APPENDIX C
CO_2 CALCULATIONS

Table 1: Baseline GHG Quantification - Bear Lake Wind Power Project *Project # 23-9128*

Power Generation via Coal			
Parameter/Variable	Value	Unit	Comments
Quantity of Power Generated via Coal	116,347,145	kWh/year	Based on 45% of electricity generated by NSPI in 2023
Emission Factors			
Parameter/Variable	Value	Unit	Comments
Coal Generated Electricity	1.0251	kg CO_2e/kWh	[Source: USEIA, 2022]
Conversion Factor	0.001	t CO_2e/kWh	1 kg = 0.001 Tonnes
Emissions	119,269.67	t CO_2e/year	B5*B8*B9
Power Generation via Oil			
Parameter/Variable	Value	Unit	Comments
Quantity of Power Generated via Oil	27,147,667	kWh/year	Based on 10.5% of electricity generated by NSPI in 2023
Emission Factors			
Parameter/Variable	Value	Unit	Comments
Oil Generated Electricity	1.1068	kg CO_2e/kWh	[Source: USEIA, 2022]
Conversion Factor	0.001	t CO_2e/kWh	1 kg = 0.001 Tonnes
Emissions	30,046.09	t CO_2e/year	B14*B17*B18
Power Generation via Natural Gas			
Parameter/Variable	Value	Unit	Comments
Quantity of Power Generated via Natrual Gas	27,147,667	kWh/year	Based on 10.5% of electricity generated by NSPI in 2023
Emission Factors			
Parameter/Variable	Value	Unit	Comments
Natural Gas Generated Electricity	0.4400	kg CO_2e/kWh	[Source: USEIA, 2022]
Conversion Factor	0.001	t CO_2e/kWh	1 kg = 0.001 Tonnes
Emissions	11,944.56	t CO_2e/year	B23*B26*B27
Power Generation via Wind			
Parameter/Variable	Value	Unit	Comments
Quantity of Power Generated via Wind	87,906,731	kWh/year	Based on 34% of electricity generated by NSPI in 2023
Emission Factors			
Parameter/Variable	Value	Unit	Comments
Wind Generated Electricity	0	t CO_2e/kWh	
Emissions	0	t CO_2e/year	B32*B35
Total Emissions	161,260.31	t CO_2e/year	B10+B19+B28

User input data
Compiled data

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Turbine Fabrication			
Parameter/Variable	Value	Unit	Comments
Turbine Steel	708,000	kg/Turbine	Based on weights provided in NREL's 2015 Report [NREL, 2017]
	708.00	tonne/Turbine	1 kg = 0.001 Tonnes
Emission Factors			
Parameter/Variable	Value	Unit	Comments
General Steel	1.5	kg CO_2e/kg	Estimated from the UK's mixture of steel types, excluding stainless steel (Inventory of Carbon & Energy (ICE), Version 2.0).
Conversion Factor	0.001	t CO_2e/kg	1 kg = 0.001 Tonnes
Emissions	15,930.00	t CO_2e	B5*B9*B10*15(WT)
Turbine Transportation			
Parameter/Variable	Value	Unit	Comments
Transportation Vehicule			
Heavy Duty Truck (Diesel)	1	ea	
Distance Travelled	27,457.20	km	From Manufacturing Facility to Chennai Port, India and Port of Dartmouth, NS, to Wind Turbine Laydowns (includes all the wind turbine components for all wind turbines).
Freight Weight	59.00	tonne	Estimate of each component; 708 tonnes/12 components
Marine Cargo and Containers (Diesel)	1	ea	
Distance Travelled	323,291	km	Chennai Port to Port of Dartmouth, NS (includes 15 WT).
Freight Weight	708.00	tonne	Cell B6
Emission Factors			
Parameter/Variable	Value	Unit	Comments
Heavy Duty Truck	135	g CO_2e/tonne·km	Freight emissions for calculating GHGs from freight (materials delivery, shipment of product to market, etc.) [Source: GHGenius v5.0d]
Conversion Factor	0.000001	t CO_2e/tonne·km	1 g = 0.000001 Tonnes
Emissions	218.70	t CO_2e/year	B16*B17*B18*B24*B25
Marine Cargo and Containers (Diesel)	15.1	g CO_2e/tonne·km	Freight emissions for calculating GHGs from freight (materials delivery, shipment of product to market, etc.) [Source: GHGenius v5.0d]
Conversion Factor	0.000001	t CO_2e/tonne·km	1 g = 0.000001 Tonnes
Emissions	3,456.24	t CO_2e/year	B20*B21*B27*B28
Concrete Tower Foundation and Pedestal			
Parameter/Variable	Value	Unit	Comments
Concrete Production Quantity	2,500,000	kg	Based on a volume of 1,000 m^3 (per Wind Turbine Pad) and concrete density of 2,500 kg/m^3
	2,500	tonne	1 kg = 0.001 Tonnes
	17.86	tonne/truck	
Concrete Transportation			
Concrete Truck	140	ea	[Source: Kenter, 2017]
Distance Travelled (freight)	1,301.10	km	Based on one-way trip from Concrete Supplier to each Wind Turbine Pad
Distance Travelled (no freight)	1,301.10	km	Based on one-way trip from each Wind Turbine Pad to Concrete Supplier
Emission Factors			
Parameter/Variable	Value	Unit	Comments
Concrete Production	300	g CO_2e/kg	0.3 kg CO_2e/kg [Source: GHGenius v5.0d].
Concrete Truck (freight)	135	g CO_2e/tonne·km	Freight emissions for calculating GHGs from freight (materials delivery, shipment of product to market, etc.) [Source: GHGenius v5.0d].
Concrete Truck (no freight)	1,106	g CO_2e/km	Emissions for calculating GHGs where the volume of fuel consumed is unknown but the distance travelled is known [Source: GHGenius v5.0d].
Conversion Factor	0.000001	t CO_2e/tonne·km	1 g = 0.000001 Tonnes
Concrete Production Emissions	11,250.00	t CO_2e/year	B33*B42*B45*15(WT)
Concrete Truck (freight) Emissions	439.12	t CO_2e/year	B35*B37*B38*B43*B45
Concrete Truck (no freight) Emissions	201.46	t CO_2e/year	B37*B39*B44*B45
Total Concrete Tower Foundation and Pedestal	11,890.58	t CO_2e/year	B46+B47+B48
Total Emissions (Construction Phase)	31,495.52	t CO_2e	B11+B26+B29+B49

User input data
Compiled data

Wind Energy			
Parameter/Variable	Value	Unit	Comments
Quantity of Power Generation via Winc	258,549,210	kWh/year	See Equation
Emission Factors			
Parameter/Variable	Value	Unit	Comments
Wind Generated Electricity	0	t CO_2e/kWh	
Emissions	0	t CO_2e/year	B5*B8
Maintenance			
Parameter/Variable	Value	Unit	Comments
Nacelle Components Replacement	9,210	kg/Turbine	15% of Nacelle [Source: Source: Padey et al., 2012, GE Renewable Energy , 2018, European Wind Energy Association, u.(
Blade Replacement	11,667	kg/Turbine	One Blade [Source: Source: Padey et al., 2012, GE Renewable Energy , 2018, European Wind Energy Association, u.(
Emission Factors			
Parameter/Variable	Value	Unit	Comments
General Steel	1.5	kg CO_2e/kg	Estimated from the UK's mixture of steel types, excluding stainless steel (Inventory of Carbon & Energy (ICE), Version 2.0).
Conversion Factor	0.001	t CO_2e/kg	1 kg = 0.001 Tonnes
Emissions	31.32	t CO_2e/turbine	(B13+B14)*B17*B18
Total Emissions	469.73	t CO_2e	B9+B19*15 (WT)

$$kWh = 15\ Turbines \times \frac{5.9\ MW}{Turbine} \times \frac{365\ days}{year} \times \frac{24\ hours}{day} \times 0.3335 \times \frac{1000\ kW}{MW} = 258{,}549{,}210\ \ kWh/year$$

User input data
Compiled data

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APPENDIX D
GROUNDWATER WELLS

