	0	0	26	0.025	0.025	0.025	0.025	0	-	-	26	0	0
Dissolved Cadmium	-	mg/L	18	0.000084	0.000431	0.000195	0.000160	0.000093	0.000022	2.09	0	0	0	26	0.000008	0.000066	0.000022	0.000018	0.000014	0.000003	1.61	0	0	0
Dissolved Calcium	-	mg/L	18	4.49	19.10	12.63	12.50	3.82	0.90	3.31	0	0	0	26	11.50	50.90	34.05	32.95	12.02	2.36	2.83	0	0	0
Dissolved Chromium	-	mg/L	18	0.00005	0.00030	0.00016	0.00020	0.00009	0.00002	1.78	6	0	0	26	0.00005	0.00030	0.00014	0.00015	0.00008	0.00001	1.87	7	0	0
Dissolved Cobalt	-	mg/L	18	0.000018	0.000554	0.000121	0.000061	0.000149	0.000035	0.81	0	0	0	26	0.000017	0.000255	0.000054	0.000043	0.000047	0.000009	1.16	0	0	0
Dissolved Copper	-	mg/L	18	0.0009	0.0079	0.0032	0.0022	0.0022	0.0005	1.43	0	0	0	26	0.0012	0.0072	0.0028	0.0022	0.0017	0.0003	1.65	0	0	0
Dissolved Iron	-	mg/L	18	0.005	0.312	0.068	0.017	0.098	0.023	0.69	0	0	0	26	0.003	0.227	0.037	0.016	0.052	0.010	0.71	0	0	0
Dissolved Lead	-	mg/L	18	0.000007	0.000330	0.000049	0.000017	0.000079	0.000019	0.62	0	0	0	26	0.000003	0.000339	0.000043	0.000016	0.000017	0.000014	0.61	2	0	0
Dissolved Lithium	-	mg/L	18	0.00025	0.00120	0.00069	0.00070	0.00027	0.00006	2.55	3	0	0	26	0.00025	0.00070	0.00044	0.00050	0.00018	0.00004	2.46	11	0	0
Dissolved Magnesium	-	mg/L	18	0.87	3.74	2.62	2.69	0.77	0.18	3.41	0	0	0	26	4.14	17.50	11.19	10.75	3.71	0.73	3.01	0	0	0
Dissolved Manganese	-	mg/L	18	0.0005	0.0672	0.0121	0.0035	0.0193	0.0045	0.63	0	0	0	26	0.0002	0.0189	0.0046	0.0030	0.0052	0.0010	0.90	0	0	0
Dissolved Mercury	-	mg/L	14	0.0000050	0.0000100	0.0000054	0.0000050	0.0000013	0.0000004	4.01	13	0	0	22	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	22	0	0
Dissolved Molybdenum	-	mg/L	18	0.00003	0.00078	0.00029	0.00026	0.00016	0.00004	1.78	1	0	0	26	0.00037	0.00143	0.00088	0.00087	0.00026	0.00005	3.34	0	0	0
Dissolved Nickel	-	mg/L	18	0.00059	0.00193	0.00101	0.00094	0.00040	0.00009	2.54	0	0	0	26	0.00044	0.00166	0.00079	0.00067	0.00035	0.00007	2.28	0	0	0
Dissolved Phosphorus	-	mg/L	14	0.0010	0.0180	0.0053	0.0025	0.0060	0.0016	0.88	4	0	0	22	0.0010	0.0130	0.0040	0.0030	0.0034	0.0007	1.18	7	0	0
Dissolved Potassium	-	mg/L	18	0.40	2.57	0.77	0.56	0.54	0.13	1.43	0	0	0	26	0.93	2.51	1.83	1.77	0.45	0.09	4.02	0	0	0
Dissolved Selenium	-	mg/L	18	0.00002	0.00015	0.00007	0.00006	0.00003	0.00001	2.16	1	0	0	26	0.00004	0.00019	0.00009	0.00008	0.00003	0.00001	2.98	0	0	0
Dissolved Silicon	-	mg/L	18	2.30	11.90	7.66	8.05	2.63	0.62	2.91	0	0	0	26	2.40	5.40	4.63	4.90	0.79	0.15	5.89	0	0	0
Dissolved Silver	-	mg/L	18	0.000003	0.000022	0.000004	0.000003	0.000005	0.000001	0.86	15	0	0	26	0.000003	0.000009	0.000003	0.000003	0.000002	0.000000	1.90	24	0	0
Dissolved Sodium	-	mg/L	18	0.99	5.03	3.59	3.94	1.29	0.30	2.78	0	0	0	26	1.50	5.81	3.90	4.10	1.16	0.23	3.35	0	0	0
Dissolved Strontium	-	mg/L	18	0.030	0.138	0.085	0.087	0.027	0.006	3.11	0	0	0	26	0.071	0.345	0.210	0.201	0.073	0.014	2.90	0	0	0
Dissolved Sulphur	-	mg/L	4	5.00	20.00	15.75	19.00	7.23	3.61	2.18	1	0	0	6	5.00	40.00	26.33	31.00	13.23	5.40	1.99	1	0	0
Dissolved Thallium	-	mg/L	18	0.000010	0.0000070	0.0000023	0.0000020	0.0000017	0.0000004	1.33	7	0	0	26	0.000010	0.0000040	0.0000020	0.0000015	0.0000011	0.0000002	1.73	13	0	0
Dissolved Tin	-	mg/L	18	0.000005	0.000090	0.000010	0.000005	0.000020	0.000005	0.50	16	0	0	26	0.000005	0.000100	0.000016	0.000005	0.000028	0.000005	0.59	22	0	0
Dissolved Titanium	-	mg/L	18	0.00025	0.00300	0.00061	0.00025	0.00077	0.00018	0.80	13	0	0	26	0.00025	0.00220	0.00050	0.00025	0.00051	0.00010	0.98	19	0	0
Dissolved Uranium	-	mg/L	18	0.00004	0.00029	0.00010	0.00007	0.00007	0.00002	1.41	0	0	0	26	0.00317	0.03560	0.01251	0.00977	0.00811	0.00159	1.54	0	0	0
Dissolved Vanadium	-	mg/L	18	0.00010	0.00050	0.00022	0.00020	0.00012	0.00003	1.74	8	0	0	26	0.00010	0.00040	0.00017	0.00010	0.00011	0.00002	1.52	18	0	0
Dissolved Zinc	-	mg/L	18	0.00810	0.02530	0.01461	0.01330	0.00522	0.00123	2.80	0	0	0	26	0.00040	0.00980	0.00173	0.00090	0.00233	0.00046	0.74	0	0	0
Dissolved Zirconium	-	mg/L	18	0.00005	0.00030	0.00011	0.00005	0.00008	0.00002	1.35	10	0	0	26	0.00005	0.00030	0.00015	0.00010	0.00009	0.00002	1.70	7	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>-4</sup>(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e<sup>-0.8545</sup>[ln(hardness)]-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>-1.273</sup>[ln(hardness)]-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>-0.76</sup>[ln(hardness)]+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