Well Number	Address	Community	County	Date Inserted	Well Depth (m)	Casing Depth (m)	Bedrock Depth (m)	Static (m)	Yield (Lpm)	Elevation (m)	Well Type	Water Use	Easting	Northing
001104	WINDSOR	VAUGHAN	HANTS	2000-06-19	127.89	6.09	2.13	3.04	9.08	131	DRILLED	Domestic	402500	4966500
002115	103 FALLS LAKE WEST	SMITHS CORNER	HANTS	2000-10-21	57.86	12.18	9.44	6.09	22.70	104	DRILLED	Domestic	401500	4966500
002129		VAUGHAN	HANTS	2000-11-16	66.99	6.09	0.61		22.70	175	DRILLED	Domestic	404500	4965500
002130		VAUGHAN	HANTS	2000-11-16	66.99	6.09	2.44	0.61	6.81	175	DRILLED	Domestic	404500	4965500
002141	FALLS LAKE WEST	SMITHS CORNER	HANTS	2000-01-05	53.29	6.09	1.83		68.10	100	DRILLED	Domestic	401500	4967500
002185		VAUGHAN	HANTS	2000-05-18	57.86	6.09	0.91		11.35	159	DRILLED	Domestic	405500	4964500
002186	FALLS LAKE	VAUGHAN	HANTS	2000-05-18	39.58	6.09	1.83		27.24	115	DRILLED	Domestic	401500	4965500
002716		MILL SECTION	HANTS	2000-06-12	38.06		1.83	7.61	36.32	14	DRILLED	Domestic	404500	4972500
010224	ZWICKER LAKE	UPPER VAUGHAN	HANTS	2001-10-26	5.02	5.48		2.44	363.20	221	DUG	Domestic	403500	4961500
011014	551 CHALET HAMLET	SMITHS CORNER	HANTS	2001-05-31	38.06	6.39	4.57		31.78	85	DRILLED	Domestic	403500	4968500
011334	1563 NEW ROSS ROAD	VAUGHAN	HANTS	2001-11-19	45.68	44.46		7.61	45.40	109	DRILLED	Domestic	402099	4966119
011405	FALLS LAKE, WINDSOR	SMITHS CORNER	HANTS	2001-06-15	48.72	6.09	2.13	7.61	9.08	100	DRILLED	Domestic	401500	4967500
011406	FALLS LAKE, WINDSOR	SMITHS CORNER	HANTS	2001-06-14	48.72	6.09	2.44	12.18	22.70	100	DRILLED	Domestic	401500	4967500
013066	201 COTTAGE COUNTRY	VAUGHAN	HANTS	2001-11-01	35.02	6.09	0.91	6.09	31.78	119	DRILLED	Domestic	403500	4966500
013109	COTTAGE COUNTRY, FALLS LAKE WEST	VAUGHAN	HANTS	2000-10-15	57.86	6.09	1.52		15.89	104	DRILLED	Domestic	401500	4966500
013140	HIGHWAY #14 WINDSOR	VAUGHAN	HANTS	2001-06-18	89.83	6.09	1.52	3.04	2.27	131	DRILLED	Domestic	402500	4966500
013145	SMELTZEN ROAD, HIGHWAY #14 WINDSOR	UPPER VAUGHAN	HANTS	2001-07-23	48.72	24.36	21.32	7.61	27.24	116	DRILLED	Domestic	402500	4963500
013146	HIGHWAY #14 WINDSOR	SMITHS CORNER	HANTS	2001-07-24	18.57	18.57		4.57	272.40	95	DRILLED	Domestic	403500	4967500
013657	1908 HIGHWAY #14, LOWER VAUGHAN	LOWER VAUGHAN	HANTS	2001-08-15	26.49	16.14	13.40	10.66	14.76	119	DRILLED	Domestic	403500	4966500
020027		SMITHS CORNER	HANTS	2002-06-18	85.26	6.09	1.83		54.48	108	DRILLED	Domestic	401530	4968587
020030	FALLS LAKE	SMITHS CORNER	HANTS	2002-06-14	73.08	6.09	2.44		18.16	100	DRILLED	Domestic	401725	4967503
020128	ARMSTRONG LAKE WEST ROAD	VAUGHAN	HANTS	2002-06-12	97.44	6.09	0.91	76.12	0.45	160	DRILLED	Domestic	405500	4965500
020662		SMITHS CORNER	HANTS	2002-07-03	22.84	21.92			90.80	125	DRILLED	Domestic	402685	4965636
020830	FALLS LAKE WEST, WINDSOR	SMITHS CORNER	HANTS	2002-11-11	48.72	6.09	0.91		11.35	99	DRILLED	Domestic	401739	4968428
020868	3721 HIGHWAY #14, MILL JUNCTION, WINDSOR	MILL SECTION	HANTS	2002-05-30	30.45	12.18	10.05	7.61	36.32	13	DRILLED	Domestic	404771	4973012
020899	15 MIDDLE LAKE ROAD	WINDSOR FORKS	HANTS	2002-09-23	38.06	6.09	2.13	3.65	22.70	166	DRILLED	Domestic	405494	4966062
020943	PIONEER DRIVE, VAUGHAN	SMITHS CORNER	HANTS	2002-05-09	74.60	7.31	1.83	3.04	27.24	153	DRILLED	Domestic	402500	4967500
021443	CHALET DRIVE, VAUGHAN	UPPER VAUGHAN	HANTS	2002-07-17	164.43	12.18	0.61		0.05	159	DRILLED		405500	4963500
021444	CHALET DRIVE, VAUGHAN	UPPER VAUGHAN	HANTS	2002-07-18	115.71	6.09	0.61	6.09	13.62	159	DRILLED	Domestic	405500	4963500
021445	249 CHALET DRIVE, CHALET HAMLET, VAUGHAN	UPPER VAUGHAN	HANTS	2002-07-20	115.71	7.92		6.09	6.81	159	DRILLED	Domestic	405500	4963500
022314	3505 HIGHWAY #14, WINDSOR	MILL SECTION	HANTS	2002-07-23	48.72	12.18	9.14	2.13	20.43	54	DRILLED	Domestic	404500	4973500
022320	HIGHWAY #14 WINDSOR	VAUGHAN	HANTS	2002-07-20	35.02	6.09	1.83	2.44	45.40	153	DRILLED	Domestic	404500	4966500
022377		VAUGHAN	HANTS	2002-10-21	57.86	6.09	4.57	6.09	36.32	159	DRILLED	Domestic	405500	4964500
022378	91 LEVY MEADOW TRAIL, FALLS LAKE WEST	VAUGHAN	HANTS	2002-10-22	35.02	7.61	6.09	6.09	27.24	104	DRILLED	Domestic	401500	4966500
030040	1230 HIGHWAY #14	UPPER VAUGHAN	HANTS	2003-04-14	49.63	6.09	4.26	0.30	45.40	149	DRILLED	Domestic	402500	4962500
030108	FALLS LAKE WEST	LOWER VAUGHAN	HANTS	2003-05-21	36.54	6.09	3.04		18.16	110	DRILLED	Domestic	401453	4966000
030180	PIONEER DR, FALLS LAKE WEST	LOWER VAUGHAN	HANTS	2003-06-30	60.90	6.09	1.52		7.94	110	DRILLED	Domestic	401453	4966000
030604	419 CHALET DRIVE	VAUGHAN	HANTS	2003-07-19	85.26	12.18	9.74	36.54	2.27	159	DRILLED	Domestic	405621	4963741
030850		SMITHS CORNER	HANTS	2003-07-25	97.44	8.53	6.09		9.08	89	DRILLED	Domestic	403678	4968125
030890		VAUGHAN	HANTS	2003-09-15	152.25	39.89	38.06		4.54	108	DRILLED	Domestic	403053	4966375
031439	30 PIONEER DRIVE	VAUGHAN	HANTS	2003-11-28	41.11	6.09	1.52		90.80	115	DRILLED	Domestic	401500	4965500
031440	1647 HIGHWAY #14	VAUGHAN	HANTS	2003-12-05	102.01	24.36	22.53	15.22	1.50	103	DRILLED	Domestic	402500	4965500
031492	29 PIONEER DRIVE	VAUGHAN	HANTS	2003-11-26	41.11	6.09	1.52	2.44	22.70	115	DRILLED	Domestic	401500	4965500
032020	762 WEST FALLS LAKE	VAUGHAN	HANTS	2003-06-12	85.26	10.35			22.70	105	DRILLED	Domestic	401407	4967958
032067	HIGHWAY #14	UPPER VAUGHAN	HANTS	2003-11-03	54.81	6.09		4.57	13.62	119	DRILLED	Domestic	402147	4962242
032506	HIGHWAY #14	VAUGHAN	HANTS	2003-10-31	57.86	6.39	3.35	3.04	7.94	167	DRILLED	Domestic	405500	4966500
032538	233 (273?) MIDDLE LAKE NORTH ROAD	VAUGHAN	HANTS	2003-08-06	30.45	6.39	3.65	6.09	68.10	167	DRILLED	Domestic	405500	4966500
032544	MIDDLE LAKE SOUTH ROAD	VAUGHAN	HANTS	2003-08-07	76.12	6.39	2.13	6.09	4.54	158	DRILLED	Domestic	406500	4965500
040005	WINDSOR	UPPER VAUGHAN	HANTS	2004-01-27	2.74	3.04	1.22	1.83	454.00	123	DUG	Domestic	401612	4960097
040281	350 LAKEVIEW CRESCENT	UPPER VAUGHAN	HANTS	2004-06-24	85.26	6.09	0.91		27.24	107	DRILLED	Domestic	402279	4964311
040282	280 LAKEVIEW CRESCENT	UPPER VAUGHAN	HANTS	2004-06-26	115.71	12.18	9.74		9.08	105	DRILLED	Agricultural (not irriga)	402257	4964321
040283	338 OLD TRUNK #14	CENTRE RAWDON	HANTS	2004-06-29	115.71	6.09	3.04	4.57	9.08	105	DRILLED	Domestic	402257	4964321
040513	660 PIONEER DRIVE	VAUGHAN	HANTS	2004-07-10	73.08	6.09	2.44	3.04	272.40	103	DRILLED	Domestic	401268	4967478
040534		MILL SECTION	HANTS	2004-10-16	3.65	3.65		1.22	90.80	157	DUG	Domestic	405500	4972500
040659	652 PIONEER DRIVE	VAUGHAN	HANTS	2004-08-09	30.45	6.09	2.44	6.09	27.24	101	DRILLED	Domestic	401328	4967410
041034	1884 HIGHWAY #14	VAUGHAN	HANTS	2004-11-26	115.71	20.71	19.79		45.40	109	DRILLED	Domestic	403219	4966497
041038	358 LAKEVIEW CRESCENT	UPPER VAUGHAN	HANTS	2004-12-06	97.44	6.09	3.65		3.40	111	DRILLED	Domestic	402308	4964338
042151	NORTH LAKE ROAD, HIGHWAY #14	VAUGHAN	HANTS	2004-07-26	54.81	6.09	2.44	7.61	90.80	165	DRILLED	Domestic	405787	4966214
050685	1046 Armstrong Lake East Road	VAUGHAN	HANTS	2005-10-18	54.81	6.09	1.22		45.40	165	DRILLED	Domestic	405915	4963714
050735	1502 New Ross Road	VAUGHAN	HANTS	2005-09-09	45.68	45.68			113.50	107	DRILLED	Domestic	401841	4965671
050765	30 Forest Heights Road	VAUGHAN	HANTS	2005-07-29	79.17	6.09	1.52		4.54	163	DRILLED	Domestic	405439	4965439
050766	1808 Highway #14	VAUGHAN	HANTS	2005-08-01	85.26	21.62	20.10		18.16	116	DRILLED	Domestic	402791	4965965
050837	58 Owls Pass	VAUGHAN	HANTS	2005-06-21	42.63	6.09	2.74		13.62	122	DRILLED	Domestic	400874	4967673
051911	846 Armstrong Lake East Road	VAUGHAN	HANTS	2005-12-02	66.99	12.18	1.52	1.52	13.62	159	DRILLED	Domestic	406049	4964429
051930	579 Pioneer Drive	VAUGHAN	HANTS	2005-10-19	85.26	18.57	15.22	1.52	15.89	106	DRILLED	Domestic	401876	4968549
051931	Pioneer Drive	VAUGHAN	HANTS	2005-10-18	79.17	6.39	2.44	1.52	18.16	110	DRILLED	Domestic	401928	4968755
052158	19 Hogan Road	UPPER VAUGHAN	HANTS	2005-12-13	79.17	13.09	4.57	9.14	18.16	124	DRILLED	Domestic	402452	4964342
060220	179 SUMMIT RIDGE ROAD	VAUGHAN	HANTS	2006-05-26	48.72	6.09	4.26		90.80	101	DRILLED	Domestic	401899	4967446
060221	359 SUMMIT RIDGE ROAD	VAUGHAN	HANTS	2006-05-27	57.86	6.09	0.91		15.89	105	DRILLED	Domestic	402108	4968162
060222	60 PINE POINT DRIVE	VAUGHAN	HANTS	2006-05-29	54.81	6.09	2.44		36.32	161	DRILLED	Domestic	405878	4964151
060400	208 SUMMIT RIDGE ROAD	VAUGHAN	HANTS	2006-07-19	60.90	6.09	1.22		13.62	124	DRILLED	Domestic	402151	4967643
060671	163 HOGAN ROAD	UPPER VAUGHAN	HANTS	2006-06-22	146.16	10.96	3.04	16.75	4.54	151	DRILLED	Domestic	402869	4964112
060878	8 SMELTZER ROAD	UPPER VAUGHAN	HANTS	2006-10-19	103.53	18.27	15.22		6.81	115	DRILLED	Domestic	402432	4963171

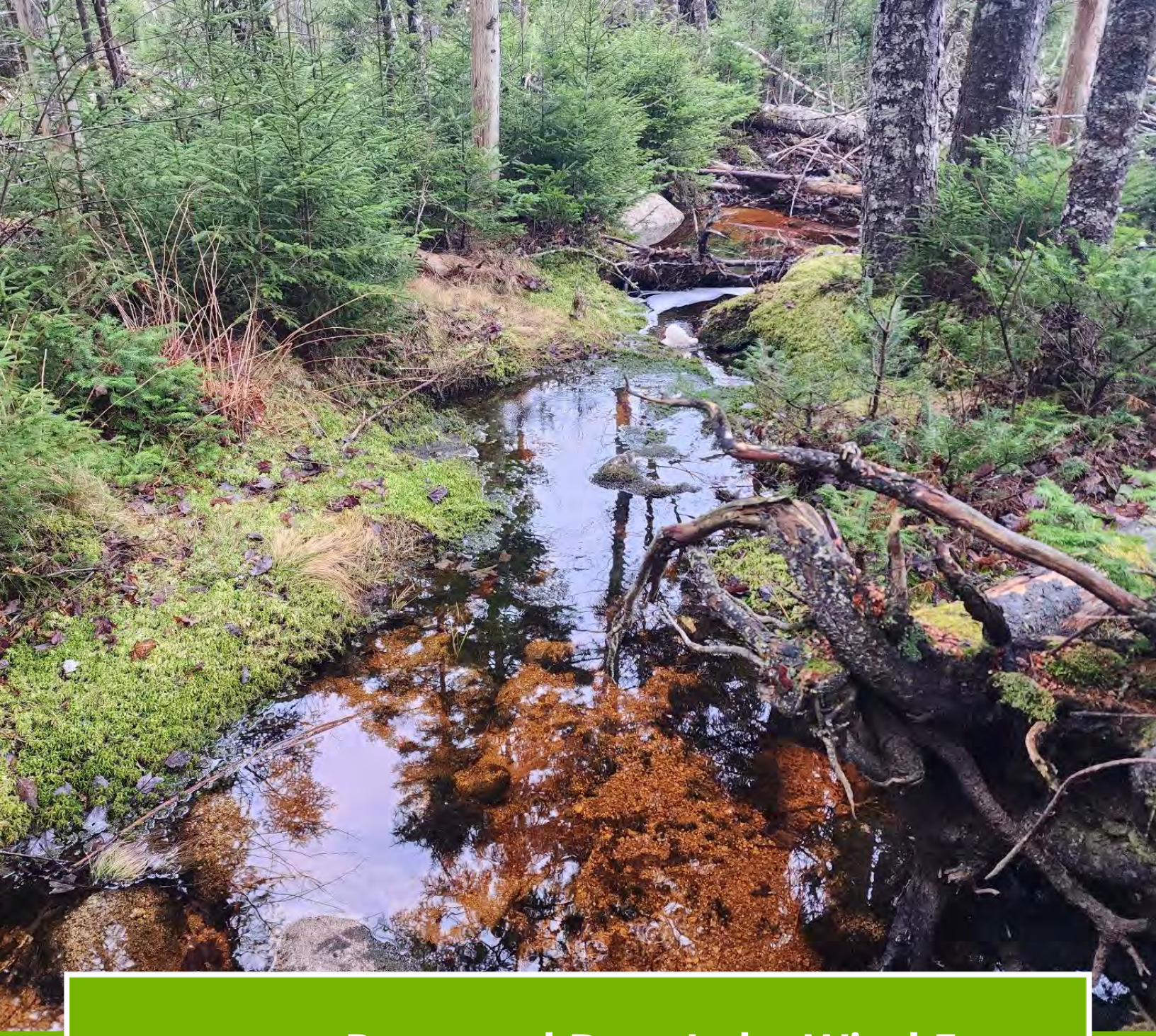
Well Number	Address	Community	County	Date Inserted	Well Depth (m)	Casing Depth (m)	Bedrock Depth (m)	Static (m)	Yield (Lpm)	Elevation (m)	Well Type	Water Use	Easting	Northing
061373	VAUGHAN	VAUGHAN	HANTS	2006-12-28	3.35					103	DUG		402500	4965500
061523	PIONEER DRIVE	VAUGHAN	HANTS	2006-06-01	92.26	12.18	4.26	2.13	9.08	142	DRILLED	Domestic	402643	4962859
061524	PIONEER DRIVE	VAUGHAN	HANTS	2006-06-02	92.26	12.18	3.65	2.13	9.08	142	DRILLED	Domestic	402643	4962859
070286	38 OWL PASS, VAUGHAN	LOWER VAUGHAN	HANTS	2007-07-27	42.63	6.09	3.04	4.57	22.70	120	DRILLED	Domestic	400928	4967755
070303	39 OWL PASS, VAUGHAN	LOWER VAUGHAN	HANTS	2007-09-11	42.63	6.09	3.04		18.16	118	DRILLED	Domestic	400910	4967588
070630	1653 NEW ROSS ROAD, VAUGHAN, WEST HANTS	SMITHS CORNER	HANTS	2007-08-02	54.81	12.18	9.14		20.43	112	DRILLED	Domestic	402542	4966038
070640	8 SMELTZER ROAD, UPPER VAUGHAN	VAUGHAN	HANTS	2007-07-14	127.89	14.01	10.05		4.54	117	DRILLED	Domestic	402453	4963150
070656	1401 NEW ROSS ROAD	LOWER VAUGHAN	HANTS	2007-09-21	42.63	12.18	9.74		36.32	106	DRILLED	Domestic	401329	4965899
070664	561 ARMSTRONG LAKE EAST ROAD, VAUGHAN, WEST HANTS	SMITHS CORNER	HANTS	2007-06-23	66.99	6.09	3.65		9.08	162	DRILLED	Domestic	405469	4965535
070687	591 HIGHWAY #14	UPPER VAUGHAN	HANTS	2007-10-17	66.99	6.70	2.13	-0.03	90.80	158	DRILLED	Domestic	401955	4960190
070737	HIGHWAY #14	UPPER VAUGHAN	HANTS	2007-05-25	127.89	6.09	3.65		11.35	110	DRILLED	Domestic	402005	4962208
070741	1583 HIGHWAY #14	VAUGHAN	HANTS	2007-05-29	127.89	20.10	16.75		4.54	102	DRILLED	Domestic	402345	4964994
072288	60 CANYON POINT ROAD, VAUGHAN, WEST HANTS	SMITHS CORNER	HANTS	2007-06-06	91.35	12.18	3.04	1.52	27.24	110	DRILLED	Domestic	401851	4968651
072289	60 CANYON POINT ROAD, VAUGHAN, WEST HANTS	SMITHS CORNER	HANTS	2007-06-05	121.80	12.18	9.14	4.57	9.08	108	DRILLED	Domestic	402006	4968725
072291	60 CANYON POINT ROAD, VAUGHAN, WEST HANTS	SMITHS CORNER	HANTS	2007-06-05	121.80	12.18	9.14	2.44	11.35	108	DRILLED	Domestic	402006	4968725
080124	314 CHALET DRIVE, WEST HANTS	VAUGHAN	HANTS	2008-05-15	85.26	6.09	0.91		6.81	175	DRILLED	Domestic	405341	4963766
080146	HANCOCK LANE (OFF HIGHWAY #14)	VAUGHAN	HANTS	2008-03-18	127.89	27.40	24.36		3.40	110	DRILLED	Domestic	402368	4965166
080439	651 PIONEER DRIVE, VAUGHAN	SMITHS CORNER	HANTS	2008-05-13	24.36	9.14	6.70	7.61	27.24	116	DRILLED	Domestic	401109	4967440
080587	786 ARMSTRONG LAKE EAST ROAD	VAUGHAN	HANTS	2008-10-29	127.89	12.18	3.04		22.70	161	DRILLED	Domestic	405824	4964574
080909	1100 ARMSTRONG LAKE EAST ROAD, CHALET ?	VAUGHAN	HANTS	2008-06-06	121.80	12.18	2.44	1.83	4.54	167	DRILLED	Domestic	406004	4963343
080910	FIVE ISLAND BROOK DRIVE, WEST HANTS	VAUGHAN	HANTS	2008-09-11	121.80	12.18	2.44		1.51	111	DRILLED	Domestic	401732	4968917
080911	FIVE ISLAND BROOK DRIVE	VAUGHAN	HANTS	2008-09-11	91.35	12.18	4.26	12.18	49.94	110	DRILLED	Domestic	401699	4968898
080915	FIVE ISLAND BROOK DRIVE, WEST HANTS	VAUGHAN	HANTS	2008-09-10	121.80	12.18	4.87		0.05	111	DRILLED	Domestic	401732	4968917
080924	FIVE ISLAND BROOK DRIVE	VAUGHAN	HANTS	2008-10-07	121.80	12.18	3.65	6.09	3.40	112	DRILLED	Domestic	401783	4968910
080925	FIVE ISLAND BROOK DRIVE	VAUGHAN	HANTS	2008-10-06	121.80	12.18	3.35	6.09	3.40	112	DRILLED	Domestic	401783	4968911
080985	60 CANYON POINT ROAD, VAUGHAN	SMITHS CORNER	HANTS	2008-04-08	121.80	18.27	8.83	3.04	6.81	107	DRILLED	Domestic	402018	4968835
080986	60 CANYON POINT ROAD, VAUGHAN	SMITHS CORNER	HANTS	2008-04-07	91.35	12.18	8.22	2.44	18.16	108	DRILLED	Domestic	402022	4968843
081036	269 VILLAGE PATH, VAUGHAN	SMITHS CORNER	HANTS	2008-06-11	103.53	12.18	3.65	3.04	6.81	107	DRILLED	Domestic	403090	4967894
090312	RESORT LANE	VAUGHAN	HANTS	2009-09-30	54.81	6.09	2.13		59.02	103	DRILLED	Domestic	402500	4965500
090313	RESORT LANE	VAUGHAN	HANTS	2009-09-30	36.54	6.09	1.83		22.70	103	DRILLED	Domestic	402500	4965500
090314	RESORT LANE	VAUGHAN	HANTS	2009-10-01	36.54	6.09	1.98		68.10	103	DRILLED	Domestic	402500	4965500
090315	RESORT LANE	VAUGHAN	HANTS	2009-10-01	42.63	6.09	2.44		22.70	103	DRILLED	Domestic	402500	4965500
090316	RESORT LANE	VAUGHAN	HANTS	2009-10-02	36.54	6.09	9.74		45.40	103	DRILLED	Domestic	402500	4965500
090317	2 RESORT LANE	VAUGHAN	HANTS	2009-09-23	42.63	6.09	3.04		10.22	103	DRILLED	Domestic	402500	4965500
090318	RESORT LANE	VAUGHAN	HANTS	2009-09-24	60.90	6.09	3.35		6.81	103	DRILLED	Domestic	402500	4965500
090319	SUMMIT RIDGE ROAD	VAUGHAN	HANTS	2009-09-23	60.90	6.09	1.22		4.54	100	DRILLED	Domestic	401500	4967500
090345	RESORT LANE	VAUGHAN	HANTS	2009-10-13	73.08	6.09	1.22		3.40	103	DRILLED	Domestic	402500	4965500
090346	RESORT LANE	VAUGHAN	HANTS	2009-10-13	36.54	6.09	0.91		40.86	103	DRILLED	Domestic	402500	4965500
090347	RESORT LANE	VAUGHAN	HANTS	2009-10-09	36.54	6.09	3.04		22.70	103	DRILLED	Domestic	402500	4965500
090348	RESORT LANE	VAUGHAN	HANTS	2009-10-09	36.54	6.09	1.83		18.16	103	DRILLED	Domestic	402500	4965500
090349	RESORT LANE	VAUGHAN	HANTS	2009-10-08	36.54	30.45	23.75		18.16	109	DRILLED	Domestic	402226	4966585
090350	RESORT LANE	VAUGHAN	HANTS	2009-10-07	18.27	18.27	20.71		36.32	109	DRILLED	Domestic	402226	4966585
090354	RESORT LANE	VAUGHAN	HANTS	2009-10-16	48.72	12.18	7.61		9.08	103	DRILLED	Domestic	402500	4965500
090355	RESORT LANE	VAUGHAN	HANTS	2009-10-15	54.81	6.09	15.83		9.08	103	DRILLED	Domestic	402500	4965500
090356	RESORT LANE	VAUGHAN	HANTS	2009-10-15	48.72	18.27	15.22		13.62	103	DRILLED	Domestic	402500	4965500
090357	RESORT LANE	VAUGHAN	HANTS	2009-10-14	30.45	12.18	8.53		45.40	103	DRILLED	Domestic	402500	4965500
090358	RESORT LANE	VAUGHAN	HANTS	2009-10-14	36.54	6.09	0.91		49.94	103	DRILLED	Domestic	402500	4965500
090359	RESORT LANE	VAUGHAN	HANTS	2009-09-26	42.63	6.09	1.22		36.32	133	DRILLED	Domestic	402500	4964500
090360	RESORT LANE	VAUGHAN	HANTS	2009-09-27	60.90	6.09	2.13		22.70	133	DRILLED	Domestic	402500	4964500
090361	RESORT LANE	VAUGHAN	HANTS	2009-09-27	66.99	6.09	3.04		4.54	133	DRILLED	Domestic	402500	4964500
090362	RESORT LANE	VAUGHAN	HANTS	2009-09-28	66.99	6.09	0.61		4.54	133	DRILLED	Domestic	402500	4964500
090363	RESORT LANE	VAUGHAN	HANTS	2009-09-28	42.63	6.09	2.13		22.70	103	DRILLED	Domestic	402500	4965500
090364	RESORT LANE	VAUGHAN	HANTS	2009-09-24	36.54	6.09	3.96		34.05	133	DRILLED	Domestic	402500	4964500
090365	RESORT LANE	VAUGHAN	HANTS	2009-09-26	36.54	6.09	1.83		22.70	133	DRILLED	Domestic	402500	4964500
090451	475 SUMMIT RIDGE ROAD, VAUGHAN, EAST HANTS	SMITHS CORNER	HANTS	2009-11-03	66.99	6.09	1.52		5.68	147	DRILLED	Domestic	402489	4968444
091131	FOREST HEIGHTS ROAD, VAUGHAN	SMITHS CORNER	HANTS	2009-05-04	85.26	12.18	0.91	66.99	9.08	175	DRILLED	Domestic	405293	4965364
091156	2855 HIGHWAY #14	MILL SECTION	HANTS	2009-04-09	66.99	27.71	25.88	6.09	68.10	20	DRILLED	Domestic	404070	4970643
091158	2855 HIGHWAY #14	MILL SECTION	HANTS	2009-04-09	140.07	24.36	22.53	9.14	45.40	25	DRILLED	Heat Pump (source or dis)	404130	4970670
091812	83 INNIS LANE (INNES LANE), UPPER VAUGHAN	VAUGHAN	HANTS	2009-06-24	127.89	12.18	11.57		9.08	111	DRILLED	Domestic	401872	4962978
100094	1689 NEW ROSS ROAD (LOT OFF ROAD OFF RESORT LANE)	VAUGHAN	HANTS	2010-05-17	60.90	12.18	10.05		18.16	106	DRILLED	Domestic	402646	4966056
100096	211 CHALET DRIVE	VAUGHAN	HANTS	2010-05-13	36.54	6.09	2.44		27.24	171	DRILLED	Domestic	405497	4964265
100097	96 (118?) FOREST HEIGHTS ROAD	VAUGHAN	HANTS	2010-05-14	36.54	6.09	0.61		15.89	159	DRILLED	Domestic	405500	4964500
100427	133 MIDDLE LAKE SOUTH ROAD, VAUGHAN	SMITHS CORNER	HANTS	2010-07-23	73.08	12.18	2.13		22.70	160	DRILLED	Domestic	405856	4965551
100577	27 RIVERVIEW ROAD, VAUGHAN	SMITHS CORNER	HANTS	2010-05-19	60.90	12.18	3.04	9.14	22.70	161	DRILLED	Domestic	405689	4965545
110008	FALLS LAKE PARK, 1541 NEW ROSS ROAD, VAUGHAN	LOWER VAUGHAN	HANTS	2011-03-29						103	DUG		402004	4966244
110272	601 PIONEER DRIVE, VAUGHAN	LOWER VAUGHAN	HANTS	2011-07-04	54.81	12.18	8.22	6.09	136.20	117	DRILLED	Domestic	401136	4967200
110295	MIDDLE LAKE NORTH ROAD, VAUGHAN	SMITHS CORNER	HANTS	2011-07-27	60.90	12.18	1.52	3.04	18.16	160	DRILLED	Domestic	405973	4966077
110306	62 WHTE TAIL PASS, VAUGHAN	SMITHS CORNER	HANTS	2011-08-06	73.08	12.18	1.52		22.70	146	DRILLED	Domestic	402633	4967332
110400	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-05-10	91.35	12.18	7.00			107	DRILLED	Domestic	402652	4966120
110401	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-05-11	36.54	6.09	4.57		11.35	106	DRILLED	Domestic	402670	4966199