"n" Count  
"min" Minimum Value  
"max" Maximum Value  
"sd" Standard Deviation  
"se" Standard Error  
"cov" Covariance  
"<DL" # of Non-detectable Values  
">GL" # of Exceedances of CCME Guideline  
"%>GL" % of Parameters that Exceed CCME Guideline  
"." No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W14										W2											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	22	7.00	8.20	7.85	7.91	0.29	0.06	27.23	0	0	0	21	7.10	8.10	7.82	7.90	0.23	0.05	33.40	0	0	0
Conductivity	-	µS/cm	22	49	585	290	283	141	30	2.06	0	0	0	21	78	445	285	287	105	23	2.72	0	0	0
Total Hardness CaCO3	-	mg/L	22	28	291	144	141	72	15	2.00	0	0	0	21	41	211	139	142	51	11	2.70	0	0	0
Dissolved Hardness CaCO3	-	mg/L	4	94	292	199	206	82	41	2.44	0	0	0	4	104	201	169	185	44	22	3.80	0	0	0
Ion Balance	-	no unit	3	0.98	1.10	1.03	1.00	0.06	0.04	15.97	0	0	0	3	1.00	1.10	1.03	1.00	0.06	0.03	17.90	0	0	0
Total Dissolved Solids	-	mg/L	22	46	370	198	200	81	17	2.44	0	0	0	21	78	320	196	200	64	14	3.06	0	0	0
Total Suspended Solids	-	mg/L	22	0.5	34.0	6.0	2.0	8.6	1.8	0.70	6	0	0	21	0.5	25.0	5.3	2.0	7.7	1.7	0.69	9	0	0
Turbidity	-	NTU	22	0.1	2.8	0.6	0.4	0.7	0.1	0.93	0	0	0	21	0.1	2.5	0.6	0.3	0.7	0.1	0.85	1	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	22	0.003	0.050	0.022	0.015	0.019	0.004	1.15	6	0	0	21	0.003	0.081	0.019	0.010	0.021	0.005	0.92	7	0	0
Alkalinity, Total (as CaCO3)	-	mg/L	22	10.0	160.0	88.09	91.5	39.74	8.47	2.22	0	0	0	21	15.0	120.0	79.81	82.0	29.05	6.34	2.75	0	0	0
Acidity (pH 4.5) as CaCO3	-	mg/L	4	0.25	0.25	0.25	0.25	0	-	-	4	0	0	4	0.25	0.25	0.25	0.25	0	-	-	4	0	0
Acidity (pH8.3) as CaCO3	-	mg/L	11	0.25	12.00	2.61	1.60	3.35	1.01	0.78	3	0	0	12	0.25	4.00	1.63	1.35	1.21	0.35	1.34	3	0	0
Bromide (Br)	-	mg/L	18	0.05	0.20	0.19	0.20	0.04	0.01	5.42	18	0	0	18	0.05	0.20	0.19	0.20	0.04	0.01	5.42	18	0	0
Chloride (Cl)	120	mg/L	22	0.25	1.70	0.79	0.70	0.45	0.10	1.76	6	0	0	21	0.25	1.40	0.59	0.60	0.35	0.08	1.69	8	0	0
Fluoride (F)	0.12	mg/L	18	0.040	0.150	0.094	0.100	0.029	0.007	3.22	0	2	11	18	0.050	0.130	0.096	0.100	0.023	0.005	4.17	0	1	6
Sulphate (SO4)	-	mg/L	22	0.25	130.00	60.59	53.50	36.94	7.88	1.64	1	0	0	21	8.80	110.00	62.61	60.00	28.09	6.13	2.23	0	0	0
Total Nitrogen (N)	-	mg/L	4	0.41	1510.00	377.89	0.58	754.74	377.37	0.50	0	0	0	4	0.34	0.60	0.45	0.44	0.11	0.06	3.96	0	0	0
Nitrate (as N)	13	mg/L	22	0.001	0.437	0.233	0.237	0.145	0.031	1.61	1	0	0	21	0.043	0.407	0.215	0.197	0.115	0.025	1.87	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	4	0.001	0.390	0.250	0.305	0.171	0.085	1.46	1	0	0	4	0.125	0.402	0.300	0.336	0.121	0.060	2.48	0	0	0
Nitrite (as N)	0.06	mg/L	22	0.001	0.010	0.002	0.001	0.003	0.001	0.87	16	0	0	21	0.001	0.012	0.003	0.001	0.003	0.001	0.89	14	0	0
Total Kjeldahl Nitrogen	-	mg/L	21	0.05	0.59	0.30	0.28	0.1513	0.0330	2.01	0	0	0	21	0.06	0.99	0.28	0.21000	0.2234	0.0487	1.23	0	0	0
Ortho Phosphate as P	-	mg/L	22	0.0005	0.0260	0.0025	0.0010	0.0053	0.0011	0.46	6	0	0	21	0.0005	0.0370	0.0032	0.0020	0.0078	0.0017	0.41	4	0	0
Cyanide, Total	0.005	mg/L	22	0.00025	0.00180	0.00091	0.00080	0.00048	0.00010	1.91	4	0	0	21	0.00025	0.00150	0.00070	0.00070	0.00043	0.00009	1.61	8	0	0
Cyanide, Weak Acid Diss	-	mg/L	22	0.00025	0.00170	0.00080	0.00085	0.00042	0.00009	1.91	6	0	0	21	0.00025	0.00140	0.00065	0.00070	0.00040	0.00009	1.62	9	0	0
Dissolved Organic Carbon	-	mg/L	10	5.20	29.20	12.39	10.70	6.40	2.02	1.94	0	0	0	9	3.70	21.20	8.86	8.00	5.16	1.72	1.71	0	0	0
Total Organic Carbon	-	mg/L	18	5.20	28.80	12.74	11.45	5.50	1.30	2.32	0	0	0	17	3.40	21.50	8.58	7.30	4.50	1.09	1.90	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	22	0.0131	0.5420	0.1448	0.0601	0.1688	0.0360	0.86	0	8	36	21	0.0059	0.4600	0.1018	0.0373	0.1259	0.0275	0.81	0	7	33
Total Antimony	-	mg/L	22	0.000120	0.000330	0.000221	0.000230	0.000064	0.000014	3.46	0	0	0	21	0.000180	0.000430	0.000289	0.000270	0.000073	0.000016	3.95	1	0	0
Total Arsenic	0.005	mg/L	22	0.000440	0.001030	0.000620	0.000565	0.000174	0.000037	3.56	0	0	0	21	0.000410	0.001100	0.000661	0.000670	0.000213	0.000046	3.11	0	0	0
Total Barium	-	mg/L	22	0.06	0.12	0.08	0.07410	0.0188	0.0040	4.16	0	0	0	21	0.05	0.08	0.06	0.06280	0.0127	0.0028	5.08	0	0	0
Total Beryllium	-	mg/L	22	0.000005	0.000040	0.000014	0.000010	0.000011	0.000002	1.27	7	0	0	21	0.000005	0.000050	0.000013	0.000005	0.000013	0.000003	1.03	14	0	0
Total Bismuth	-	mg/L	22	0.0000025	0.0000200	0.0000041	0.0000025	0.0000049	0.0000010	0.85	19	0	0	21	0.0000025	0.0005000	0.0000275	0.0000025	0.0001083	0.0000236	0.25	18	0	0
Total Boron	1.5	mg/L	22	0.03	0.03	0.03	0.02500	0	-	-	22	0	0	21	0.03	0.15	0.03	0.02500	0.0273	0.0060	1.13	21	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	22	0.000003	0.000031	0.000013	0.000012	0.000010	0.000002	1.30	6	4	18	21	0.000008	0.000069	0.000022	0.000021	0.000014	0.000003	1.59	1	2	10
Total Calcium	-	mg/L	22	7.03	68.10	34.58	33.65	16.96	3.62	2.04	0	0	0	21	10.30	53.60	34.83	35.70	12.96	2.83	2.69	0	0	0
Total Chromium	0.001	mg/L	22	0.00005	0.00070	0.00030	0.00030	0.00017	0.00004	1.80	1	0	0	21	0.00005	0.00070	0.00025	0.00020	0.00016	0.00004	1.55	3	0	0
Total Cobalt	-	mg/L	22	0.000024	0.000418	0.000111	0.000059	0.000105	0.000022	1.06	0	0	0	21	0.000020	0.000492	0.000120	0.000081	0.000117	0.000025	1.03	1	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	22	0.0008	0.0042	0.0018	0.0016	0.0008	0.0002	2.38	0	5	23	21	0.0013	0.0060	0.0025	0.0024	0.0012	0.0003	2.06	0	8	38
Total Iron	0.3	mg/L	22	0.008	0.567	0.143	0.045	0.167	0.036	0.85	0	5	23	21	0.004	0.549	0.116	0.042	0.143	0.031	0.81	0	2	10
Total Lead	0.003 <sup>e</sup>	mg/L	22	0.000007	0.001500	0.000145	0.000024	0.000318	0.000068	0.45	0	0	0	21	0.000007	0.000443	0.000124	0.000066	0.000131	0.000029	0.94	0	0	0
Total Lithium	-	mg/L	22	0.00025	0.00250	0.00094	0.00090	0.00044	0.00009	2.14	1	0	0	21	0.00025	0.00250	0.00082	0.00070	0.00051	0.00011	1.60	6	0	0
Total Magnesium	-	mg/L	22	2.61	29.50	14.12	13.80	7.32	1.56	1.93	0	0	0	21	3.76	19.60	12.65	12.80	4.66	1.02	2.72	0	0	0
Total Manganese	-	mg/L	22	0.0004	0.0431	0.0108	0.0054	0.0127	0.0027	0.85	0	0	0	21	0.0008	0.0369	0.0102	0.0050	0.0103	0.0022	1.00	0	0	0
Total Mercury	0.000026	mg/L	19	0.0000050	0.0000100	0.0000055	0.0000050	0.0000016	0.000004	3.51	17	0	0	17	0.0000050	0.0000250	0.0000065	0.0000050	0.0000049	0.0000012	1.31	16	1	6
Total Molybdenum	0.073	mg/L	22	0.00009	0.00127	0.00051	0.00054	0.00026	0.00005	1.97	0	0	0	21	0.00026	0.00152	0.00077	0.00071	0.00034	0.00007	2.27	1	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	22	0.00045	0.00107	0.00066	0.00056	0.00021	0.00004	3.20	0	0	0	21	0.00046	0.00270	0.00087	0.00067	0.00052	0.00011	1.69	0	0	0
Total Phosphorus	-	mg/L	19	0.0010	0.0360	0.0111	0.0080	0.0098	0.0022	1.13	1	0	0	18	0.0010	0.0390	0.0098	0.0050	0.0097	0.0023	1.02	3	0	0
Total Potassium	-	mg/L	22	0.80	2.82	1.80	1.73	0.63	0.14	2.83	0	0	0	21	0.94	2.56	1.88	1.90	0.48	0.11	3.89	0	0	0
Total Selenium	0.001	mg/L	22	0.00002	0.00045	0.00010	0.00008	0.00008	0.00002	1.18	1	0	0	21	0.00002	0.00030	0.00010	0.00010	0.00006	0.00001	1.77	1	0	0
Total Silicon	-	mg/L	22	1.60	5.40	4.04	4.20	0.97	0.21	4.16	0	0	0	21	2.40	5.70	4.49	4.60	0.77	0.17	5.83	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH3) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>0.86\*(log(hardness))-3.2</sup>/1000
- d) Copper (Cu) mg/L: (e<sup>0.8545\*ln(hardness)</sup>-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>1.273\*ln(hardness)</sup>-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>0.76\*(ln(hardness))+1.06</sup>)/1000; minimum is 0.025mg/L regardless of water hardness

Highlighted cells indicate updates from Project Proposal

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guid
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W14											W2										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	22	0.000003	0.000011	0.000003	0.000003	0.000002	0.000000	1.58	20	0	0	21	0.000003	0.000015	0.000004	0.000003	0.000004	0.000001	1.08	20	0	0
Total Sodium	-	mg/L	22	0.87	9.44	4.39	4.49	2.17	0.46	2.02	0	0	0	21	1.30	6.67	4.24	4.45	1.48	0.32	2.86	0	0	0
Total Strontium	-	mg/L	22	0.055	0.531	0.277	0.281	0.134	0.029	2.06	0	0	0	21	0.067	0.340	0.235	0.244	0.086	0.019	2.73	0	0	0
Total Sulphur	-	mg/L	4	12.00	57.00	33.75	33.00	18.68	9.34	1.81	0	0	0	4	16.00	38.00	29.50	32.00	9.98	4.99	2.95	0	0	0
Total Thallium	0.0008	mg/L	22	0.000010	0.000070	0.000032	0.000030	0.000019	0.000004	1.64	5	0	0	21	0.000010	0.000250	0.000040	0.000030	0.000052	0.000011	0.76	9	0	0
Total Tin	-	mg/L	22	0.000005	0.000060	0.000010	0.000005	0.000016	0.000003	0.62	20	0	0	21	0.000005	0.002500	0.000130	0.000005	0.000543	0.000119	0.24	19	0	0
Total Titanium	-	mg/L	22	0.00025	0.01610	0.00366	0.00140	0.00443	0.00095	0.83	3	0	0	21	0.00025	0.01510	0.00318	0.00120	0.00421	0.00092	0.76	7	0	0
Total Uranium	0.015	mg/L	22	0.00125	0.09710	0.01278	0.00842	0.01992	0.00425	0.64	0	0	0	21	0.00290	0.04160	0.01495	0.01060	0.01180	0.00257	1.27	0	0	0
Total Vanadium	-	mg/L	22	0.00010	0.00140	0.00051	0.00045	0.00040	0.00009	1.28	5	0	0	21	0.00010	0.00250	0.00049	0.00030	0.00056	0.00012	0.88	9	0	0
Total Zinc	0.03	mg/L	22	0.00020	0.00410	0.00132	0.00095	0.00111	0.00024	1.19	0	0	0	21	0.00050	0.00600	0.00159	0.00130	0.00140	0.00031	1.13	0	0	0
Total Zirconium	-	mg/L	22	0.00010	0.00070	0.00036	0.00040	0.00014	0.00003	2.50	0	0	0	21	0.00005	0.00050	0.00022	0.00020	0.00013	0.00003	1.74	5	0	0
Dissolved Aluminum	0.1	mg/L	22	0.0085	0.3680	0.1020	0.0449	0.1170	0.0250	0.87	0	7	32	21	0.0056	0.2720	0.0613	0.0334	0.0792	0.0173	0.77	0	4	19
Dissolved Antimony	-	mg/L	22	0.00010	0.00032	0.00022	0.00023	0.00007	0.00014	3.33	0	0	0	21	0.00016	0.00042	0.00029	0.00028	0.00007	0.00016	3.91	0	0	0
Dissolved Arsenic	-	mg/L	22	0.00037	0.00078	0.00054	0.00053	0.00008	0.00018	6.42	0	0	0	21	0.00036	0.00076	0.00057	0.00061	0.00011	0.00024	5.20	0	0	0
Dissolved Barium	-	mg/L	22	0.043	0.118	0.075	0.071	0.021	0.004	3.60	0	0	0	21	0.036	0.081	0.062	0.060	0.014	0.003	4.43	0	0	0
Dissolved Beryllium	-	mg/L	22	0.000005	0.000030	0.000011	0.000010	0.000008	0.000002	1.37	10	0	0	21	0.000005	0.000020	0.000008	0.000005	0.000005	0.000001	1.64	14	0	0
Dissolved Bismuth	-	mg/L	22	0.000025	0.000060	0.000027	0.000025	0.000007	0.000002	3.56	21	0	0	21	0.000025	0.000025	0.000025	0.000025	0	-	-	21	0	0
Dissolved Boron	-	mg/L	22	0.025	0.025	0.025	0.025	0	-	-	22	0	0	21	0.025	0.025	0.025	0.025	0	-	-	21	0	0
Dissolved Cadmium	-	mg/L	22	0.000028	0.000028	0.000012	0.000010	0.000007	0.000002	1.55	4	0	0	21	0.000028	0.000049	0.000019	0.000015	0.000010	0.000002	1.83	0	0	0
Dissolved Calcium	-	mg/L	22	6.83	68.90	33.86	33.30	16.66	3.55	2.03	0	0	0	21	10.30	52.00	34.35	33.70	12.86	2.81	2.67	0	0	0
Dissolved Chromium	-	mg/L	22	0.00005	0.00050	0.00025	0.00020	0.00012	0.00003	2.03	1	0	0	21	0.00005	0.00030	0.00017	0.00020	0.00009	0.00002	1.97	3	0	0
Dissolved Cobalt	-	mg/L	22	0.00022	0.000225	0.000079	0.000053	0.000058	0.00012	1.35	0	0	0	21	0.00017	0.000241	0.000064	0.000051	0.000052	0.000011	1.23	0	0	0
Dissolved Copper	-	mg/L	22	0.0008	0.0032	0.0017	0.0016	0.0006	0.0001	2.91	0	0	0	21	0.0012	0.0053	0.0024	0.0022	0.0011	0.0002	2.09	0	0	0
Dissolved Iron	-	mg/L	22	0.004	0.284	0.083	0.035	0.092	0.020	0.89	0	0	0	21	0.003	0.236	0.054	0.025	0.067	0.015	0.81	0	0	0
Dissolved Lead	-	mg/L	22	0.000003	0.000786	0.000072	0.000019	0.000166	0.000035	0.43	2	0	0	21	0.000003	0.000577	0.000078	0.000024	0.000146	0.000032	0.53	2	0	0
Dissolved Lithium	-	mg/L	22	0.00025	0.00240	0.00086	0.00080	0.00046	0.00010	1.89	3	0	0	21	0.00025	0.00120	0.00068	0.00070	0.00026	0.00006	2.68	3	0	0
Dissolved Magnesium	-	mg/L	22	2.43	29.20	13.97	13.55	6.95	1.48	2.01	0	0	0	21	3.74	18.60	12.35	12.60	4.49	0.98	2.75	0	0	0
Dissolved Manganese	-	mg/L	22	0.0001	0.0320	0.0075	0.0032	0.0093	0.0020	0.81	0	0	0	21	0.0008	0.0186	0.0060	0.0030	0.0063	0.0014	0.96	0	0	0
Dissolved Mercury	-	mg/L	18	0.0000050	0.0000100	0.0000056	0.0000050	0.0000016	0.000004	3.44	16	0	0	17	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	17	0	0
Dissolved Molybdenum	-	mg/L	22	0.00015	0.00138	0.00053	0.00053	0.00026	0.00006	1.99	0	0	0	21	0.00028	0.00145	0.00081	0.00079	0.00031	0.00007	2.58	0	0	0
Dissolved Nickel	-	mg/L	22	0.00040	0.00223	0.00068	0.00055	0.00039	0.00008	1.73	0	0	0	21	0.00047	0.00129	0.00070	0.00063	0.00022	0.00005	3.12	0	0	0
Dissolved Phosphorus	-	mg/L	18	0.0010	0.0150	0.0058	0.0035	0.0042	0.0010	1.39	1	0	0	17	0.0010	0.0130	0.0041	0.0030	0.0036	0.0009	1.15	4	0	0
Dissolved Potassium	-	mg/L	22	0.72	2.97	1.80	1.74	0.64	0.14	2.83	0	0	0	21	0.85	2.56	1.85	1.91	0.49	0.11	3.76	0	0	0
Dissolved Selenium	-	mg/L	22	0.00002	0.00043	0.00010	0.00009	0.00008	0.00002	1.33	1	0	0	21	0.00002	0.00020	0.00010	0.00009	0.00004	0.00001	2.64	1	0	0
Dissolved Silicon	-	mg/L	22	1.30	5.30	4.00	4.25	1.01	0.22	3.96	0	0	0	21	2.10	5.78	4.44	4.60	0.86	0.19	5.14	0	0	0
Dissolved Silver	-	mg/L	22	0.000003	0.000008	0.000003	0.000003	0.000001	0.000000	2.35	21	0	0	21	0.000003	0.000008	0.000003	0.000003	0.000001	0.000000	2.11	19	0	0
Dissolved Sodium	-	mg/L	22	0.96	9.41	4.37	4.41	2.09	0.44	2.10	0	0	0	21	1.40	6.08	4.13	4.65	1.34	0.29	3.09	0	0	0
Dissolved Strontium	-	mg/L	22	0.053	0.522	0.272	0.265	0.131	0.028	2.07	0	0	0	21	0.069	0.341	0.233	0.236	0.085	0.018	2.76	0	0	0
Dissolved Sulphur	-	mg/L	4	13.00	55.00	34.25	34.50	17.19	8.60	1.99	0	0	0	4	15.00	37.00	30.00	34.00	10.13	5.07	2.96	0	0	0
Dissolved Thallium	-	mg/L	22	0.000010	0.000060	0.000026	0.000030	0.000015	0.000003	1.73	8	0	0	21	0.000010	0.000040	0.000020	0.000020	0.000011	0.000002	1.83	10	0	0
Dissolved Tin	-	mg/L	22	0.000005	0.000100	0.000011	0.000005	0.000020	0.000004	0.52	19	0	0	21	0.000005	0.000060	0.000008	0.000005	0.000012	0.000003	0.65	19	0	0
Dissolved Titanium	-	mg/L	22	0.00025	0.00410	0.00117	0.00060	0.00131	0.00028	0.89	10	0	0	21	0.00025	0.00260	0.00074	0.00025	0.00079	0.00017	0.94	13	0	0
Dissolved Uranium	-	mg/L	22	0.00109	0.09540	0.01257	0.00806	0.01948	0.00415	0.65	0	0	0	21	0.00275	0.04200	0.01492	0.01040	0.01175	0.00256	1.27	0	0	0
Dissolved Vanadium	-	mg/L	22	0.00010	0.00080	0.00040	0.00040	0.00022	0.00005	1.77	4	0	0	21	0.00010	0.00060	0.00023	0.00020	0.00015	0.00003	1.53	9	0	0
Dissolved Zinc	-	mg/L	22	0.00020	0.00830	0.00178	0.00070	0.00218	0.00047	0.82	0	0	0	21	0.00040	0.00810	0.00156	0.00080	0.00192	0.00042	0.81	0	0	0
Dissolved Zirconium	-	mg/L	22	0.00010	0.00070	0.00034	0.00030	0.00014	0.00003	2.43	0	0	0	21	0.00005	0.00040	0.00021	0.00020	0.00011	0.00002	1.87	3	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
  - a) Ammonia (NH3) guideline based on pH=8 and temp=20
  - b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
  - c) Cadmium (Cd) mg/L: 10<sup>-5</sup>(0.86\*(log(hardness))-3.2)/1000
  - d) Copper (Cu) mg/L: (e<sup>-0.8545ln(hardness)</sup>-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
  - e) Lead (Pb) mg/L: (e<sup>-1.273ln(hardness)</sup>-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
  - f) Nickel (Ni) mg/L: (e<sup>-0.76ln(hardness)</sup>+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