Well Number	Address	Community	County	Date Inserted	Well Depth (m)	Casing Depth (m)	Bedrock Depth (m)	Static (m)	Yield (Lpm)	Elevation (m)	Well Type	Water Use	Easting	Northing
110402	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-05-12	36.54	6.09	3.96		11.35	105	DRILLED	Domestic	402669	4966221
110403	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-05-12	79.17	6.09	1.22		4.54	105	DRILLED	Domestic	402664	4966249
110404	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-05-18	54.81	6.09	2.44		9.08	124	DRILLED	Domestic	402456	4966267
110405	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-05-31	36.54	6.09	1.22		31.78	125	DRILLED	Domestic	402397	4966229
110406	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-05-31	60.90	6.09	0.91		5.68	108	DRILLED	Domestic	402662	4966172
110407	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-01	73.08	6.09	1.22		3.40	118	DRILLED	Domestic	402563	4966152
110408	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-01	91.35	6.09	1.22			118	DRILLED	Domestic	402565	4966144
110409	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-03	91.35	6.09	0.61		2.27	124	DRILLED	Domestic	402453	4966273
110410	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-06	91.35	6.09	1.22		2.27	124	DRILLED	Domestic	402459	4966270
110411	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-07	73.08	6.09	2.44		4.54	108	DRILLED	Domestic	402662	4966172
110412	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-08	91.35	12.18	10.05		1.51	123	DRILLED	Domestic	402325	4966237
110413	MURPHY CRESCENT (RESORT LANE), VAUGHAN	SMITHS CORNER	HANTS	2011-06-09	36.54	6.09	3.04		31.78	121	DRILLED	Domestic	402397	4966344
110414	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-22	48.72	6.09	1.22		11.35	125	DRILLED	Domestic	402460	4966307
110415	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-22	60.90	6.09	0.91		4.54	125	DRILLED	Domestic	402452	4966333
110416	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-23	54.81	6.09	3.04		6.81	121	DRILLED	Domestic	402396	4966345
110417	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-24	91.35	6.09	0.61			122	DRILLED	Domestic	402509	4966247
110418	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-06-27	48.72	6.09	1.22		11.35	124	DRILLED	Domestic	402503	4966243
110419	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-07-04	36.54	6.09	3.04		18.16	118	DRILLED	Domestic	402536	4966151
110420	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-07-04	85.26	12.18	9.14		2.27	125	DRILLED	Domestic	402360	4966249
110421	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-07-04	60.90	6.09	2.44		9.08	106	DRILLED	Domestic	402652	4966330
110422	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-07-05	91.35	6.09	3.04			106	DRILLED	Domestic	402658	4966306
110423	MURPHY CRESCENT, VAUGHAN	SMITHS CORNER	HANTS	2011-07-06	91.35	6.09	3.04		2.27	105	DRILLED	Domestic	402657	4966296
111503	HIGHWAY #14	MILL SECTION	HANTS	2011-11-14	91.35	10.35	4.26		13.62	58	DRILLED	Domestic	405235	4973529
120257	45 CHALET DRIVE (ON ARMSTRONG LAKE), WEST HANTS	VAUGHAN	HANTS	2012-06-25	109.62	12.18	2.44		8.17	165	DRILLED	Domestic	405410	4965027
121399	186 WHITE TAIL PASS, VAUGHAN	SMITHS CORNER	HANTS	2012-09-25	103.53	12.18	0.61		2.27	147	DRILLED	Domestic	402887	4967919
121515	24 MIDDLE LAKE ROAD (MIDDLE LAKE NORTH RD),VAUGHAN	SMITHS CORNER	HANTS	2012-11-22	66.99	12.18	0.91		22.70	161	DRILLED	Domestic	405555	4965942
121730	19 INNIS LANE (ON ZWICKER LAKE)	UPPER VAUGHAN	HANTS	2012-10-25	109.62	35.93	35.02	18.27	6.81	106	DRILLED	Domestic	402102	4963164
130188	PIONEER DRIVE, VAUGHAN	LOWER VAUGHAN	HANTS	2013-07-22	48.72	12.18	2.13		22.70	113	DRILLED	Domestic	401090	4967639
140047	280LAKEVIEW CRESCENT, UPPER VAUGHAN	VAUGHAN	HANTS	2014-05-10	91.35	12.18	4.87		18.16	117	DRILLED	Domestic	402230	4964097
140065	88 OWL PASS, VAUGHAN	LOWER VAUGHAN	HANTS	2014-06-16	54.81	12.18	2.74		9.08	116	DRILLED	Domestic	400872	4967491
140190	60 PINE POINT DRIVE, WEST HANTS	VAUGHAN	HANTS	2014-07-18	54.81	6.09	2.44		36.32	161	DRILLED	Domestic	405878	4964151
150214	720 PIONEER DRIVE, VAUGHAN	LOWER VAUGHAN	HANTS	2015-09-16	54.81	12.18	4.87	6.09	22.70	101	DRILLED	Domestic	401299	4967825
150271	449 WEST ARMSTRONG ROAD (ARMSTRONG LAKE WEST ROAD)	VAUGHAN	HANTS	2015-08-18	91.35	12.18	1.52		5.45	195	DRILLED	Domestic	405217	4963901
150954	59 LAKEVIEW CRESCENT	UPPER VAUGHAN	HANTS	2015-04-18	152.25	59.68	52.07		2.27	110	DRILLED	Domestic	402271	4962921
161006	536 HIGHWAY 14	UPPER VAUGHAN	HANTS	2016-09-15	30.45	6.09	1.52	10.05	68.10	169	DRILLED	Domestic	402093	4960066
170163	61 MID LAKE NORTH ROAD	SMITHS CORNER	HANTS	2017-01-31	54.81	12.18	3.65		18.16	165	DRILLED	Domestic	405598	4966126
170381	551 ARMSTRONG LAKE EAST ROAD	LOWER VAUGHAN	HANTS	2017-08-07	42.63	21.32			13.62	165	DRILLED	Domestic	405463	4965620
170439	551 ARMSTRONG LAKE EAST ROAD	LOWER VAUGHAN	HANTS	2017-06-20	42.63	15.22			13.62	165	DRILLED	Domestic	405463	4965620
170740	69 INNES LANE	VAUGHAN	HANTS	2017-09-01	97.44	23.75	15.22	6.09	18.16	116	DRILLED	Domestic	401849	4962999
170741	244 NEW ROSS ROAD	LEMINSTER	HANTS	2017-07-18	91.35	11.57	6.09	6.09	13.62	171	DRILLED	Domestic	400405	4960097
180025	72 OWL PASS ROAD	VAUGHAN	HANTS	2018-04-01	42.63	6.09	1.22		13.62	119	DRILLED	Domestic	400846	4967587
180173	417 SUMMIT RIDGE ROAD	UPPER VAUGHAN	HANTS	2018-05-28	79.17	6.09	2.13	2.13	36.32	102	DRILLED	Domestic	402140	4968530
180207	RESORT ROAD	VAUGHAN	HANTS	2018-09-06	60.90	6.09	2.44		6.81	109	DRILLED	Domestic	402226	4966585
180803	576 ARMSTRONG LAKE EAST ROAD	SMITHS CORNER	HANTS	2018-06-07	54.81	12.18	2.13		36.32	167	DRILLED	Domestic	405385	4965491
190030	FALLS LAKE	VAUGHAN	HANTS	2019-07-17	54.81	6.09	2.13		6.81	129	DRILLED	Domestic	402210	4966940
190032	29 PHOENIX HCCC#3	VAUGHAN	HANTS	2019-08-02	48.72	6.09	0.61		36.32	109	DRILLED	Domestic	401973	4967221
190360	2010 HIGHWAY 14	VAUGHAN	HANTS	2019-12-04	66.99	17.66	15.22	6.09	18.16	112	DRILLED	Domestic	403372	4966753
200050	71 PIPER	FALLS LAKE	HANTS	2020-12-30	79.17	6.09	0.30		2.27	116	DRILLED	Domestic	402188	4966707
200051	56 WHITETAIL	FALLS LAKE	HANTS	2020-11-25	36.54	6.09	1.22		11.35	140	DRILLED	Domestic	402775	4967581
200052	65 PIPER CRESCENT	FALLS LAKE	HANTS	2020-11-26	79.17	6.09	2.13			116	DRILLED	Domestic	402188	4966707
200063	125 PINE HILL DRIVE	VAUGHAN	HANTS	2020-12-20	39.58		1.22		10.44	184	DRILLED	Domestic	405161	4965269
200328	106 PIONEER DRIVE	VAUGHAN	HANTS	2020-07-10	66.99	18.27	10.96		13.62	118	DRILLED	Domestic	401100	4967407
200479	24 PINEWOOD CLOSE	VAUGHAN	HANTS	2020-04-30	36.54	12.18	1.22	3.04	36.32	192	DRILLED	Domestic	405071	4964715
200562	M-7 MIDDLE LAKE NORTH ROAD	VAUGHAN	HANTS	2020-12-10	73.08	12.18	0.91		9.08	162	DRILLED	Domestic	405900	4966332
200668	495 ARMSTRONG LAKE ROAD	VAUGHAN	HANTS	2020-04-20	54.81	12.18	1.83		4.54	186	DRILLED	Domestic	405214	4963720
200669	339 ARMSTRONG LAKE EAST ROAD	VAUGHAN	HANTS	2020-04-20	79.17	12.18	3.96		9.08	159	DRILLED	Domestic	404698	4966263
200713	70 HARTT ROAD	SMITHS CORNER	HANTS	2020-05-13	60.90	18.27	16.75		15.89	93	DRILLED	Domestic	403531	4968388
200882	1979 HIGHWAY 14	VAUGHAN	HANTS	2020-09-17	91.35	17.36	15.22		9.08	105	DRILLED	Domestic	403233	4966741
660648		UPPER VAUGHAN	HANTS	1966-07-14	26.80	4.72	3.04	5.48	22.70	108	DRILLED	Domestic	401500	4961500
681154	FALLS LAKE	SMITHS CORNER	HANTS	1968-05-13	15.22	6.39	4.57		15.89	100	DRILLED	Domestic	401500	4967500
681157	FALLS LAKE	SMITHS CORNER	HANTS	1968-05-08	21.32	9.14	7.61		11.35	107	DRILLED		401500	4968500
752914	FALLS LAKE PROVINCIAL PARK	LOWER VAUGHAN	HANTS	1975-12-31	4.81			2.59		103	DUG	Public (not municipal)	402004	4966244
782037			HALIFAX	1978-12-31	18.27	6.39	9.44	2.44	36.32	166	DRILLED	Domestic	406903	4961253
782038		UPPER VAUGHAN	HANTS	1978-12-31	62.42	4.26	2.44	3.96	13.62	105	DRILLED	Domestic	401984	4962869
791497		UPPER VAUGHAN	HANTS	1979-12-22	38.06	3.65	0.30	4.87	72.64	105	DRILLED	Domestic	401984	4962869
791499		UPPER VAUGHAN	HANTS	1979-12-08	38.67	2.44		5.18	77.18	105	DRILLED	Domestic	401984	4962869
801322		UPPER VAUGHAN	HANTS	1980-02-22	47.20	36.54	35.32	10.66	13.62	105	DRILLED	Domestic	401984	4962869
801323		UPPER VAUGHAN	HANTS	1980-01-21	38.06	6.70	5.18	3.04	31.78	105	DRILLED	Domestic	401984	4962869
801335		UPPER VAUGHAN	HANTS	1980-01-16	36.54	6.39	4.57	3.04	22.70	105	DRILLED	Domestic	401984	4962869
820824	VAUGHAN	UPPER VAUGHAN	HANTS	1982-07-30	29.54	4.57	1.52	1.52	36.32	207	DRILLED	Domestic	403631	4962844
860152		UPPER VAUGHAN	HANTS	1986-02-21	79.17	24.36	18.27		0.91	149	DRILLED	Domestic	402500	4962500

Well Number	Address	Community	County	Date Inserted	Well Depth (m)	Casing Depth (m)	Bedrock Depth (m)	Static (m)	Yield (Lpm)	Elevation (m)	Well Type	Water Use	Easting	Northing
871405		VAUGHAN	HANTS	1987-04-10	45.68	14.92	13.70	1.52	31.78	145	DRILLED	Domestic	403500	4965500
871701		FALMOUTH	HANTS	1987-08-01	28.93	9.74	9.14	1.52	204.30	109	DRILLED	Domestic	405500	4973500
890095		LAKE CHARLOTTE	HALIFAX	1989-04-04	48.72	18.27	12.18	3.04	136.20	244	DRILLED	Domestic	403500	4956500
891757		SMITHS CORNER	HANTS	1989-06-08	91.35	13.09	10.96		2.27	89	DRILLED		403678	4968125
900179	RR#1	VAUGHAN	HANTS	1990-04-23	30.45	6.70	0.61		68.10	159	DRILLED		405500	4964500
900182	RR#1 CAMBRIDGE	SMITHS CORNER	HANTS	1990-04-23	30.45	9.74	8.22		36.32	153	DRILLED		402500	4967500
900188	NEW ROSS	SMITHS CORNER	HANTS	1990-05-02	30.45	6.09			18.16	131	DRILLED		402500	4966500
900189	NEW ROSS	SMITHS CORNER	HANTS	1990-05-03	36.54	6.09	0.61	1.52	18.16	153	DRILLED		404500	4966500
900190	NEW ROSS	SMITHS CORNER	HANTS	1990-05-04	66.99	6.09	1.52		9.08	153	DRILLED		404500	4966500
900616	RR#3 WINDSOR	SMITHS CORNER	HANTS	1990-08-14	48.72	19.79	19.18		13.62	85	DRILLED		403500	4968500
900625	NEW ROSS	SMITHS CORNER	HANTS	1990-08-27	36.54	6.09	2.13		15.89	153	DRILLED		402500	4967500
901011	RR#3 WINDSOR	VAUGHAN	HANTS	1990-10-02	109.62	6.09	1.83		18.16	133	DRILLED		402500	4964500
903125	HAMLET	VAUGHAN	HANTS	1990-12-21	98.96	6.09			4.54	172	DRILLED		404500	4964500
910562	NEW ROSS PROFESSIONAL CENTRE	VAUGHAN	HANTS	1991-08-06	73.08	8.22	7.31	3.04	4.54	160	DRILLED	Domestic	405500	4965500
910563	NEW ROSS PROFESSIONAL CENTRE	SMITHS CORNER	HANTS	1991-08-06	30.45	6.09	0.30		36.32	153	DRILLED	Domestic	402500	4967500
911387		VAUGHAN	HANTS	1991-08-03	30.45	6.09	3.04	3.04	36.32	145	DRILLED	Domestic	403500	4965500
920143	SUMMIT RIDGE	SMITHS CORNER	HANTS	1992-06-04	60.90	6.09			13.62	153	DRILLED	Domestic	402500	4967500
920479		VAUGHAN	HANTS	1992-07-06	73.08	6.09	1.52	4.57	18.16	131	DRILLED	Domestic	402500	4966500
920593	13 TOWER VEIW DRIVE	VAUGHAN	HANTS	1992-07-16	30.45	6.09			36.32	131	DRILLED	Domestic	402500	4966500
920789		VAUGHAN	HANTS	1992-10-09	56.64	6.09	4.26	4.26	6.81	175	DRILLED	Domestic	404500	4965500
921086		SMITHS CORNER	HANTS	1992-11-02	73.08	6.09	2.44	-0.03	18.16	140	DRILLED	Domestic	402500	4968500
921150		VAUGHAN	HANTS	1992-06-18	30.45	6.09	1.83	3.04	3.18	103	DRILLED	Domestic	402500	4965500
930716		VAUGHAN	HANTS	1993-07-15	73.08	6.09	0.61		4.54	131	DRILLED	Domestic	402500	4966500
930717		VAUGHAN	HANTS	1993-07-15	30.45	6.09	0.91		13.62	131	DRILLED	Domestic	402500	4966500
930718		VAUGHAN	HANTS	1993-07-15	54.81	6.09	0.30		36.32	159	DRILLED	Domestic	405500	4964500
931514		VAUGHAN	HANTS	1993-07-15	91.35	6.09	2.13	1.52	11.35	119	DRILLED	Domestic	403500	4966500
940075	ARMSTRONG LAKE	VAUGHAN	HANTS	1994-05-11	62.42	6.70	1.22		7.72	159	DRILLED	Domestic	405500	4964500
940370	VAUGHAN	SMITHS CORNER	HANTS	1994-07-09	30.45	6.09	3.04	6.09	36.32	95	DRILLED	Domestic	403500	4967500
940608		VAUGHAN	HANTS	1994-06-26	66.99	6.09	0.91		6.81	153	DRILLED	Domestic	404500	4966500
940609		VAUGHAN	HANTS	1994-06-26	24.36	6.09	0.91		36.32	167	DRILLED	Domestic	405500	4966500
940626		VAUGHAN	HANTS	1994-07-26	60.90	6.09	1.52		4.54	167	DRILLED	Domestic	405500	4966500
940666		UPPER VAUGHAN	HANTS	1994-08-27	42.63	6.09	1.52		11.35	167	DRILLED	Domestic	405500	4962500
940667		SMITHS CORNER	HANTS	1994-08-27	66.99	6.09	0.30		13.62	153	DRILLED	Domestic	402500	4967500
942101	ARMSTRONG LAKE	VAUGHAN	HANTS	1994-12-05	53.29	6.09	1.52			159	DRILLED	Domestic	405500	4964500
950250		SMITHS CORNER	HANTS	1995-03-09	66.99	30.45	27.40		22.70	95	DRILLED	Domestic	403500	4967500
950261		VAUGHAN	HANTS	1995-04-25	54.81	6.09	1.52		6.81	131	DRILLED	Domestic	402500	4966500
950333		VAUGHAN	HANTS	1995-07-12	115.71	6.09	1.83		0.91	133	DRILLED	Domestic	402500	4964500
950341		VAUGHAN	HANTS	1995-07-25	48.72	6.09	1.52		6.81	160	DRILLED	Domestic	405500	4965500
950342		SMITHS CORNER	HANTS	1995-07-25	54.81	6.09	1.52		11.35	153	DRILLED	Domestic	402500	4967500
951465	MOCKINGIGH LAKE	VAUGHAN	HANTS	1995-02-27	24.36	20.40	18.27	12.18	45.40	103	DRILLED	Domestic	402500	4965500
951499		VAUGHAN	HANTS	1995-06-07	97.44	6.09	2.44	4.57	9.08	131	DRILLED	Domestic	402500	4966500
951603	CHATEAU VILLAGE, WINDSOR	SMITHS CORNER	HANTS	1995-12-20	127.89	6.09	2.13		6.81	153	DRILLED	Domestic	402500	4967500
951615		UPPER VAUGHAN	HANTS	1995-08-31	97.44	17.36	16.75		9.08	149	DRILLED	Domestic	402500	4962500
951678		VAUGHAN	HANTS	1995-11-01	30.45	6.09	2.44		227.00	153	DRILLED	Domestic	402500	4967500
951679		VAUGHAN	HANTS	1995-11-01	30.45	6.09	3.04		22.70	172	DRILLED	Domestic	406500	4964500
951684		VAUGHAN	HANTS	1995-11-09	54.81	6.09			6.81	153	DRILLED	Domestic	402500	4967500
951687	VAUGHAN	SMITHS CORNER	HANTS	1995-11-22	79.17	6.09	1.83		2.27	153	DRILLED	Domestic	402500	4967500
951698	VAUGHAN	SMITHS CORNER	HANTS	1995-12-09	42.63	6.09			13.62	153	DRILLED	Domestic	402500	4967500
961054	56 WHITE TAIL LANE	SMITHS CORNER	HANTS	1996-10-09	103.53	6.09	1.22		2.27	132	DRILLED	Domestic	403500	4969500
962512	1641 NEW ROSS ROAD	VAUGHAN	HANTS	1996-12-12	39.58	12.79	10.05	1.98	14.53	131	DRILLED	Domestic	402500	4966500
970225		VAUGHAN	HANTS	1997-05-13	79.17	6.09	0.91		68.10	159	DRILLED	Domestic	405500	4964500
970227	VAUGHAN	SMITHS CORNER	HANTS	1997-05-15	121.80	6.09	1.52		2.27	121	DRILLED	Domestic	401349	4968596
970230		VAUGHAN	HANTS	1997-05-23	85.26	6.09	3.04		68.10	116	DRILLED	Domestic	401478	4968652
970268		VAUGHAN	HANTS	1997-07-08	27.40	6.09	0.61		68.10	116	DRILLED	Domestic	401478	4968652
970269	VAUGHAN	SMITHS CORNER	HANTS	1997-07-08	91.35	21.62	19.79		11.35	95	DRILLED	Domestic	403500	4967500
971213	VAUGHAN	SMITHS CORNER	HANTS	1997-07-28	73.08	6.09	2.44		27.24	108	DRILLED	Domestic	401426	4968204
971214	VAUGHAN	SMITHS CORNER	HANTS	1997-07-28	42.63	6.70	4.87	3.04	54.48	102	DRILLED	Domestic	401469	4968299
971215	VAUGHAN	SMITHS CORNER	HANTS	1997-07-29	91.35	6.09	4.87		4.54	104	DRILLED	Domestic	401443	4968169
971255	VAUGHAN	SMITHS CORNER	HANTS	1997-09-03	109.62	6.09	1.52		27.24	116	DRILLED	Domestic	401478	4968652
971256	VAUGHAN	SMITHS CORNER	HANTS	1997-09-04	152.25	6.09	2.13		9.08	109	DRILLED	Domestic	401476	4968517
980043	434 PIONEER DRIVE	VAUGHAN	HANTS	1998-04-21	53.29	6.09	0.30	3.65	13.62	103	DRILLED	Domestic	402500	4965500
980264		VAUGHAN	HANTS	1998-05-21	30.45	6.09	4.87		45.40	159	DRILLED	Domestic	405500	4964500
980265		VAUGHAN	HANTS	1998-05-22	30.45	6.09	1.22		34.05	159	DRILLED	Domestic	405500	4964500
980266		VAUGHAN	HANTS	1998-05-23	109.62	6.09	2.44		11.35	159	DRILLED	Domestic	405500	4963500
980293	VAUGHAN	SMITHS CORNER	HANTS	1998-06-24	66.99	6.09	1.83		4.54	107	DRILLED	Domestic	401500	4968500
980294		VAUGHAN	HANTS	1998-06-24	79.17	6.09	3.65		5.45	159	DRILLED	Domestic	405500	4964500
981734	124 SUMMIT RIDGE	VAUGHAN	HANTS	1998-10-06	48.72	6.09	0.91		13.62	131	DRILLED	Domestic	402500	4966500
982597	MARTOCK	VAUGHAN	HANTS	1998-10-08	30.45	10.66	8.53		181.60	175	DRILLED	Domestic	404500	4965500
982599	FULFORD	SMITHS CORNER	HANTS	1998-10-15	44.15	6.24	3.65	3.04	9.08	95	DRILLED	Domestic	403500	4967500
982600	FALLS LAKE WEST, NEW ROSS CROSS ROAD	VAUGHAN	HANTS	1998-10-16	30.45	10.35	6.09		20.43	104	DRILLED	Domestic	401500	4966500
982601	21 FALLS LAKE WEST, COTTAGE COUNTRY	VAUGHAN	HANTS	1998-10-16	48.72	6.09			9.08	104	DRILLED	Domestic	401500	4966500
982613	HIGHWAY #14	VAUGHAN	HANTS	1998-12-16	66.99	6.09	2.44		9.08	159	DRILLED	Domestic	405500	4964500
982636	1017 CHESTER ROAD	UPPER VAUGHAN	HANTS	1998-06-09	33.50	6.09	1.83	0.61	36.32	149	DRILLED	Domestic	402500	4962500
990360		VAUGHAN	HANTS	1999-05-03	97.44	6.09			27.24	131	DRILLED	Domestic	402500	4966500