"n" Count  
 "min" Minimum Value  
 "max" Maximum Value  
 "sd" Standard Deviation  
 "se" Standard Error  
 "cov" Covariance  
 "<DL" # of Non-detectable Values  
 ">GL" # of Exceedances of CCME Guic  
 "%>GL" % of Parameters that Exceed CCME Guidelin  
 "-" No Data Available



Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W1											W17										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	21	7.20	8.20	7.84	7.90	0.25	0.05	31.14	0	0	0	9	7.40	8.06	7.81	7.90	0.21	0.07	36.57	0	0	0
Conductivity	-	µS/cm	21	92	492	314	312	113	25	2.77	0	0	0	9	96	350	220	193	92	31	2.38	0	0	0
Total Hardness CaCO3	-	mg/L	21	50	248	152	149	57	12	2.66	0	0	0	9	47	159	103	97	40	13	2.59	0	0	0
Dissolved Hardness CaCO3	-	mg/L	4	113	242	188	199	55	28	3.41	0	0	0	5	46	167	115	129	47	21	2.44	0	0	0
Ion Balance	-	no unit	3	0.96	1.00	0.99	1.00	0.02	0.01	42.72	0	0	0	3	0.88	1.00	0.96	0.99	0.07	0.04	14.37	0	0	0
Total Dissolved Solids	-	mg/L	21	92	350	213	220	70	15	3.06	0	0	0	9	94	210	145	150	44	15	3.27	0	0	0
Total Suspended Solids	-	mg/L	21	0.5	190.0	11.1	2.0	41.1	9.0	0.27	8	0	0	9	0.5	37.7	7.2	4.0	11.8	3.9	0.61	3	0	0
Turbidity	-	NTU	21	0.1	3.6	0.6	0.3	0.8	0.2	0.72	0	0	0	9	0.2	5.2	1.0	0.5	1.6	0.5	0.61	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	20	0.003	0.070	0.016	0.008	0.018	0.004	0.88	8	0	0	9	0.003	0.059	0.018	0.010	0.019	0.006	0.98	3	0	0
Alkalinity, Total (as CaCO3)	-	mg/L	21	21.0	120.0	83.38	84.0	27.03	5.90	3.08	0	0	0	9	30.0	110.0	73.22	68.0	28.91	9.64	2.53	0	0	0
Acidity (pH 4.5) as CaCO3	-	mg/L	4	0.25	0.25	0.25	0.25	0	-	-	4	0	0	5	0.25	0.25	0.25	0.25	0	-	-	5	0	0
Acidity (pH8.3) as CaCO3	-	mg/L	12	0.25	5.30	2.02	1.40	1.81	0.52	1.12	3	0	0	6	0.25	5.50	1.73	1.19	1.96	0.80	0.88	2	0	0
Bromide (Br)	-	mg/L	17	0.20	0.20	0.20	0.20	0	-	-	17	0	0	6	0.01	0.20	0.14	0.20	0.10	0.04	1.34	6	0	0
Chloride (Cl)	120	mg/L	21	0.25	7.40	1.30	0.80	1.81	0.39	0.72	7	0	0	9	0.25	1.30	0.94	1.10	0.37	0.12	2.57	1	0	0
Fluoride (F)	0.12	mg/L	17	0.070	0.120	0.101	0.100	0.014	0.003	7.42	0	0	0	6	0.047	0.080	0.067	0.069	0.013	0.005	5.34	0	0	0
Sulphate (SO4)	-	mg/L	21	17.00	140.00	72.29	68.00	33.79	7.37	2.14	0	0	0	9	1.60	66.00	33.56	30.00	21.70	7.23	1.55	0	0	0
Total Nitrogen (N)	-	mg/L	4	0.38	0.61	0.51	0.52	0.10	0.05	4.98	0	0	0	5	0.36	0.74	0.54	0.54	0.17	0.08	3.17	0	0	0
Nitrate (as N)	13	mg/L	21	0.050	0.470	0.229	0.202	0.128	0.028	1.79	0	0	0	8	0.052	0.282	0.153	0.152	0.075	0.026	2.05	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	4	0.201	0.470	0.340	0.344	0.110	0.055	3.08	0	0	0	4	0.099	0.282	0.183	0.176	0.077	0.039	2.38	0	0	0
Nitrite (as N)	0.06	mg/L	21	0.001	0.010	0.002	0.001	0.003	0.001	0.89	15	0	0	9	0.001	0.010	0.002	0.001	0.003	0.001	0.81	6	0	0
Total Kjeldahl Nitrogen	-	mg/L	20	0.05	0.50	0.24	0.23500	0.1124	0.0251	2.09	0	0	0	9	0.13	0.60	0.27	0.23000	0.1547	0.0516	1.73	0	0	0
Ortho Phosphate as P	-	mg/L	21	0.0005	0.0140	0.0020	0.0010	0.0028	0.0006	0.69	5	0	0	9	0.0005	0.0030	0.0012	0.0010	0.0009	0.0003	1.35	4	0	0
Cyanide, Total	0.005	mg/L	21	0.00025	0.00160	0.00060	0.00060	0.00041	0.00009	1.47	10	0	0	9	0.00025	0.00130	0.00074	0.00070	0.00043	0.00014	1.72	3	0	0
Cyanide, Weak Acid Diss	-	mg/L	21	0.00025	0.00140	0.00058	0.00050	0.00038	0.00008	1.53	10	0	0	9	0.00025	0.00140	0.00067	0.00060	0.00035	0.00012	1.89	2	0	0
Dissolved Organic Carbon	-	mg/L	10	0.25	11.30	7.41	7.45	3.09	0.98	2.40	1	0	0	5	4.22	16.80	9.66	9.20	4.79	2.14	2.02	0	0	0
Total Organic Carbon	-	mg/L	17	5.20	20.00	9.09	7.70	4.00	0.97	2.27	0	0	0	6	4.42	19.70	9.85	8.35	5.36	2.19	1.84	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	21	0.0089	0.7230	0.0875	0.0222	0.1600	0.0349	0.55	0	3	14	9	0.0166	0.4580	0.1187	0.0600	0.1447	0.0482	0.82	0	4	44
Total Antimony	-	mg/L	21	0.000180	0.000360	0.000272	0.000280	0.000054	0.000012	5.03	0	0	0	9	0.000130	0.000270	0.000216	0.000230	0.000053	0.000018	4.09	0	0	0
Total Arsenic	0.005	mg/L	21	0.000370	0.001620	0.000589	0.000500	0.000263	0.000057	2.24	0	0	0	9	0.000440	0.001100	0.000668	0.000620	0.000215	0.000072	3.10	0	0	0
Total Barium	-	mg/L	21	0.04	0.11	0.07	0.06060	0.0178	0.0039	3.71	0	0	0	9	0.05	0.12	0.08	0.06950	0.0217	0.0072	3.48	0	0	0
Total Beryllium	-	mg/L	21	0.000005	0.000060	0.000010	0.000005	0.000012	0.000003	0.78	14	0	0	9	0.000005	0.000034	0.000012	0.000005	0.000010	0.000003	1.17	5	0	0
Total Bismuth	-	mg/L	21	0.0000025	0.0000090	0.0000028	0.0000025	0.0000014	0.0000003	1.98	20	0	0	9	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	9	0	0
Total Boron	1.5	mg/L	21	0.03	0.03	0.03	0.03	0	-	-	21	0	0	9	0.03	0.03	0.03	0.03	0	-	-	9	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	21	0.000009	0.000080	0.000019	0.000015	0.000015	0.000003	1.29	0	1	5	9	0.000013	0.000087	0.000027	0.000021	0.000023	0.000008	1.19	0	2	22
Total Calcium	-	mg/L	21	12.40	62.50	38.08	37.30	14.44	3.15	2.64	0	0	0	9	11.80	37.70	25.18	24.50	9.21	3.07	2.73	0	0	0
Total Chromium	0.001	mg/L	21	0.00005	0.00110	0.00022	0.00020	0.00022	0.00005	1.00	3	1	5	9	0.00005	0.00051	0.00022	0.00030	0.00016	0.00005	1.43	2	0	0
Total Cobalt	-	mg/L	21	0.000026	0.000848	0.000105	0.000051	0.000176	0.000038	0.60	0	0	0	9	0.000023	0.000342	0.000100	0.000062	0.000099	0.000033	1.01	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	21	0.0013	0.0066	0.0023	0.0019	0.0012	0.0003	1.96	0	6	29	9	0.0009	0.0027	0.0016	0.0018	0.0006	0.0002	2.87	0	1	11
Total Iron	0.3	mg/L	21	0.006	1.000	0.102	0.031	0.216	0.047	0.47	0	1	5	9	0.014	0.589	0.144	0.058	0.183	0.061	0.79	0	1	11
Total Lead	0.003 <sup>e</sup>	mg/L	21	0.00005	0.000866	0.000085	0.000033	0.000184	0.000040	0.46	0	0	0	9	0.000017	0.000401	0.000130	0.000094	0.000121	0.000040	1.07	0	0	0
Total Lithium	-	mg/L	21	0.00025	0.00090	0.00069	0.00070	0.00015	0.00003	4.44	1	0	0	9	0.00050	0.0110	0.00078	0.00080	0.00017	0.00006	4.57	0	0	0
Total Magnesium	-	mg/L	21	4.54	22.30	13.83	13.30	5.16	1.13	2.68	0	0	0	9	4.18	15.70	9.78	8.77	4.12	1.37	2.37	0	0	0
Total Manganese	-	mg/L	21	0.0001	0.0689	0.0071	0.0021	0.0152	0.0033	0.47	0	0	0	9	0.0016	0.0410	0.0106	0.0069	0.0121	0.0040	0.88	0	0	0
Total Mercury	0.000026	mg/L	18	0.000050	0.0000100	0.000056	0.000050	0.000016	0.000004	3.44	16	0	0	7	0.000050	0.000050	0.000050	0.000050	0	-	-	7	0	0
Total Molybdenum	0.073	mg/L	21	0.00030	0.00110	0.00077	0.00078	0.00023	0.00005	3.40	0	0	0	9	0.00020	0.00049	0.00036	0.00039	0.00010	0.00003	3.71	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	21	0.00044	0.00227	0.00074	0.00063	0.00039	0.00008	1.91	0	0	0	9	0.00039	0.00154	0.00074	0.00067	0.00036	0.00012	2.04	0	0	0
Total Phosphorus	-	mg/L	18	0.0010	0.0840	0.0093	0.0040	0.0191	0.0045	0.49	2	0	0	7	0.0030	0.0326	0.0102	0.0050	0.0106	0.0040	0.96	0	0	0
Total Potassium	-	mg/L	21	1.12	2.90	1.96	1.97	0.47	0.10	4.16	0	0	0	9	0.95	1.73	1.23	1.16	0.26	0.09	4.76	0	0	0
Total Selenium	0.001	mg/L	21	0.00002	0.00017	0.00011	0.00011	0.00003	0.00001	3.20	1	0	0	9	0.00002	0.00011	0.00007	0.00007	0.00003	0.00001	2.41	1	0	0
Total Silicon	-	mg/L	21	2.60	5.60	4.49	4.50	0.67	0.15	6.71	0	0	0	9	2.30	4.60	3.83	4.00	0.85	0.28	4.49	0	0	0

Note:

1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007  
a) Ammonia (NH3) guideline based on pH=8 and temp=20  
b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5  
c) Cadmium (Cd) mg/L: 10<sup>0.86\*(log(hardness))-3.2</sup>/1000  
d) Copper (Cu) mg/L: (e<sup>0.8545\*ln(hardness)</sup>)-1.465\*0.2/1000; minimum is 0.002mg/L regardless of water hardness  
e) Lead (Pb) mg/L: (e<sup>1.273\*ln(hardness)</sup>)-4.705/1000; minimum is 0.001mg/L regardless of water hardness  
f) Nickel (Ni) mg/L: (e<sup>0.76\*(ln(hardness))+1.06</sup>)/1000; minimum is 0.025mg/L regardless of water hardness

Highlighted cells indicate updates from Project Proposal

"n" Count  
"min" Minimum Value  
"max" Maximum Value  
"sd" Standard Deviation  
"se" Standard Error  
"cov" Covariance  
"<DL" # of Non-detectable Values  
">GL" # of Exceedances of CCME Guid  
"%>GL" % of Parameters that Exceed CCME Guidelin  
"." No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W1										W17											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	21	0.000003	0.000010	0.000003	0.000003	0.000002	0.000000	1.75	20	0	0	9	0.000003	0.000012	0.000005	0.000003	0.000003	0.000001	1.31	6	0	0
Total Sodium	-	mg/L	21	1.39	6.09	4.17	4.39	1.30	0.28	3.20	0	0	0	9	1.54	5.05	3.48	3.87	1.24	0.41	2.80	0	0	0
Total Strontium	-	mg/L	21	0.081	0.381	0.239	0.236	0.085	0.019	2.82	0	0	0	9	0.083	0.265	0.171	0.163	0.063	0.021	2.72	0	0	0
Total Sulphur	-	mg/L	4	19.00	50.00	35.75	37.00	13.15	6.57	2.72	0	0	0	5	5.00	23.00	15.00	16.00	7.52	3.36	2.00	1	0	0
Total Thallium	0.0008	mg/L	21	0.000010	0.0000110	0.0000027	0.0000030	0.0000023	0.0000005	1.20	8	0	0	9	0.000010	0.000052	0.000028	0.000030	0.000014	0.000005	1.95	2	0	0
Total Tin	-	mg/L	21	0.000005	0.000090	0.000009	0.000005	0.000019	0.000004	0.50	19	0	0	9	0.000005	0.000100	0.000034	0.000005	0.000043	0.000014	0.79	7	0	0
Total Titanium	-	mg/L	21	0.00025	0.02540	0.00247	0.00080	0.00550	0.00120	0.45	7	0	0	9	0.00025	0.01630	0.00386	0.00110	0.00529	0.00176	0.73	3	0	0
Total Uranium	0.015	mg/L	21	0.00350	0.03280	0.01385	0.01090	0.00943	0.00206	1.47	0	0	0	9	0.00126	0.00554	0.00248	0.00198	0.00141	0.00047	1.76	0	0	0
Total Vanadium	-	mg/L	21	0.00010	0.00200	0.00032	0.00020	0.00041	0.00009	0.77	9	0	0	9	0.00020	0.00169	0.00053	0.00030	0.00047	0.00016	1.12	0	0	0
Total Zinc	0.03	mg/L	21	0.00030	0.00620	0.00109	0.00080	0.00124	0.00027	0.87	0	0	0	9	0.00040	0.00523	0.00174	0.00140	0.00147	0.00049	1.18	0	0	0
Total Zirconium	-	mg/L	21	0.00010	0.00050	0.00022	0.00020	0.00011	0.00002	2.03	0	0	0	9	0.00010	0.00039	0.00022	0.00020	0.00011	0.00004	2.06	0	0	0
Dissolved Aluminum	0.1	mg/L	21	0.0078	0.2890	0.0574	0.0202	0.0739	0.0161	0.78	0	4	19	9	0.0113	0.1850	0.0638	0.0488	0.0651	0.0217	0.98	0	2	22
Dissolved Antimony	-	mg/L	21	0.00018	0.00039	0.00027	0.00027	0.00006	0.00013	4.50	0	0	0	9	0.00012	0.00027	0.00021	0.00024	0.00006	0.00019	3.77	0	0	0
Dissolved Arsenic	-	mg/L	21	0.00032	0.00076	0.00053	0.00052	0.00012	0.00026	4.49	0	0	0	9	0.00045	0.00069	0.00057	0.00056	0.00008	0.00025	7.45	0	0	0
Dissolved Barium	-	mg/L	21	0.037	0.106	0.064	0.059	0.019	0.004	3.35	0	0	0	9	0.043	0.121	0.073	0.063	0.025	0.008	2.88	0	0	0
Dissolved Beryllium	-	mg/L	21	0.000005	0.000020	0.000007	0.000005	0.000005	0.000001	1.59	15	0	0	9	0.000005	0.000020	0.000008	0.000005	0.000006	0.000002	1.38	7	0	0
Dissolved Bismuth	-	mg/L	21	0.0000025	0.0000050	0.0000026	0.0000025	0.0000005	0.0000001	4.80	20	0	0	9	0.0000025	0.0000084	0.0000032	0.0000025	0.0000020	0.0000007	1.60	8	0	0
Dissolved Boron	-	mg/L	21	0.025	0.025	0.025	0.025	0	-	-	21	0	0	9	0.025	0.025	0.025	0.025	0	-	-	9	0	0
Dissolved Cadmium	-	mg/L	21	0.000003	0.000049	0.000016	0.000014	0.000013	0.000003	1.29	4	0	0	9	0.000003	0.000029	0.000016	0.000018	0.000008	0.000003	1.91	1	0	0
Dissolved Calcium	-	mg/L	21	12.30	63.50	37.64	35.00	14.35	3.13	2.62	0	0	0	9	11.70	38.90	25.18	22.90	9.31	3.10	2.70	0	0	0
Dissolved Chromium	-	mg/L	21	0.00005	0.00040	0.00018	0.00020	0.00010	0.00002	1.73	5	0	0	9	0.00005	0.00030	0.00016	0.00020	0.00010	0.00003	1.58	3	0	0
Dissolved Cobalt	-	mg/L	21	0.000023	0.000204	0.000062	0.000045	0.000048	0.000011	1.29	0	0	0	9	0.000026	0.000086	0.000048	0.000041	0.000023	0.000008	2.13	0	0	0
Dissolved Copper	-	mg/L	21	0.0012	0.0051	0.0023	0.0019	0.0010	0.0002	2.35	0	0	0	9	0.0009	0.0025	0.0015	0.0015	0.0005	0.0002	2.86	0	0	0
Dissolved Iron	-	mg/L	21	0.004	0.236	0.052	0.021	0.066	0.014	0.79	0	0	0	9	0.011	0.157	0.059	0.050	0.054	0.018	1.09	0	0	0
Dissolved Lead	-	mg/L	21	0.000003	0.000564	0.000072	0.000014	0.000136	0.000030	0.53	7	0	0	9	0.000005	0.002260	0.000284	0.000031	0.000742	0.000247	0.38	0	0	0
Dissolved Lithium	-	mg/L	21	0.00025	0.00090	0.00066	0.00070	0.00019	0.00004	3.50	2	0	0	9	0.00025	0.00110	0.00070	0.00070	0.00025	0.00008	2.79	1	0	0
Dissolved Magnesium	-	mg/L	21	4.44	22.50	13.79	13.20	5.05	1.10	2.73	0	0	0	9	4.12	16.90	9.82	8.31	4.28	1.43	2.29	0	0	0
Dissolved Manganese	-	mg/L	21	0.0001	0.0184	0.0037	0.0013	0.0053	0.0012	0.71	0	0	0	9	0.0003	0.0073	0.0037	0.0033	0.0023	0.0008	1.59	0	0	0
Dissolved Mercury	-	mg/L	17	0.0000050	0.0000100	0.0000053	0.0000050	0.0000012	0.0000003	4.37	16	0	0	6	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	6	0	0
Dissolved Molybdenum	-	mg/L	21	0.00033	0.00106	0.00077	0.00082	0.00021	0.00005	3.62	0	0	0	9	0.00021	0.00055	0.00038	0.00040	0.00010	0.00003	3.65	0	0	0
Dissolved Nickel	-	mg/L	21	0.00047	0.00135	0.00073	0.00063	0.00026	0.00006	2.84	0	0	0	9	0.00030	0.00084	0.00056	0.00053	0.00017	0.00006	3.35	0	0	0
Dissolved Phosphorus	-	mg/L	17	0.0010	0.0130	0.0042	0.0030	0.0036	0.0009	1.16	6	0	0	6	0.0020	0.0110	0.0058	0.0040	0.0040	0.0016	1.45	0	0	0
Dissolved Potassium	-	mg/L	21	1.24	2.89	1.97	1.93	0.45	0.10	4.33	0	0	0	9	0.91	1.84	1.24	1.07	0.30	0.10	4.19	0	0	0
Dissolved Selenium	-	mg/L	21	0.00006	0.00016	0.00011	0.00011	0.00003	0.00001	3.61	0	0	0	9	0.00002	0.00011	0.00007	0.00008	0.00003	0.00001	2.49	1	0	0
Dissolved Silicon	-	mg/L	21	2.20	5.73	4.54	4.60	0.82	0.18	5.56	0	0	0	9	2.16	4.50	3.72	4.10	0.91	0.30	4.11	0	0	0
Dissolved Silver	-	mg/L	21	0.000003	0.000003	0.000003	0.000003	0	-	-	21	0	0	9	0.000003	0.000006	0.000003	0.000003	0.000001	0.000000	2.48	8	0	0
Dissolved Sodium	-	mg/L	21	1.50	5.95	4.10	4.20	1.18	0.26	3.47	0	0	0	9	1.55	5.31	3.50	3.71	1.22	0.41	2.87	0	0	0
Dissolved Strontium	-	mg/L	21	0.079	0.377	0.237	0.227	0.086	0.019	2.76	0	0	0	9	0.081	0.264	0.170	0.157	0.064	0.021	2.68	0	0	0
Dissolved Sulphur	-	mg/L	4	18.00	47.00	34.75	37.00	12.23	6.12	2.84	0	0	0	5	5.00	23.00	14.40	17.00	8.88	3.97	1.62	2	0	0
Dissolved Thallium	-	mg/L	21	0.000010	0.0000050	0.0000024	0.0000020	0.0000014	0.0000003	1.74	8	0	0	9	0.000010	0.000040	0.000018	0.000010	0.000011	0.000004	1.63	5	0	0
Dissolved Tin	-	mg/L	21	0.000005	0.000080	0.000011	0.000005	0.000017	0.000004	0.63	17	0	0	9	0.000005	0.000100	0.000034	0.000005	0.000045	0.000015	0.77	8	0	0
Dissolved Titanium	-	mg/L	21	0.00025	0.00410	0.00085	0.00025	0.00110	0.00024	0.77	14	0	0	9	0.00025	0.00191	0.00076	0.00025	0.00067	0.00022	1.13	5	0	0
Dissolved Uranium	-	mg/L	21	0.00304	0.03340	0.01386	0.01100	0.00950	0.00207	1.46	0	0	0	9	0.00110	0.00561	0.00246	0.00201	0.00147	0.00049	1.68	0	0	0
Dissolved Vanadium	-	mg/L	21	0.00010	0.00060	0.00023	0.00020	0.00016	0.00004	1.39	10	0	0	9	0.00010	0.00080	0.00035	0.00030	0.00020	0.00007	1.71	1	0	0
Dissolved Zinc	-	mg/L	21	0.00020	0.00690	0.00160	0.00080	0.00187	0.00041	0.86	0	0	0	9	0.00040	0.00860	0.00236	0.00140	0.00277	0.00092	0.85	0	0	0
Dissolved Zirconium	-	mg/L	21	0.00010	0.00040	0.00021	0.00020	0.00009	0.00002	2.36	0	0	0	9	0.00010	0.00030	0.00019	0.00020	0.00008	0.00003	2.42	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>-6</sup>(0.86<sup>ln(hardness)</sup>-3.2)/1000
- d) Copper (Cu) mg/L: (e<sup>-0.8545[ln(hardness)]-1.465</sup>)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>-1.273[ln(hardness)]-4.705</sup>)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>-0.76[ln(hardness)]+1.06</sup>)/1000; minimum is 0.025mg/L regardless of water hardness