Well Number	Address	Community	County	Date Inserted	Well Depth (m)	Casing Depth (m)	Bedrock Depth (m)	Static (m)	Yield (Lpm)	Elevation (m)	Well Type	Water Use	Easting	Northing
990361		SMITHS CORNER	HANTS	1999-05-03	30.45	6.09			29.51	153	DRILLED	Domestic	402500	4967500
990380		VAUGHAN	HANTS	1999-05-25	115.71	6.09	4.26		11.35	131	DRILLED	Domestic	402500	4966500
990381		VAUGHAN	HANTS	1999-05-26	36.54	19.49	17.66		22.70	119	DRILLED	Domestic	403500	4966500
991122		SMITHS CORNER	HANTS	1999-09-18	60.90	6.09	0.30		18.16	153	DRILLED	Domestic	402500	4967500
991434	RR#1 NEW ROSS	SMITHS CORNER	HANTS	1999-09-11	36.54	12.18	10.35		11.35	95	DRILLED	Domestic	403500	4967500
991851		VAUGHAN	HANTS	1999-11-11	49.63	9.14	1.83		45.40	103	DRILLED	Domestic	402500	4965500
991883		SMITHS CORNER	HANTS	1999-09-16		6.09	1.83	7.61	68.10	89	DRILLED	Domestic	403678	4968125
991916		UPPER VAUGHAN	HANTS	1999-07-27	38.06	7.61	6.09	10.66	363.20	116	DRILLED	Domestic	402500	4963500
991919	FALLS LAKE	UPPER VAUGHAN	HANTS	1999-07-27	31.97	10.66	8.53	10.66	90.80	149	DRILLED	Domestic	402500	4962500
992895		SMITHS CORNER	HANTS	1999-05-21	53.29	6.09				153	DRILLED	Domestic	402500	4967500
Statistics			**Minimum**	**1966-07-14**	**2.74**	**2.44**	**0.30**	**-0.03**	**0.05**	**13**				
			Maximum	**2020-12-30**	**164.43**	**59.68**	**52.07**	**76.12**	**454.00**	**244**				
			Average	**n/a**	**64.36**	**9.84**	**5.32**	**6.60**	**29.99**	**127**				

APPENDIX E
CBCL TECHNICAL SUMMARY REPORT - FISH AND FISH HABITAT, WATER QUALITY, AQUATICS, AND TURTLE HABITAT ASSESSMENTS



Proposed Bear Lake Wind Farm
Technical Summary Report

Fish and Fish Habitat, Water Quality, Aquatics, and Turtle Habitat Assessments

FINAL Report

CBCL

221266.01 • May 19, 2023

01	FINAL	L. Hardwick	19-May-2023	C. Thorpe
00	DRAFT	L. Hardwick	3-Apr-2023	C. Thorpe
Rev.	Issue	Reviewed By:	Date	Issued By:

Project No. 221265.01

May 19, 2023

Glenn Goudey
Manager, Environment – T&D
Nova Scotia Power
glenn.goudey@nspower.ca

RE: Environmental Studies at Proposed Bear Lake Wind Site – FINAL Aquatics Technical Summary Report

Dear Glenn:

CBCL Limited is pleased to provide Nova Scotia Power Incorporated with the final Bear Lake Aquatics Technical Summary Report. We trust this report meets your expectations, and we appreciate the opportunity to work with NSPI on this project

Yours very truly,

CBCL Limited

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CC: I. Bryson, CBCL

Project No.: 221265.01

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Acronyms and Abbreviations

%	Percent
‰	Per Thousand
°C	Degrees Celsius
>	Greater than
µg	Microgram
µg/cm	Microgram per centimetre
AC CDC	Atlantic Canada Conservation Data Centre
$CaCO_3$	Carbonate Hardness
CBCL	CBCL Limited
CEAA	Canadian Environmental Assessment Act
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
cm	Centimetre
DFO	Fisheries and Oceans Canada
E	East / Easting
EA	Environmental Assessment
GIS	Geographic Information System
GPS	Global Positioning System
IAAC	Impact Assessment Agency Canada
iBoF	Inner Bay of Fundy
L	Litre
m	Metre
mg	Milligram
mg/L	Milligrams per litre
mm	Millimetre
m/s	Velocity
mV	Millivolts
N	North / Northing
NS ECC	Nova Scotia Environment and Climate Change
NS DNRR	Nova Scotia Department of Natural Resources and Renewables
NSPI	Nova Scotia Power Inc.
NTU	Nephelometric Turbidity Unit
pH	Power of hydrogen
ppt	Parts Per Thousand
the Project	Bear Lake Wind Project
RISC	British Columbia Resources Information Standards Committee
ROW	Right-of-Way
QA/QC	Quality Assurance / Quality Control
s	Second
SAR	Species at Risk
SARA	Species at Risk Act

SoCC	Species of Conservation Concern
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
UTM	Universal Transverse Mercator
VEC	Valued Ecosystem Component
VES	Visual Encounter Survey
WC	Watercourse

1 Introduction

1.1 Overview & Purpose

Nova Scotia Power Inc. (NSPI) is proposing the Bear Lake Wind Farm (the Project) in Hants County, Nova Scotia. CBCL Limited (CBCL) was contracted by NSPI to complete an assessment of watercourses and turtle habitat that could be affected by the proposed Bear Lake Project as part of a preliminary environmental constraints analysis.

The objective of this technical data report is to provide baseline information on the existing conditions for the aquatic environment; specifically, fish and fish habitat, turtle habitat, and water quality. The data collected will be used to support further design and an environmental impact assessment of the Bear Lake Project.

1.2 Project Boundaries

The Project is located in Hants County, Nova Scotia. The Project area is located along HWY 14 approximately 15 kms from the junction of HWY 1 and HWY 14 near Windsor, NS and spans approximately 14 km north to south. The communities of Smiths Corner and Upper Vaughan are located to the west of the Project area. The approximate centre of the Project area is at UTM 20 T 404544m E and 4959543m N (Figure 1, Appendix A). The Project Area is defined as the anticipated footprint for the proposed development; this includes areas of vegetation clearing, ground disturbance, and construction that will be required. At the time of completion of this report the detailed Project design had not been finalized and was subject to change. Any changes in the design or location of Project components may not be captured or accurately represented by the information presented in this report.

The Study Area for the aquatic environment was assessed in two components—a Preliminary Study Area and a Detailed Study Area (see Figure 1 Appendix A):

- Preliminary Study Area for watercourse identification consisted of the area within a 150-m radius around each planned turbine site and 50 m on either side of the centreline of planned roads, substations, and laydown areas

- Detailed Study Area for detailed assessment of watercourses consisted of the area within a 400 m zone of influence[1] for access road crossings (i.e., 100 m upstream of the crossing to 300 m downstream)

Preliminary watercourse identification surveys were carried out within the Study Area. Detailed assessments were conducted on watercourses deemed to be, or have the potential to be, fish-bearing as determined during the preliminary survey completed in summer and fall of 2022.

Surveys within the Study Area were implemented to collect watercourse and habitat information in the Project Area and to accommodate adjustment of the Project footprint during the design phase. In some cases, surveys extended beyond the Study Area where deemed prudent by the assessors to appropriately characterize the aquatic environment.

The Study Area for the Project was divided into 25 quaternary watersheds, fourth order watershed of two main rivers: the Avon River and St. Croix River. Of these 25 quaternary watersheds, 23 were identified to be impacted by the proposed Project infrastructure or access roads.

1.3 Regulatory Setting

The Project is subject to the provincial EA process; however, the regulatory setting described in this report is specific to the regulatory regime for fish and fish habitat, and Wood Turtles and their habitat, relevant to construction and operation of the Project. Some of the applicable legislation pertinent to fish, fish habitat, and Wood Turtles is outlined below.

1.3.1 Federal

1.3.1.1 Fisheries Act

The federal *Fisheries Act* provides protection to fish and fish habitat in Canada and is administered by Fisheries and Oceans Canada (DFO). The *Fisheries Act* is applicable to permanent and seasonal fish habitat. Sections of the *Fisheries Act* that may be relevant to the construction and operation of the Project are as indicated below:

- Section 34(1). Deleterious substances
- Section 34.2(1). Establishment of codes of practice for protection of fish
- Section 34.3(1),(2),(4),(7). Protection of fish passage
- Section 34.4(1). Death of fish
- Section 35(1). Harmful alteration, disruption or destruction of fish habitat

[1] The zone of influence was determined to be the most likely extent of disturbance from construction of the Project with appropriate mitigation measures implemented.

- Section 35.2(1). Work in an ecologically significant area

DFO Codes of Practice and relevant guidance documents may be applicable to the implementation of the Project in order to protect fish and fish habitat. These would be implemented during the construction and operation phases of a project.

1.3.1.2 Species at Risk Act

The federal *Species at Risk Act* (SARA) provides a governmental commitment to prevent wildlife species, including aquatic species, from becoming extinct and to secure the necessary actions for their recovery. The Act provides legal protection to wildlife species and conservation of their biological diversity. Sections of SARA that may be relevant to the construction and operation of the Bear Lake Project are, but not limited to, as presented below:

- Section 27. List of Wildlife Species at Risk
- Section 32. General Prohibitions on killing or harming species
- Section 33. General Prohibition on damaging or destroying a species' residence
- Section 56. Protection of Critical Habitat
- Section 73. Agreements and Permits
- Section 80. Emergency Orders to protect critical habitat of a specific wildlife species
- Section 85. Enforcement Measures

Should the Project require a permit to allow the disturbance of an aquatic species at risk, the *Fisheries Act* Authorization can act as a SARA permit, with DFO reviewing the provided information and issuing the permit.

1.3.2 Provincial

1.3.2.1 Environment Act

Nova Scotia Environment and Climate Change (NS ECC) administers the provincial regulations for alterations to wetlands and watercourses including culvert installation and modifications through Watercourse Alteration Approval Applications or Notifications.

Designated activities that require an Approval or Notification are stated in the Activities Designation Regulations, under Section 66 of the provincial *Environment Act*. Applicable Project activities that may trigger an Approval or Notification are as per the following sections:

- Section 5A (2). Approval
  - Altering a watercourse, water resource, or wetland
- Section 5B (1). Notification
  - (a) Watercourse Alterations to improve fish habitat, unless exempt under Section 5D if all the following conditions are met:
    - (i) watercourse is altered for less than 15 m.
    - (ii) the work is done by hand or equipment.
    - (iii) the work occurs between June 1 and September 30.