"n"	Count
"min"	Minimum Value
"max"	Maximum Value
"sd"	Standard Deviation
"se"	Standard Error
"cov"	Covariance
"<DL"	# of Non-detectable Values
">GL"	# of Exceedances of CCME Guic
"%>GL"	% of Parameters that Exceed CCME Guidelin
."	No Data Available

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W6B										W6A											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	25	7.70	8.20	7.97	8.00	0.14	0.03	56.05	0	0	0	23	7.60	8.20	7.95	8.00	0.15	0.03	53.24	0	0	0
Conductivity	-	µS/cm	25	170	243	205	204	17	3	12.16	0	0	0	23	150	257	187	180	29	6	6.39	0	0	0
Total Hardness CaCO3	-	mg/L	24	82	117	102	104	7	2	13.58	0	0	0	22	74	115	90	88	13	3	7.17	0	0	0
Dissolved Hardness CaCO3	-	mg/L	5	99	105	102	103	2	1	44.82	0	0	0	3	77	105	89	86	14	8	6.27	0	0	0
Ion Balance	-	no unit	3	0.88	1.00	0.94	0.93	0.06	0.03	15.54	0	0	0	2	0.91	1.00	0.96	0.96	0.06	0.05	15.01	0	0	0
Total Dissolved Solids	-	mg/L	25	80	180	129	130	25	5	5.15	0	0	0	23	68	150	114	110	22	5	5.18	0	0	0
Total Suspended Solids	-	mg/L	24	0.5	190.0	25.1	11.0	39.5	8.1	0.63	5	0	0	22	0.5	140.0	22.5	10.0	30.7	6.6	0.73	3	0	0
Turbidity	-	NTU	25	0.2	47.4	9.6	5.1	11.2	2.2	0.85	0	0	0	23	0.1	35.1	7.5	2.7	10.2	2.1	0.74	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	24	0.003	0.060	0.017	0.007	0.018	0.004	0.95	12	0	0	22	0.003	0.051	0.012	0.005	0.012	0.003	1.04	12	0	0
Alkalinity, Total (as CaCO3)	-	mg/L	25	61.0	93.9	79.35	79.9	7.74	1.55	10.25	0	0	0	23	61.0	96.0	74.78	73.0	9.92	2.07	7.54	0	0	0
Acidity (pH 4.5) as CaCO3	-	mg/L	6	0.25	0.25	0.25	0.25	0	-	-	6	0	0	4	0.25	0.25	0.25	0.25	0	-	-	4	0	0
Acidity (pH8.3) as CaCO3	-	mg/L	14	0.25	3.70	1.05	0.80	0.95	0.25	1.11	4	0	0	12	0.25	5.00	1.05	0.85	1.32	0.38	0.80	5	0	0
Bromide (Br)	-	mg/L	21	0.01	0.20	0.17	0.20	0.07	0.01	2.68	21	0	0	18	0.05	0.20	0.19	0.20	0.04	0.01	5.42	18	0	0
Chloride (Cl)	120	mg/L	25	0.25	1.30	0.43	0.25	0.31	0.06	1.37	17	0	0	23	0.25	2.20	0.51	0.25	0.46	0.09	1.12	14	0	0
Fluoride (F)	0.12	mg/L	21	0.080	0.140	0.111	0.110	0.014	0.003	7.82	0	3	14	19	0.090	0.130	0.107	0.110	0.011	0.002	10.11	0	1	5
Sulphate (SO4)	-	mg/L	25	19.00	33.00	25.98	25.00	4.31	0.86	6.03	0	0	0	23	12.00	34.00	21.13	21.00	6.23	1.30	3.39	0	0	0
Total Nitrogen (N)	-	mg/L	6	0.12	0.27	0.18	0.16	0.07	0.03	2.76	0	0	0	4	0.10	0.24	0.16	0.15	0.07	0.03	2.39	0	0	0
Nitrate (as N)	13	mg/L	25	0.001	0.117	0.033	0.019	0.033	0.007	1.00	2	0	0	23	0.001	0.168	0.034	0.015	0.044	0.009	0.77	2	0	0
Nitrate plus Nitrite (N)	-	mg/L	6	0.005	0.117	0.049	0.036	0.045	0.018	1.08	0	0	0	4	0.001	0.168	0.053	0.022	0.078	0.039	0.68	1	0	0
Nitrite (as N)	0.06	mg/L	25	0.001	0.008	0.002	0.001	0.002	0.000	1.11	18	0	0	23	0.001	0.019	0.002	0.001	0.004	0.001	0.57	18	0	0
Total Kjeldahl Nitrogen	-	mg/L	25	0.01	0.25	0.11	0.09000	0.0620	0.0124	1.77	1	0	0	23	0.01	0.24	0.12	0.11000	0.0669	0.0139	1.76	1	0	0
Ortho Phosphate as P	-	mg/L	25	0.0005	0.0450	0.0031	0.0010	0.0088	0.0018	0.36	7	0	0	23	0.0005	0.0460	0.0035	0.0010	0.0093	0.0019	0.37	5	0	0
Cyanide, Total	0.005	mg/L	24	0.00025	0.00070	0.00028	0.00025	0.00011	0.00002	2.49	22	0	0	22	0.00025	0.00110	0.00031	0.00025	0.00021	0.00005	1.49	20	0	0
Cyanide, Weak Acid Diss	-	mg/L	24	0.00025	0.00025	0.00025	0.00025	0	-	-	24	0	0	22	0.00025	0.00110	0.00029	0.00025	0.00018	0.00004	1.59	21	0	0
Dissolved Organic Carbon	-	mg/L	12	0.90	9.26	3.41	2.65	2.36	0.68	1.44	0	0	0	10	0.50	7.20	2.80	2.45	1.92	0.61	1.46	0	0	0
Total Organic Carbon	-	mg/L	20	1.60	10.00	3.50	2.85	2.16	0.48	1.62	0	0	0	18	0.80	7.70	2.69	2.45	1.53	0.36	1.76	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	24	0.0024	0.6780	0.1814	0.1220	0.1809	0.0369	1.00	0	14	58	22	0.0022	0.6360	0.1477	0.0911	0.1621	0.0346	0.91	0	10	45
Total Antimony	-	mg/L	24	0.0000700	0.0002500	0.0001367	0.0001250	0.0000465	0.0000095	2.94	1	0	0	22	0.0000700	0.0001700	0.0001082	0.0001000	0.0000226	0.0000048	4.79	0	0	0
Total Arsenic	0.005	mg/L	24	0.0002200	0.0021200	0.0006687	0.0005350	0.0004188	0.0000855	1.60	0	0	0	22	0.0001400	0.0017700	0.0005841	0.0005050	0.0003428	0.0000731	1.70	0	0	0
Total Barium	-	mg/L	24	0.05	0.15	0.06	0.05700	0.0223	0.0045	2.80	0	0	0	22	0.03	0.11	0.05	0.04600	0.0173	0.0037	2.98	0	0	0
Total Beryllium	-	mg/L	24	0.000005	0.000100	0.000020	0.000010	0.000022	0.000004	0.91	11	0	0	22	0.000005	0.000080	0.000013	0.000005	0.000017	0.000004	0.78	13	0	0
Total Bismuth	-	mg/L	24	0.0000025	0.0005000	0.0000256	0.0000025	0.0001011	0.0000206	0.25	16	0	0	22	0.0000025	0.0000160	0.0000044	0.0000025	0.0000037	0.0000008	1.18	16	0	0
Total Boron	1.5	mg/L	24	0.03	0.03	0.03	0.03	0	-	-	24	0	0	22	0.03	0.03	0.03	0.03	0	-	-	22	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	24	0.000014	0.000621	0.000111	0.000067	0.000133	0.000027	0.83	0	17	71	22	0.000008	0.000369	0.000064	0.000039	0.000081	0.000017	0.78	0	14	64
Total Calcium	-	mg/L	24	22.20	33.40	27.76	28.05	2.17	0.44	12.79	0	0	0	22	20.20	32.10	24.95	24.30	3.56	0.76	7.02	0	0	0
Total Chromium	0.001	mg/L	24	0.00005	0.00110	0.00033	0.00025	0.00028	0.00006	1.15	7	1	4	22	0.00005	0.00110	0.00029	0.00020	0.00026	0.00006	1.11	1	1	5
Total Cobalt	-	mg/L	24	0.000014	0.001930	0.000298	0.000172	0.000405	0.000083	0.74	1	0	0	22	0.000003	0.001160	0.000202	0.000110	0.000266	0.000057	0.76	1	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	24	0.0004	0.0081	0.0018	0.0011	0.0017	0.0004	1.02	0	5	21	22	0.0003	0.0060	0.0014	0.0012	0.0013	0.0003	1.13	0	4	18
Total Iron	0.3	mg/L	24	0.019	2.170	0.399	0.190	0.497	0.102	0.80	0	10	42	22	0.002	1.560	0.300	0.161	0.366	0.078	0.82	0	8	36
Total Lead	0.003 <sup>e</sup>	mg/L	24	0.000009	0.002900	0.000409	0.000162	0.000611	0.000125	0.67	1	0	0	22	0.000003	0.001830	0.000301	0.000135	0.000411	0.000088	0.73	1	0	0
Total Lithium	-	mg/L	24	0.00110	0.00262	0.00198	0.00195	0.00043	0.00009	4.57	1	0	0	22	0.00100	0.00210	0.00149	0.00140	0.00033	0.00007	4.57	0	0	0
Total Magnesium	-	mg/L	24	6.37	9.01	7.88	7.93	0.68	0.14	11.66	0	0	0	22	5.24	8.73	6.77	6.53	0.98	0.21	6.88	0	0	0
Total Manganese	-	mg/L	24	0.0048	0.1970	0.0395	0.0263	0.0423	0.0086	0.93	0	0	0	22	0.0003	0.1320	0.0223	0.0147	0.0286	0.0061	0.78	0	0	0
Total Mercury	0.000026	mg/L	22	0.0000050	0.0000200	0.0000057	0.0000050	0.0000032	0.0000007	1.78	21	0	0	20	0.0000050	0.0000100	0.0000053	0.0000050	0.0000011	0.0000003	4.70	19	0	0
Total Molybdenum	0.073	mg/L	24	0.00059	0.00126	0.00103	0.00102	0.00018	0.00004	5.70	0	0	0	22	0.00068	0.00128	0.00102	0.00101	0.00015	0.00003	6.61	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	24	0.00042	0.01010	0.00253	0.00214	0.00229	0.00047	1.10	0	0	0	22	0.00028	0.00662	0.00164	0.00124	0.00145	0.00031	1.13	0	0	0
Total Phosphorus	-	mg/L	22	0.0010	0.2680	0.0360	0.0170	0.0574	0.0122	0.63	3	0	0	20	0.0010	0.1970	0.0279	0.0130	0.0441	0.0099	0.63	4	0	0
Total Potassium	-	mg/L	24	0.70	1.17	0.84	0.80	0.13	0.03	6.19	0	0	0	22	0.69	1.07	0.80	0.76	0.11	0.02	7.17	0	0	0
Total Selenium	0.001	mg/L	24	0.00030	0.00069	0.00047	0.00047	0.00010	0.00002	4.68	0	0	0	22	0.0									

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W6B										W6A											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silver	0.0001	mg/L	24	0.000003	0.000022	0.000005	0.000003	0.000005	0.000001	1.10	16	0	0	22	0.000003	0.000011	0.000004	0.000003	0.000002	0.000001	1.46	18	0	0
Total Sodium	-	mg/L	24	1.43	2.21	1.82	1.84	0.21	0.04	8.63	0	0	0	22	1.54	2.23	1.84	1.81	0.21	0.04	8.71	0	0	0
Total Strontium	-	mg/L	24	0.104	0.147	0.126	0.128	0.010	0.002	12.79	0	0	0	22	0.089	0.135	0.113	0.111	0.014	0.003	7.94	0	0	0
Total Sulphur	-	mg/L	5	5.00	11.00	9.60	11.00	2.61	1.17	3.68	1	0	0	3	5.00	10.00	6.67	5.00	2.89	1.67	2.31	2	0	0
Total Thallium	0.0008	mg/L	24	0.000010	0.0000250	0.0000066	0.0000045	0.0000061	0.0000012	1.07	6	0	0	22	0.000010	0.0000160	0.0000042	0.0000035	0.0000034	0.0000007	1.25	4	0	0
Total Tin	-	mg/L	24	0.000005	0.002500	0.000125	0.000005	0.000507	0.000104	0.25	20	0	0	22	0.000005	0.000050	0.000007	0.000005	0.000010	0.000002	0.76	20	0	0
Total Titanium	-	mg/L	24	0.00025	0.01710	0.00450	0.00265	0.00451	0.00092	1.00	6	0	0	22	0.00025	0.01720	0.00403	0.00215	0.00455	0.00097	0.88	4	0	0
Total Uranium	0.015	mg/L	24	0.00086	0.00144	0.00104	0.00098	0.00016	0.00003	6.55	0	0	0	22	0.00085	0.00161	0.00105	0.00098	0.00023	0.00005	4.68	0	0	0
Total Vanadium	-	mg/L	24	0.00010	0.00320	0.00086	0.00045	0.00087	0.00018	0.99	6	0	0	22	0.00010	0.00280	0.00063	0.00035	0.00068	0.00014	0.94	6	0	0
Total Zinc	0.03	mg/L	24	0.00110	0.04360	0.00820	0.00560	0.00930	0.00190	0.88	1	1	4	22	0.00080	0.02480	0.00484	0.00285	0.00559	0.00119	0.87	0	0	0
Total Zirconium	-	mg/L	24	0.00005	0.00050	0.00014	0.00010	0.00014	0.00003	0.99	12	0	0	22	0.00005	0.00060	0.00012	0.00005	0.00014	0.00003	0.88	13	0	0
Dissolved Aluminum	0.1	mg/L	24	0.0014	0.0809	0.0228	0.0217	0.0193	0.0039	1.18	0	0	0	22	0.0015	0.0642	0.0182	0.0170	0.0150	0.0032	1.21	0	0	0
Dissolved Antimony	-	mg/L	24	0.00008	0.00017	0.00012	0.00012	0.00002	0.00005	5.14	0	0	0	22	0.00007	0.00013	0.00010	0.00010	0.00001	0.00003	6.85	0	0	0
Dissolved Arsenic	-	mg/L	24	0.00018	0.00059	0.00042	0.00042	0.00010	0.00020	4.30	0	0	0	22	0.00012	0.00053	0.00039	0.00042	0.00011	0.00023	3.71	0	0	0
Dissolved Barium	-	mg/L	24	0.039	0.061	0.047	0.046	0.005	0.001	8.59	0	0	0	22	0.035	0.073	0.042	0.039	0.010	0.002	4.22	0	0	0
Dissolved Beryllium	-	mg/L	24	0.000005	0.000010	0.000005	0.000005	0.000001	0.000000	5.10	23	0	0	22	0.000005	0.000010	0.000005	0.000005	0.000001	0.000000	4.90	21	0	0
Dissolved Bismuth	-	mg/L	24	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	24	0	0	22	0.0000025	0.0000060	0.0000027	0.0000025	0.0000007	0.0000002	3.56	21	0	0
Dissolved Boron	-	mg/L	24	0.025	0.025	0.025	0.025	0	-	-	24	0	0	22	0.025	0.025	0.025	0.025	0	-	-	22	0	0
Dissolved Cadmium	-	mg/L	24	0.000011	0.000094	0.000033	0.000025	0.000022	0.000005	1.51	0	0	0	22	0.000005	0.000064	0.000023	0.000019	0.000016	0.000003	1.44	0	0	0
Dissolved Calcium	-	mg/L	24	24.70	32.30	27.17	27.00	1.82	0.37	14.97	0	0	0	22	20.10	32.80	24.40	23.80	3.46	0.74	7.06	0	0	0
Dissolved Chromium	-	mg/L	24	0.00005	0.00020	0.00008	0.00005	0.00005	0.00001	1.51	17	0	0	22	0.00005	0.00020	0.00009	0.00005	0.00005	0.00001	1.67	12	0	0
Dissolved Cobalt	-	mg/L	24	0.000007	0.000098	0.000028	0.000022	0.000023	0.000005	1.22	0	0	0	22	0.000003	0.000073	0.000021	0.000015	0.000020	0.000004	1.07	1	0	0
Dissolved Copper	-	mg/L	24	0.0003	0.0026	0.0010	0.0008	0.0006	0.0001	1.69	0	0	0	22	0.0003	0.0021	0.0008	0.0007	0.0005	0.0001	1.70	0	0	0
Dissolved Iron	-	mg/L	24	0.004	0.170	0.036	0.024	0.040	0.008	0.90	0	0	0	22	0.001	0.128	0.026	0.018	0.032	0.007	0.81	1	0	0
Dissolved Lead	-	mg/L	24	0.000003	0.000137	0.000038	0.000040	0.000031	0.000006	1.24	3	0	0	22	0.000003	0.000199	0.000047	0.000024	0.000055	0.000012	0.86	4	0	0
Dissolved Lithium	-	mg/L	24	0.00130	0.00232	0.00177	0.00180	0.00026	0.00005	6.82	0	0	0	22	0.00100	0.00180	0.00135	0.00125	0.00025	0.00005	5.46	0	0	0
Dissolved Magnesium	-	mg/L	24	6.69	8.55	7.78	7.92	0.54	0.11	14.51	0	0	0	22	5.16	8.53	6.64	6.43	0.95	0.20	6.98	0	0	0
Dissolved Manganese	-	mg/L	24	0.0010	0.0853	0.0103	0.0034	0.0183	0.0037	0.56	0	0	0	22	0.0003	0.0117	0.0034	0.0023	0.0034	0.0007	1.00	0	0	0
Dissolved Mercury	-	mg/L	21	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	21	0	0	19	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	19	0	0
Dissolved Molybdenum	-	mg/L	24	0.00088	0.00129	0.00111	0.00109	0.00013	0.00003	8.66	0	0	0	22	0.00090	0.00129	0.00108	0.00106	0.00011	0.00002	9.94	0	0	0
Dissolved Nickel	-	mg/L	24	0.00039	0.00386	0.00143	0.00121	0.00090	0.00018	1.58	0	0	0	22	0.00027	0.00252	0.00095	0.00079	0.00062	0.00013	1.53	0	0	0
Dissolved Phosphorus	-	mg/L	21	0.0010	0.0100	0.0027	0.0010	0.0028	0.0006	0.98	12	0	0	19	0.0010	0.0080	0.0023	0.0010	0.0023	0.0005	0.99	13	0	0
Dissolved Potassium	-	mg/L	24	0.64	1.11	0.81	0.78	0.12	0.02	6.63	0	0	0	22	0.67	1.06	0.79	0.76	0.11	0.02	7.42	0	0	0
Dissolved Selenium	-	mg/L	24	0.00035	0.00062	0.00047	0.00048	0.00008	0.00002	5.63	0	0	0	22	0.00023	0.00066	0.00034	0.00032	0.00011	0.00002	3.12	0	0	0
Dissolved Silicon	-	mg/L	24	1.95	3.60	2.89	2.98	0.32	0.07	9.04	0	0	0	22	2.30	3.50	2.89	2.80	0.29	0.06	9.79	0	0	0
Dissolved Silver	-	mg/L	24	0.000003	0.000003	0.000003	0.000003	0	-	-	24	0	0	22	0.000003	0.000003	0.000003	0.000003	0	-	-	22	0	0
Dissolved Sodium	-	mg/L	24	1.51	3.50	1.90	1.82	0.38	0.08	5.06	0	0	0	22	1.55	2.11	1.83	1.84	0.17	0.04	10.44	0	0	0
Dissolved Strontium	-	mg/L	24	0.109	0.145	0.125	0.126	0.010	0.002	12.96	0	0	0	22	0.087	0.136	0.112	0.112	0.014	0.003	7.80	0	0	0
Dissolved Sulphur	-	mg/L	5	5.00	13.00	8.60	10.00	3.51	1.57	2.45	2	0	0	3	5.00	12.00	7.33	5.00	4.04	2.33	1.81	2	0	0
Dissolved Thallium	-	mg/L	23	0.000010	0.0000054	0.0000025	0.0000030	0.0000014	0.0000003	1.73	9	0	0	22	0.000010	0.0000050	0.0000020	0.0000020	0.0000011	0.0000002	1.87	9	0	0
Dissolved Tin	-	mg/L	24	0.000005	0.000100	0.000015	0.000005	0.000028	0.000006	0.54	23	0	0	22	0.000005	0.000080	0.000009	0.000005	0.000016	0.000003	0.54	20	0	0
Dissolved Titanium	-	mg/L	24	0.00025	0.00350	0.00055	0.00025	0.00079	0.00016	0.69	20	0	0	22	0.00025	0.00210	0.00043	0.00025	0.00043	0.00009	1.00	17	0	0
Dissolved Uranium	-	mg/L	24	0.00075	0.00152	0.00103	0.00096	0.00019	0.00004	5.42	0	0	0	22	0.00080	0.00162	0.00104	0.00096	0.00023	0.00005	4.54	0	0	0
Dissolved Vanadium	-	mg/L	24	0.00010	0.00050	0.00019	0.00010	0.00012	0.00002	1.63	13	0	0	22	0.00010	0.00060	0.00020	0.00020	0.00013	0.00003	1.59	10	0	0
Dissolved Zinc	-	mg/L	24	0.00030	0.00900	0.00231	0.00175	0.00200	0.00041	1.15	0	0	0	22	0.00030	0.00690	0.00168	0.00110	0.00171	0.00036	0.98	0	0	0
Dissolved Zirconium	-	mg/L	24	0.00005	0.00020	0.00006	0.00005	0.00003	0.00001	1.83	22	0	0	22	0.00005	0.00020	0.00006	0.00005	0.00003	0.00001	1.79	19	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
  - a) Ammonia (NH<sub>3</sub>) guideline based on pH=8 and temp=20
  - b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
  - c) Cadmium (Cd) mg/L: 10<sup>-4</sup>(0.86\*(log(hardness)))-3.2/1000
  - d) Copper (Cu) mg/L: (e<sup>-0.8545\*ln(hardness)-1.465</sup>)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
  - e) Lead (Pb) mg/L: (e<sup>-1.273\*ln(hardness)-4.705</sup>)/1000; minimum is 0.001mg/L regardless of water hardness
  - f) Nickel (Ni) mg/L: (e<sup>-0.76\*ln(hardness)+1.06</sup>)/1000; minimum is 0.025mg/L regardless of water hardness