- (b) Constructing or modifying a single culvert, or closed-bottom structure, for the purpose of a road, railbed, trail or footpath crossing, if:
  - (i) Culvert is less than 25 m in length.
  - (ii) Watercourse slope is less than 8.0%.
  - (iii) Watershed is 20 km^2 or less in area.
  - (iv) work occurs between June 1 and September 30.

- Section 5C. Qualifications for certain alterations
  - (1) Structure described in 5(B)(1)(b) to be installed in a watercourse with a slope of less than or equal to 0.5% must be sized by a Watercourse Alteration Sizer or professional engineer.
  - (2) Structure described in 5(B)(1)(b) to be installed in a watercourse with a slope between 0.5% and 8.0% must be designed by an engineer.
- Section 5D. Exemptions
  - (e) maintaining alterations or structures associated with activities designated in subsections 5A (1) and (2) and clauses 5B(1)(a) to (d), if works if work is done above the ordinary high-water mark.

Where the proposed works do not alter the bed or bank of a watercourse, no approval or notification from NS ECC is required.

1.3.2.2 Endangered Species Act

The provincial *Endangered Species Act* (ESA) protects species in Nova Scotia that have been assessed and are at risk of extinction. The Act is applicable to all flora and fauna species in the province that require protection and ranks species in categories based on risk. Sections of the ESA that may be applicable to the Project during construction or operation are, but may not be limited to, as presented below:

- Section 12(1). Listing of Species at Risk
- Section 13(1). Prohibitions
- Section 14(1). Issuance of a permit
- Section 22(1). Contravention of the Act

Permitting requirements for the ESA are administered by the NS Department of Natural Resources and Renewables. Where works associated with the Project may impact a species at risk or its habitat, a permit may be required to allow the work to proceed, as described in Section 14 of the Act.

2 Methodology

The following section describes the methods used for the desktop and field data collection programs for the Project.

2.1 Desktop Review

Background reports, literature, available information from NSPI, and publicly available databases and information sources related to aquatic environment were reviewed prior to the start of the preliminary field survey. Available information was reviewed for the following within the Bear Lake Study Area:

- Known or mapped watercourses
- Locations of known spawning, overwintering, or important fish habitat
- Known species presence and distribution
- Occurrence or possible occurrence of turtle species, as well as their seasonal habitat requirements

Additional information sources used include the following:

- *Reptiles and Amphibians of the Atlantic Maritime Ecozone* (McAlpine, 2010)
- *Amphibians of Nova Scotia* (Gilhen, 1984)
- *Natural History of Nova Scotia* (Davis and Browne, 1996)
- NSDNR's Significant Species and Habitats database
- A project-specific AC CDC data request (AC CDC, 2023)
- *The ROM field guide to amphibians and reptiles of Ontario* (MacCulloch, 2002)
- Records within the Nova Scotia Herpetafauna Atlas iNaturalist project
- Species at Risk in Nova Scotia: Identification and Information Guide (MTRI, 2008)
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports for turtle species in NS
- Personal knowledge of CBCL ecologists

Existing biophysical features within the proposed Study Area were mapped using available geospatial data.

2.2 Preliminary Survey

A preliminary survey of the proposed Project Right-of-Way (ROW) and access roads was conducted by CBCL biologists to identify and classify, watercourses within the study corridor that may be crossed by the Project. Additionally, identified watercourses were assessed to determine which of those are potential permanent and/or fish-bearing watercourses. Watercourses that were identified as possibly supporting fish habitat or possibly permanent were selected for additional detailed assessment.

The preliminary survey was conducted in the Preliminary Study Area by a minimum of two experienced field staff who travelled along the proposed Project corridor to classify and assess the known watercourses and to identify and classify field-identified watercourses not shown on existing maps.

2.3 Detailed Fish Habitat Assessment

The detailed assessment generally followed the assessment methods presented in the BC Reconnaissance 1:20 000 Fish and Fish Habitat Inventory: Standards and Procedures (BC MoE, 2001) and the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt a Stream, 2018). The detailed assessment focussed on those watercourses that were deemed to be fish-bearing, possibly fish-bearing, or permanent in nature. Detailed assessments covered a 400 m area: 100 m upstream of the proposed watercourse crossing or Project interaction location (at intervals of 50 m) to 300 m downstream (at intervals of 100 m). The assessment locations represent areas that could be monitored throughout the construction and operations periods of the Project to provide comparisons to baseline (upstream) and impacted areas (downstream).

For the detailed fish habitat assessment, the selected watercourses were assessed for the following parameters:

- Channel width (m)
- Wetted width (m)
- Water depth (m)
- Pool depth (m)
- Bankfull depth (m)
- Water velocity (seconds per metre (sec/m))
- Water quality (e.g., temperature (^{o}C), turbidity (NTU), pH, dissolved oxygen (mg/L))
- Channel characteristics and morphology (e.g., pattern, islands, confinement)
- Substrate type and percent (e.g., gravels, cobble (see Table 2.1))
- Instream cover (e.g., overhanging vegetation, undercut banks)
- Crown closure (percentage (%))
- Riparian vegetation
- Fish habitat type and quality (e.g., spawning, overwintering)
- Potential for fish presence (based on habitat, water quality, barriers, etc.)

- Barrier or other features (e.g., waterfalls, beaver dams, perched culverts)
- Photographs (upstream, downstream, right and left bank, important features)
- Incidental observations of other features, including flora or fauna
- UTM locations

Watercourses substrate was classified based on their size described in Table 2.1.

Table 2.1 Substrate sizes and classes (Wentworth Scale (Wentworth, 1922))

Substrate Type	Size
Fines (e.g., sand, silt)	< 2 mm
Small Gravel (e.g., pebbles)	2 to 16 mm
Large Gravel (e.g., pebbles)	17 to 64 mm
Cobble	65 to 256 mm
Boulder	> 256 mm
Bedrock	Continuous slab (> 2m diameter)

Watercourses were classified based on their potential for permanence as described in Table 2.2. Those watercourses with characteristics of another watercourse type, e.g., Intermittent with Ephemeral Characteristics, were described as such, but included with the leading watercourse type.

Table 2.2 Watercourse Type Descriptions

Watercourse Type	Average Channel Width	Description
Large Permanent	> 5 m	• Defined channel • Defined bed, banks, floodplain • Year-round flows
Small Permanent	2 to 5 m	• Defined channel • Defined bed, banks, floodplain • Year-round flows
Intermittent	< 2 m	• Defined channel • Defined bed and banks • Seasonal flows
Ephemeral	No defined channel or surface flow only	• No defined channel • No defined bed or banks or floodplain • Typically only contains water after rain events or snow melt

Spawning, rearing, staging/holding and overwintering fish habitat in each watercourse was evaluated based on the characteristics described below.

- Spawning habitat quality was based on water flow and substrate (i.e., large and small gravels) and location of pools and or instream vegetation.
- Rearing habitat quality was based on instream cover type and abundance, water flow, and downstream habitat connectivity.
- Overwintering habitat quality was based on the presence or absence of deep pools or ponds (≥50 cm (minimum)), water quality and the potential for year-round flow.

The potential for fish presence year-round was based on the results of water quality measurements (Section 2.3) habitat quality at the time of the assessment, the quality of overwintering and spring/summer habitat and upstream/downstream connectivity of the watercourse to other watercourses.

2.4 Water Quality

2.4.1 In Situ Surface Water Quality Sampling

During the detailed watercourse assessments, *in situ* water quality parameters were measured at field sites using a handheld YSI Multimeter unit or a Horiba unit. The YSI multimeter or Horiba units were calibrated prior to use in the field and maintained according to manufacturer specifications. Field locations chosen for surface water sampling were based on those identified for further assessment by the preliminary survey. The following water quality parameters were measured at each detailed assessment site:

- Temperature (^{o}C)
- pH
- Conductivity (µS / cm)
- Turbidity (Clear, Low, Moderate, Turbid)
- Total Dissolved Solids (mg / L)
- Oxidation Reduction Potential (mV)
- Dissolved Oxygen (mg / L and % Saturation)
- Salinity (‰)

Water quality parameters (i.e., temperature, pH, and dissolved oxygen) measured in the field were compared to the water quality limits[2] and tolerance ranges presented in Table 2.3 to provide a likelihood of fish presence.

[2] Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME, 2017) and Brook Trout tolerance and optimal ranges for water quality (Raleigh, 1982)

Table 2.3 Water Quality Limits for the Protection of Aquatic Life and Salmonids (CCME, 2017)

Water Quality Parameter	CCME Water Quality Guideline for the Protection of Aquatic Life (CCME 2017)	Brook Trout Tolerance and Optimum Range (Raleigh 1982)
pH	6.5 to 9.0	Tolerance: 4.0 to 9.5 Optimal: 6.5 to 8.0
Temperature (°C)	N/A	Tolerance: 0.5 to 22 Optimal: 11.0 to 16.0
Dissolved Oxygen (mg/L)	Cold water: 6.5 to 9.5	Tolerance: ≥ 5.0 Optimal: ≥ 7.0

2.4.2 Laboratory Analysis

Surface water quality samples collected during the detailed watercourse assessments were set to the Bureau Veritas Laboratories in Bedford, NS for analysis. Bureau Veritas Laboratories is a Standards Council of Canada accredited laboratory.

Water quality sampling stations were chosen based on the preliminary survey and the locations of permanent watercourses. Surface water quality samples were collected in laboratory-supplied bottles. Nitrile gloves were used during sampling events and each of the four sample bottles were submerged in the flowing watercourse to collect samples. All sampling locations were collected upstream of existing anthropogenic structures (e.g., bridge, culvert) at a sufficient distance (i.e., greater than 10 m) to avoid direct influence in the sample matrix.

Analytical results were compared to the Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (NSE Tier 1 EQS Freshwater) for Surface Water (Fresh Water Receptor Pathway) (NS ECC, 2021) and the CCME guidelines.

Samples were analysed for the following parameters:

- Carbonate, Bicarbonate and Hydroxide
- Alkalinity
- Chloride
- Colour
- Conductance – water
- Hardness (calculated as $CaCO_3$)
- Total Metals (30 metals analysed)
- Ion Balance (% Difference)
- Anion and Cation Sum
- Nitrogen Ammonia – water
- Nitrogen – Nitrate + Nitrite
- Nitrogen – Nitrite

- Nitrogen – Nitrate (as N)
- pH (1)
- Phosphorus – ortho
- Sat. pH and Langelier Index (@20°C)
- Sat. pH and Langelier Index (@4°C)
- Reactive Silica
- Sulphate
- Total Dissolved Solids (TDS calc)
- Organic Carbon – Total (TOC) (2)
- Turbidity

2.5 Aquatic Invertebrate Presence

The presence of aquatic invertebrates, within assessed watercourses, was determined through observations of invertebrates during selected examination of instream substrates. At each assessed watercourse at least three rocks, within the watercourse channel, were flipped over or lifted out of the water and examined for the presence of aquatic invertebrates or larvae. A record of invertebrate presence was recorded based on the prevalence of invertebrates in assessed areas (i.e., number of locations where invertebrates were observed versus total number of areas sampled). Abundance of aquatic of invertebrates were rated on a scale of none, trace (< 5%), low (5 to 20%), moderate (20 to 60%), and high (>60%).

2.6 Turtle Habitat Assessments

CBCL biologists evaluated the Bear Lake Study for the presence of suitable turtle habitat features within the identified watercourses intersecting the Project Area. Turtle habitat assessments were conducted during the detailed watercourse assessments, and generally covered a minimum of 50 m up- and down-stream of a planned crossing. In some instances, these distances varied, depending on access and watercourse conditions.

Survey details and environmental conditions such as temperature, cloud cover, wind speed and precipitation were recorded for each assessment site. Additionally, other environmental conditions, such as water temperature, pH, and flow conditions were recorded. Stream characteristics were determined based on flow conditions (dry, low, mid, high, floodplain), water clarity (clear, tannic, turbid, zero visibility), velocity (flat, slow, moderate, fast, turbulent), and dominant substrate (silt, sand, gravel, cobble, boulder). Observations of aquatic and riparian vegetation were also documented.