"n" Count  
 "min" Minimum Value  
 "max" Maximum Value  
 "sd" Standard Deviation  
 "se" Standard Error  
 "cov" Covariance  
 "<DL" # of Non-detectable Values  
 ">GL" # of Exceedances of CCME Guid  
 "%>GL" % of Parameters that Exceed CCME Guidelin  
 "-" No Data Available



Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W15											W23										
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
pH	6.5 - 9.0	pH unit	21	7.70	8.10	7.94	7.99	0.11	0.02	70.18	0	0	0	2	7.83	7.96	7.90	7.90	0.09	0.07	85.89	0	0	0
Conductivity	-	µS/cm	21	150	224	196	203	23	5	8.47	0	0	0	2	214	390	302	302	124	88	2.43	0	0	0
Total Hardness CaCO <sub>3</sub>	-	mg/L	21	79	113	97	100	10	2	10.22	0	0	0	2	104	187	146	146	59	42	2.48	0	0	0
Dissolved Hardness CaCO <sub>3</sub>	-	mg/L	3	99	102	101	101	2	1	65.90	0	0	0	2	102	196	149	149	66	47	2.24	0	0	0
Moisture	-	%	1	41	41	41	41	0	-	-	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Ion Balance	-	no unit	2	0.93	0.96	0.95	0.95	0.02	0.01	44.55	0	0	0	2	0.99	1.00	1.00	1.00	0.01	0.01	140.71	0	0	0
Total Dissolved Solids	-	mg/L	21	92	150	118	120	17	4	7.14	0	0	0	2	150	240	195	195	64	45	3.06	0	0	0
Total Suspended Solids	-	mg/L	21	0.5	200.0	23.9	8.0	43.7	9.5	0.55	5	0	0	2	0.5	2.0	1.3	1.3	1.1	0.8	1.18	1	0	0
Turbidity	-	NTU	21	0.1	39.7	7.2	3.9	9.5	2.1	0.76	0	0	0	2	0.1	0.3	0.2	0.2	0.1	0.1	1.41	0	0	0
Ammonia as N	0.499 <sup>a</sup>	mg/L	21	0.003	0.047	0.015	0.011	0.013	0.003	1.18	9	0	0	2	0.025	0.085	0.055	0.055	0.042	0.030	1.30	0	0	0
Alkalinity, Total (as CaCO <sub>3</sub> )	-	mg/L	21	63.0	92.0	77.24	77.0	9.23	2.01	8.37	0	0	0	2	64.0	100.0	82.0	82.0	25.46	18.00	3.22	0	0	0
Acidity (pH 4.5) as CaCO <sub>3</sub>	-	mg/L	3	0.25	0.25	0.25	0.25	0	-	-	3	0	0	2	0.25	0.25	0.25	0.25	0	-	-	2	0	0
Acidity (pH8.3) as CaCO <sub>3</sub>	-	mg/L	12	0.25	2.60	0.84	0.55	0.77	0.22	1.08	5	0	0	2	0.25	1.90	1.08	1.08	1.17	0.83	0.92	1	0	0
Bromide (Br)	-	mg/L	18	0.20	0.20	0.20	0.20	0	-	-	18	0	0	2	0.20	0.20	0.20	0.20	0	-	-	2	0	0
Chloride (Cl)	120	mg/L	21	0.25	1.60	0.48	0.25	0.37	0.08	1.32	13	0	0	2	0.80	1.40	1.10	1.10	0.42	0.30	2.59	0	0	0
Fluoride (F)	0.12	mg/L	18	0.090	0.130	0.111	0.110	0.011	0.003	10.30	0	2	11	2	0.070	0.070	0.070	0.070	0	-	-	0	0	0
Sulphate (SO <sub>4</sub> )	-	mg/L	21	13.00	32.00	23.14	23.00	5.11	1.12	4.53	0	0	0	2	43.00	94.00	68.50	68.50	36.06	25.50	1.90	0	0	0
Total Nitrogen (N)	-	mg/L	3	0.11	0.35	0.24	0.25	0.12	0.07	1.96	0	0	0	2	0.54	0.76	0.65	0.65	0.16	0.11	4.18	0	0	0
Nitrate (as N)	13	mg/L	21	0.001	0.099	0.034	0.016	0.036	0.008	0.95	3	0	0	2	0.313	0.443	0.378	0.378	0.092	0.065	4.11	0	0	0
Nitrate plus Nitrite (N)	-	mg/L	3	0.001	0.071	0.027	0.009	0.038	0.022	0.70	1	0	0	2	0.313	0.443	0.378	0.378	0.092	0.065	4.11	0	0	0
Nitrite (as N)	0.06	mg/L	21	0.001	0.009	0.002	0.001	0.002	0.000	1.06	14	0	0	2	0.001	0.001	0.001	0.001	0	-	-	2	0	0
Total Kjeldahl Nitrogen	-	mg/L	21	0.01	0.42	0.13	0.10000	0.1017	0.0222	1.26	1	0	0	2	0.23	0.31	0.27	0.27000	0.0566	0.0400	4.77	0	0	0
Ortho Phosphate as P	-	mg/L	21	0.0005	0.0090	0.0019	0.0010	0.0020	0.0004	0.93	5	0	0	2	0.0020	0.0060	0.0040	0.0040	0.0028	0.0020	1.41	0	0	0
Cyanide, Total	0.005	mg/L	21	0.00025	0.00150	0.00033	0.00025	0.00029	0.00006	1.16	19	0	0	2	0.00025	0.00140	0.00083	0.00083	0.00081	0.00058	1.01	1	0	0
Cyanide, Weak Acid Diss	-	mg/L	21	0.00025	0.00025	0.00025	0.00025	0	-	-	21	0	0	2	0.00025	0.00160	0.00093	0.00093	0.00095	0.00068	0.97	1	0	0
Dissolved Organic Carbon	-	mg/L	10	0.90	6.20	2.58	2.25	1.74	0.55	1.48	0	0	0	2	11.20	13.70	12.45	12.45	1.77	1.25	7.04	0	0	0
Total Organic Carbon	-	mg/L	18	0.70	6.90	2.74	2.40	1.63	0.38	1.68	0	0	0	2	10.20	14.00	12.10	12.10	2.69	1.90	4.50	0	0	0
Total Aluminum	0.1 <sup>b</sup>	mg/L	21	0.0015	0.7080	0.1536	0.0847	0.1944	0.0424	0.79	0	9	43	2	0.0380	0.1590	0.0985	0.0985	0.0856	0.0605	1.15	0	1	50
Total Antimony	-	mg/L	21	0.000090	0.000230	0.000123	0.000110	0.000035	0.000008	3.50	0	0	0	2	0.00034	0.00046	0.00040	0.00040	0.00008	0.00006	4.71	0	0	0
Total Arsenic	0.005	mg/L	21	0.000140	0.002040	0.000583	0.000490	0.000437	0.000095	1.33	0	0	0	2	0.00070	0.00094	0.00082	0.00082	0.00017	0.00012	4.83	0	0	0
Total Barium	-	mg/L	21	0.039	0.139	0.061	0.056	0.022	0.005	2.74	0	0	0	2	0.046	0.066	0.056	0.056	0.014	0.010	4.11	0	0	0
Total Beryllium	-	mg/L	21	0.000005	0.000100	0.000016	0.000005	0.000022	0.000005	0.71	13	0	0	2	0.000005	0.000020	0.000013	0.000013	0.000011	0.000008	1.18	1	0	0
Total Bismuth	-	mg/L	21	0.0000025	0.0000150	0.0000040	0.0000025	0.0000035	0.0000008	1.14	17	0	0	2	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	2	0	0
Total Boron	1.5	mg/L	21	0.03	0.03	0.03	0.03	0	-	-	21	0	0	2	0.03	0.03	0.03	0.03	0	-	-	2	0	0
Total Cadmium	0.000032 <sup>c</sup>	mg/L	21	0.000003	0.000591	0.000082	0.000036	0.000136	0.000030	0.60	1	11	52	2	0.000009	0.000018	0.000014	0.000014	0.000006	0.000005	2.12	0	0	0
Total Calcium	-	mg/L	21	22.00	31.50	26.82	27.60	2.51	0.55	10.69	0	0	0	2	26.80	47.60	37.20	37.20	14.71	10.40	2.53	0	0	0
Total Chromium	0.001	mg/L	21	0.00005	0.00120	0.00030	0.00020	0.00031	0.00007	0.95	7	1	5	2	0.00010	0.00040	0.00025	0.00025	0.00021	0.00015	1.18	0	0	0
Total Cobalt	-	mg/L	21	0.000003	0.001400	0.000221	0.000091	0.000336	0.000073	0.66	1	0	0	2	0.000042	0.000103	0.000073	0.000073	0.000043	0.000031	1.68	0	0	0
Total Copper	0.0023 <sup>d</sup>	mg/L	21	0.0002	0.0072	0.0015	0.0009	0.0016	0.0004	0.89	0	2	10	2	0.0015	0.0020	0.0017	0.0017	0.0004	0.0003	4.24	0	0	0
Total Iron	0.3	mg/L	21	0.001	1.950	0.313	0.132	0.477	0.104	0.66	0	6	29	2	0.024	0.145	0.085	0.085	0.086	0.061	0.99	0	0	0
Total Lead	0.003 <sup>e</sup>	mg/L	21	0.000005	0.002490	0.000326	0.000118	0.000563	0.000123	0.58	0	0	0	2	0.000008	0.000041	0.000025	0.000025	0.000023	0.000017	1.05	0	0	0
Total Lithium	-	mg/L	21	0.00120	0.00260	0.00170	0.00160	0.00046	0.00010	3.67	0	0	0	2	0.00060	0.00070	0.00065	0.00065	0.00007	0.00005	9.19	0	0	0
Total Magnesium	-	mg/L	21	5.80	9.04	7.41	7.65	0.90	0.20	8.25	0	0	0	2	8.99	16.60	12.80	12.80	5.38	3.81	2.38	0	0	0
Total Manganese	-	mg/L	21	0.0001	0.1730	0.0244	0.0109	0.0400	0.0087	0.61	0	0	0	2	0.0035	0.0074	0.0054	0.0054	0.0027	0.0019	1.97	0	0	0
Total Mercury	0.000026	mg/L	19	0.0000050	0.0000100	0.0000053	0.0000050	0.0000011	0.0000003	4.59	18	0	0	1	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	1	0	0
Total Molybdenum	0.073	mg/L	21	0.00066	0.00130	0.00099	0.00099	0.00019	0.00004	5.20	0	0	0	2	0.00036	0.00041	0.00039	0.00039	0.00004	0.00003	10.89	0	0	0
Total Nickel	0.0033 <sup>f</sup>	mg/L	21	0.00019	0.00925	0.00187	0.00113	0.00218	0.00047	0.86	0	0	0	2	0.00059	0.00078	0.00069	0.00069	0.00013	0.00010	5.10	0	0	0
Total Phosphorus	-	mg/L	19	0.0010	0.2340	0.0305	0.0110	0.0542	0.0124	0.56	5	0	0	1	0.0050	0.0050	0.0050	0.0050	0	-	-	0	0	0
Total Potassium	-	mg/L	21	0.71	1.11	0.80	0.76	0.11	0.02	7.45	0	0	0	2	1.43	1.91	1.67	1.67	0.34	0.24	4.92	0	0	0
Total Selenium	0.001	mg/L	21	0.00026	0.00057	0.00042	0.00038	0.00010	0.00002	4.16	0	0												

Appendix B5. Surface Water Quality Statistics: All sites all parameters, Casino Project, 2008-2012

Parameters	CCME <sup>1</sup> Guideline	unit	W15										W23											
			n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL	n	min	max	mean	median	sd	se	cov	<DL	>GL	%>GL
Total Silicon	-	mg/L	21	2.60	3.60	3.12	3.00	0.30	0.06	10.54	0	0	0	2	4.10	4.20	4.15	4.15	0.07	0.05	58.69	0	0	0
Total Silver	0.0001	mg/L	21	0.000003	0.000012	0.000004	0.000003	0.000003	0.000001	1.30	16	0	0	2	0.000003	0.000003	0.000003	0.000003	0	-	-	2	0	0
Total Sodium	-	mg/L	21	1.50	2.23	1.80	1.82	0.19	0.04	9.48	0	0	0	2	2.53	3.86	3.20	3.20	0.94	0.67	3.40	0	0	0
Total Strontium	-	mg/L	21	0.091	0.136	0.119	0.123	0.013	0.003	9.41	0	0	0	2	0.182	0.342	0.262	0.262	0.113	0.080	2.32	0	0	0
Total Sulphur	-	mg/L	3	5.00	12.00	9.00	10.00	3.61	2.08	2.50	1	0	0	2	14.00	32.00	23.00	23.00	12.73	9.00	1.81	0	0	0
Total Thallium	0.0008	mg/L	21	0.000010	0.0000200	0.0000045	0.0000040	0.0000043	0.0000009	1.05	6	0	0	2	0.000030	0.000050	0.0000040	0.0000040	0.0000014	0.0000010	2.83	0	0	0
Total Tin	-	mg/L	21	0.000005	0.000070	0.000008	0.000005	0.000014	0.000003	0.59	19	0	0	2	0.000005	0.000070	0.000038	0.000038	0.000046	0.000033	0.82	1	0	0
Total Titanium	-	mg/L	21	0.00025	0.01610	0.00406	0.00300	0.00446	0.00097	0.91	6	0	0	2	0.00060	0.00320	0.00190	0.00190	0.00184	0.00130	1.03	0	0	0
Total Uranium	0.015	mg/L	21	0.00086	0.00153	0.00106	0.00101	0.00018	0.00004	5.84	0	0	0	2	0.00693	0.01410	0.01052	0.01052	0.00507	0.00359	2.07	0	0	0
Total Vanadium	-	mg/L	21	0.00010	0.00320	0.00064	0.00040	0.00078	0.00017	0.82	7	0	0	2	0.00030	0.00080	0.00055	0.00055	0.00035	0.00025	1.56	0	0	0
Total Zinc	0.03	mg/L	21	0.00080	0.03810	0.00618	0.00280	0.00921	0.00201	0.67	0	1	5	2	0.00040	0.00070	0.00055	0.00055	0.00021	0.00015	2.59	0	0	0
Total Zirconium	-	mg/L	21	0.00005	0.00070	0.00011	0.00005	0.00015	0.00003	0.72	13	0	0	2	0.00020	0.00040	0.00030	0.00030	0.00014	0.00010	2.12	0	0	0
Dissolved Aluminum	0.1	mg/L	21	0.0010	0.0693	0.0199	0.0150	0.0187	0.0041	1.06	0	0	0	2	0.0356	0.1070	0.0713	0.0713	0.0505	0.0357	1.41	0	1	50
Dissolved Antimony	-	mg/L	21	0.00009	0.00016	0.00011	0.00010	0.00002	0.000004	5.68	0	0	0	2	0.00035	0.00044	0.00040	0.00040	0.00006	0.000045	6.21	0	0	0
Dissolved Arsenic	-	mg/L	21	0.00013	0.00055	0.00036	0.00042	0.00013	0.000029	2.77	0	0	0	2	0.00071	0.00076	0.00074	0.00074	0.00004	0.000025	20.79	0	0	0
Dissolved Barium	-	mg/L	21	0.0366	0.0723	0.0489	0.0445	0.0129	0.0028	3.80	0	0	0	2	0.0420	0.0701	0.0561	0.0561	0.0199	0.0141	2.82	0	0	0
Dissolved Beryllium	-	mg/L	21	0.000005	0.000010	0.000005	0.000005	0.000002	0.000000	3.64	19	0	0	2	0.000005	0.000020	0.000013	0.000013	0.000011	0.000008	1.18	1	0	0
Dissolved Bismuth	-	mg/L	21	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	21	0	0	2	0.0000025	0.0000025	0.0000025	0.0000025	0	-	-	2	0	0
Dissolved Boron	-	mg/L	21	0.025	0.025	0.025	0.025	0	-	-	21	0	0	2	0.025	0.025	0.025	0.025	0	-	-	2	0	0
Dissolved Cadmium	-	mg/L	21	0.000003	0.000095	0.000025	0.000021	0.000022	0.000005	1.15	1	0	0	2	0.000003	0.000011	0.000007	0.000007	0.000006	0.000004	1.12	1	0	0
Dissolved Calcium	-	mg/L	21	18.50	30.00	25.82	26.00	3.07	0.67	8.41	0	0	0	2	26.60	49.30	37.95	37.95	16.05	11.35	2.36	0	0	0
Dissolved Chromium	-	mg/L	21	0.00005	0.00020	0.00009	0.00005	0.00005	0.00001	1.62	12	0	0	2	0.00020	0.00040	0.00030	0.00030	0.00014	0.00010	2.12	0	0	0
Dissolved Cobalt	-	mg/L	21	0.000003	0.000083	0.000020	0.000013	0.000021	0.000005	0.94	3	0	0	2	0.000050	0.000071	0.000061	0.000061	0.000015	0.000011	4.07	0	0	0
Dissolved Copper	-	mg/L	21	0.0003	0.0026	0.0008	0.0007	0.0006	0.0001	1.38	0	0	0	2	0.0016	0.0018	0.0017	0.0017	0.0002	0.0001	8.27	0	0	0
Dissolved Iron	-	mg/L	21	0.001	0.159	0.027	0.013	0.040	0.009	0.68	1	0	0	2	0.021	0.076	0.049	0.049	0.039	0.028	1.25	0	0	0
Dissolved Lead	-	mg/L	21	0.000003	0.000125	0.000042	0.000030	0.000035	0.000008	1.19	2	0	0	2	0.000005	0.000027	0.000016	0.000016	0.000016	0.000011	1.03	0	0	0
Dissolved Lithium	-	mg/L	21	0.00110	0.00210	0.00152	0.00150	0.00031	0.00007	4.86	0	0	0	2	0.00050	0.00060	0.00055	0.00055	0.00007	0.00005	7.78	0	0	0
Dissolved Magnesium	-	mg/L	21	5.54	8.52	7.22	7.52	0.87	0.19	8.26	0	0	0	2	8.74	17.60	13.17	13.17	6.26	4.43	2.10	0	0	0
Dissolved Manganese	-	mg/L	21	0.0001	0.0131	0.0025	0.0016	0.0035	0.0008	0.72	0	0	0	2	0.0010	0.0034	0.0022	0.0022	0.0017	0.0012	1.32	0	0	0
Dissolved Mercury	-	mg/L	18	0.0000050	0.0000050	0.0000050	0.0000050	0	-	-	18	0	0	-	-	-	-	-	-	-	-	-	-	-
Dissolved Molybdenum	-	mg/L	21	0.00078	0.00132	0.00105	0.00104	0.00017	0.00004	6.18	0	0	0	2	0.00042	0.00045	0.00044	0.00044	0.00002	0.00002	20.51	0	0	0
Dissolved Nickel	-	mg/L	21	0.00016	0.00378	0.00105	0.00086	0.00091	0.00020	1.16	0	0	0	2	0.00064	0.00065	0.00065	0.00065	0.00001	0.00000	91.22	0	0	0
Dissolved Phosphorus	-	mg/L	18	0.0010	0.0090	0.0022	0.0010	0.0026	0.0006	0.86	13	0	0	-	-	-	-	-	-	-	-	-	-	-
Dissolved Potassium	-	mg/L	21	0.69	1.07	0.78	0.76	0.09	0.02	8.95	0	0	0	2	1.35	2.10	1.73	1.73	0.53	0.38	3.25	0	0	0
Dissolved Selenium	-	mg/L	21	0.00025	0.00057	0.00041	0.00039	0.00010	0.00002	4.07	0	0	0	2	0.00011	0.00018	0.00015	0.00015	0.00005	0.00004	2.93	0	0	0
Dissolved Silicon	-	mg/L	21	1.84	3.80	2.79	2.80	0.41	0.09	6.77	0	0	0	2	4.10	4.40	4.25	4.25	0.21	0.15	20.03	0	0	0
Dissolved Silver	-	mg/L	21	0.000003	0.000003	0.000003	0.000003	0	-	-	21	0	0	2	0.000003	0.000003	0.000003	0.000003	0	-	-	2	0	0
Dissolved Sodium	-	mg/L	21	1.55	3.10	1.83	1.79	0.32	0.07	5.82	0	0	0	2	2.55	4.10	3.33	3.33	1.10	0.78	3.03	0	0	0
Dissolved Strontium	-	mg/L	21	0.091	0.132	0.117	0.121	0.013	0.003	9.26	0	0	0	2	0.174	0.349	0.262	0.262	0.124	0.088	2.11	0	0	0
Dissolved Sulphur	-	mg/L	3	5.00	12.00	9.00	10.00	3.61	2.08	2.50	1	0	0	2	14.00	36.00	25.00	25.00	15.56	11.00	1.61	0	0	0
Dissolved Thallium	-	mg/L	21	0.000010	0.000050	0.0000023	0.0000020	0.0000013	0.0000003	1.77	8	0	0	2	0.000020	0.000040	0.0000030	0.0000030	0.0000014	0.0000010	2.12	0	0	0
Dissolved Tin	-	mg/L	21	0.000005	0.000080	0.000009	0.000005	0.000016	0.000004	0.54	19	0	0	2	0.000005	0.000060	0.000033	0.000033	0.000039	0.000028	0.84	1	0	0
Dissolved Titanium	-	mg/L	21	0.00025	0.00220	0.00050	0.00025	0.00051	0.00011	1.00	14	0	0	2	0.00025	0.00110	0.00068	0.00068	0.00060	0.00043	1.12	1	0	0
Dissolved Uranium	-	mg/L	21	0.00080	0.00154	0.00102	0.00099	0.00018	0.00004	5.82	0	0	0	2	0.00682	0.01410	0.01046	0.01046	0.00515	0.00364	2.03	0	0	0
Dissolved Vanadium	-	mg/L	21	0.00010	0.00060	0.00020	0.00010	0.00013	0.00003	1.52	11	0	0	2	0.00030	0.00080	0.00055	0.00055	0.00035	0.00025	1.56	0	0	0
Dissolved Zinc	-	mg/L	21	0.00030	0.00840	0.00193	0.00110	0.00213	0.00046	0.91	0	0	0	2	0.00030	0.00030	0.00030	0.00030	0	-	-	0	0	0
Dissolved Zirconium	-	mg/L	21	0.00005	0.00020	0.00006	0.00005	0.00003	0.00001	1.75	20	0	0	2	0.00030	0.00040	0.00035	0.00035	0.00007	0.00005	4.95	0	0	0

Note:

- 1) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
- a) Ammonia (NH3) guideline based on pH=8 and temp=20
- b) Aluminum (AL-T)= 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5
- c) Cadmium (Cd) mg/L: 10<sup>-5</sup>\*(0.86\*(log(hardness))-3.2)/1000
- d) Copper (Cu) mg/L: (e<sup>-0.8545ln(hardness)</sup>-1.465)\*0.2/1000; minimum is 0.002mg/L regardless of water hardness
- e) Lead (Pb) mg/L: (e<sup>-1.273ln(hardness)</sup>-4.705)/1000; minimum is 0.001mg/L regardless of water hardness
- f) Nickel (Ni) mg/L: (e<sup>-0.76ln(hardness)</sup>+1.06)/1000; minimum is 0.025mg/L regardless of water hardness

- "n" Count
- "min" Minimum Value
- "max" Maximum Value
- "sd" Standard Deviation
- "se" Standard Error
- "cov" Covariance
- "<DL" # of Non-detectable Values
- ">GL" # of Exceedances of CCME Guid
- "%>GL" % of Parameters that Exceed CCME Guidelin
- "-" No Data Available