CBCL evaluated habitat features of the watercourses and surrounding riparian areas to determine habitat quality in terms of summer habitat, overwintering sites, nesting sites,

and foraging potential for each possibly occurring turtle species. Table 2.4 outlines the environmental data assessed for each watercourse and defines preferred habitat types for each of the three target turtle species.

Turtle habitat requirements were then compared against the general watercourse types, to assess potential use of each watercourse by each turtle species. Table 2.5 summarizes the general suitability of each watercourse category as habitat for the three turtle species. In general, watercourses that were determined to be likely fish-bearing were considered to be also suitable for turtles, particularly Wood Turtles.

Incidental sightings of any turtles or evidence of such were also recorded by CBCL field staff during the vegetation inventory, wetland and watercourse reconnaissance, detailed wetland assessment, and detailed watercourse surveys conducted for the Bear Lake Project between August and December 2022.

Table 2.4 Definitions of potentially suitable habitats for target turtle species in the Study Area

Turtle Habitat Type	Watercourse Assessment Criteria	Description of Suitable Habitats, by Species		
		Wood Turtle	Common Snapping Turtle	Eastern Painted Turtle
Summering and Basking	• Watercourse category/ size • Water depth • Flow conditions • Water quality • Water clarity • Velocity • Substrate type	Terrestrial woody and/ or grassy habitats adjacent to permanent watercourses with higher velocities and rocky substrates.	Waterbodies / permanent watercourses with lower velocities and soft sediments.	Waterbodies / permanent watercourses with lower velocities and soft sediments.
Overwintering	• Presence of deep pools, root masses of large trees, undercut banks, oxbows, large woody debris, log jams, and boulders • Sediment type (soft vs. rocky) • Apparent flow rate, • Water depth, • Sediment depth.	Permanent watercourses or waterbodies with deep pools, root masses of large trees, undercut banks, oxbows, large woody debris, log jams, and boulders.	1) Waterbodies / permanent watercourses with logs, sticks, or overhanging banks in small streams that flow continuously throughout the winter; 2) Submerged logs and stumps, sometimes silt-covered, within 5 m of lake shorelines; or	Waterbodies / permanent watercourses with shallow water depths (<0.5 m) and thick sediment layers (> 50 cm).

Turtle Habitat Type	Watercourse Assessment Criteria	Description of Suitable Habitats, by Species		
		Wood Turtle	Common Snapping Turtle	Eastern Painted Turtle
			3) Deep anoxic mud in marshy areas or beneath floating mats of vegetation in watercourse or waterbodies.	
Nesting	• Presence of sand or sand-gravel areas (sand bars, cut banks along watercourse, areas of over-washed sand in open floodplains) • Degree of canopy cover/ level of sun exposure • Aspect/compass direction	Areas of sand or gravel-sand beaches, banks of streams, sidebars, over-washed areas, in-stream sand-gravel bars, or gravel pits, road shoulders, and decommissioned railway beds.	Sand and gravel banks along waterways, including artificial dam and railway embankments, muskrat houses, abandoned beaver lodges, road shoulders, fissures in rocky shorelines, sawdust heaps, and forest clearings.	Areas of sand, loam, clay, and/or gravel substrates usually within 1.2 km of their aquatic habitats, in areas of open canopy, sloped with southern exposure, such as the shorelines of lakes and wetlands, beaver dams, or sand dunes.
Foraging	• Availability of vegetative food sources in watercourse and adjacent riparian zone[3]	Areas with abundant alder, willow, strawberry, blackberry, violets, mushrooms and grasses.	Areas with abundant aquatic or wetland vegetation, such as filamentous algae, duckweed, pondweed, cattail, sedge, and water lily.	Areas with abundant algae and aquatic plants, such as duckweed, pondweed, cattail, sedge, and water lily.

[3] Assessment of potential invertebrate and vertebrate food sources was not considered feasible.

Table 2.5 General Suitability of Watercourse Types for Target Turtle Species, by Species and Habitat Requirements.

Species	Watercourse Category		
	Ephemeral / Intermittent	Small Permanent	Large Permanent
Wood Turtle	• Unsuitable summering habitat • Suitable foraging habitat • Unsuitable for overwintering	• Possibly suitable summering habitat, depending on velocity and substrate • Suitable foraging • Unsuitable for overwintering	• Possibly suitable summering habitat, depending on velocity and substrate • Suitable foraging habitat • Possibly suitable for overwintering, depending on watercourse features • Possibly suitable for nesting, depending on if large gravels sidebars are present
Eastern Painted Turtle	• Unsuitable summering habitat • Suitable foraging habitat • Unsuitable for overwintering	• Possibly suitable summering habitat, depending on velocity and substrate • Suitable foraging habitat • Unsuitable for overwintering	• Possibly suitable summering habitat, depending on velocity and substrate • Possibly suitable foraging habitat, depending on watercourse features • Possibly suitable for overwintering, depending on watercourse features
Common Snapping Turtle	• Unsuitable summering habitat (though may be used by juveniles moving between waterbodies) • Unsuitable for foraging • Unsuitable for overwintering	• Possibly suitable summering habitat, depending on velocity and substrate • Suitable foraging habitat • Unsuitable for overwintering	• Possibly suitable summering habitat, depending on velocity and substrate • Possibly suitable foraging habitat, depending on watercourse features • Possibly suitable for overwintering, depending on watercourse features

2.7 Survey Dates

All watercourse assessment work for the Project was conducted by CBCL biologists or environmental scientists between August and December 2022. Preliminary surveys were conducted between August and October 2022, while detailed watercourse assessments were conducted between late-October and mid-December 2022.

The typical survey methods for Wood Turtles in NS (Nova Scotia Department of Natural Resources and Renewables (NS DNRR)'s *2018 Wood Turtle Survey Protocol*) could not be used due to the survey timing, and so the surveys focused on identifying possibly suitable habitat for individual turtle species. No turtle survey methods have been specified for Snapping Turtles or Eastern Painted Turtles, but the spring wood turtle survey method is generally considered sufficient for these species (Maureen Cameron-MacMillan, NS DNRR Regional Biologist, pers. comm, March 2023).

2.8 Data Management

CBCL organized the collected field data for the Project based on the watersheds and watercourses surveyed and assessed. Preliminary survey data was uploaded to the CBCL Project database and used to identify the watercourses where detailed habitat assessments and water quality analysis was required.

2.9 QA/QC

CBCL implemented a quality assurance and quality control (QA/QC) program to evaluate the precision and accuracy of all data collected for the Project, which included the application of unique site identifiers, adherence to applicable field procedures, labelling and proper storage of all field samples, and delivery of samples to be analysed at the laboratory as per sample requirements. Chain of custody forms and laboratory QA/QC measures were followed.

Field data collection followed the protocols described in Section 2.3. Field data were reviewed by an experienced fisheries biologist for accuracy prior to analysis and reporting.

During field work, various QA/QC measures were undertaken, including the following:

- Use of laboratory supplied/prepared containers for samples
- Use of disposable nitrile gloves when handling and collecting samples
- Use of laboratory supplied storage coolers
- Maintaining samples at a cool temperature in a secure location,
- Keeping samples under direct custody until delivery to the laboratory
- Laboratory submission within required hold times
- Implementation of field duplicate samples and travel blanks, as required

3 Results

The results of the preliminary watercourse reconnaissance surveys and detailed assessments are provided in the following section. A total of 61 watercourses, drainages, and water features were identified and assessed during the Project field assessments. Watercourses and watersheds within the Study Area are presented in Appendix A.

3.1 Watercourse Summary

Within the Project Area a total of 61 watercourses were identified during the initial mapping review and preliminary survey. Of the initially defined watercourses, 12 were determined to be fish-bearing or likely fish-bearing and subject to a detailed assessment, while the remaining 49 were determined to be non-fish-bearing. The majority of the watercourses assessed had either poor quality or no fish habitat, while those with the potential for fish habitat were usually had mostly moderate or poor-quality for all main habitat categories (e.g., spawning, foraging, etc.). Detailed fact sheets for the identified fish-bearing and non-fish-bearing watercourses are provided in Appendix B.

In general, the majority of the watercourses within the Project Area were small intermittent or ephemeral drainages, with little or no habitat present that would be suitable to support a population of fish. Only eight watercourses were considered as permanent watercourses. Many of the watercourses observed or assessed were anthropogenically influenced existing roads, or tree harvest areas, and had minimal natural fish habitat potential.

No large permanent watercourses were identified within the Study Area, as the larger primary watershed level streams (e.g., Avon River/St. Croix River) were downstream of the Study and Project Areas.

3.1.1 Fish-bearing

Preliminary watercourse assessments conducted within the Study Area were based on the existing mapped or known watercourses, including those previously identified as fish-bearing. Fish-bearing watercourses were categorized as such based on the biophysical characteristics observed and measured, water quality parameters, and observed fish presence and/or observed suitable fish habitat and are presented in Appendix A, Figure 2. Watercourses located during initial mapping and preliminary surveys that were identified

as permanent and fish-bearing or had the potential to be fish-bearing, were marked for detailed watercourse assessments. Summary results for fish-bearing watercourses are provided in Table 3.1.

Table 3.1 Fish-bearing watercourse summary

Watercourse ID	Quaternary Watershed ID	Watercourse Name	Watercourse Classification	Avg. Channel Width (m)	Avg. Wetted Width (m)	Avg. Bankfull Depth (m)	Avg. Water Depth (m)	Avg. Pool Depth (m)	Dominant Substrate	Dominant Instream Cover	Overall Habitat Quality	Spawning	Rearing	Foraging	Migration	Overwintering	Potential for Fish Presence
BL-WC105-1267	105	Unnamed Tributary #4 to South Branch Avon River	Small Permanent with Intermittent Characteristics	1.6	1.6	0.2	0.2	0.3	Gravel		Moderate	Moderate	Moderate	Good	N/A	Moderate	High
BL-WC106f-2773	106f	Unnamed Tributary #6 to Black Brook	Intermittent with Ephemeral Characteristics	1.7	1.4	0.4	0.1		Fines	Overhanging Vegetation	Poor	Poor	Moderate	Moderate	Poor	Poor	High
BL-WC106g-2780	106g	Unnamed Tributary #7 to Black Brook	Intermittent with Ephemeral Characteristics	1.23	1.05	0.37	0.14	0.32	Fines	Overhanging Vegetation	Poor	Poor	Poor-Moderate	Poor	Poor	Poor	Moderate
BL-WC106g-2958	106g	Unnamed Tributary #7 to Black Brook	Intermittent	1.2	0.9	N/A	0.3	0.13	Gravel	Overhanging Vegetation	Moderate	Poor	Moderate	Moderate	N/A	Poor	Moderate
BL-WC201a-3333	201a	Unnamed Tributary #1 to Southwest Brook	Small Permanent with Intermittent Characteristics	2.2	2.17	6.75	0.18		Fines		Moderate	Poor	Good	Good	N/A	Poor	High
BL-WC201a-3772	201a	Unnamed Tributary #1 to Southwest Brook	Small Permanent	3.78	3.20	0.71	0.2	0.45	Cobble	Instream Vegetation	Good	Good	Moderate	N/A	N/A	Moderate	High
BL-WC201c-3446	201c	Southwest Brook	Small Permanent	2.3	2.1	0.3	0.2	0.33	Gravel	Instream Vegetation	Good	Moderate	Good	N/A	N/A	Poor	High
BL-WC202a-2795	202a	Unnamed Tributary #1 to Armstrong River	Intermittent	1.77	1.43	0.4	0.33	0.5	Gravel	Overhanging Vegetation	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
BL-WC202a-3383	202a	Unnamed Tributary #1 to Armstrong River	Intermittent with Ephemeral Characteristics	1.6	1.5	N/A	0.3	0.4	Gravel	Overhanging Vegetation	Poor	Poor	Moderate	Moderate	N/A	Poor	High
BL-WC202d-669	202d	Unnamed Tributary #4 to Armstrong River	Small Permanent	2.03	1.7	N/A	N/A	0.3	Fines	Undercut Banks	Moderate	Moderate	Moderate	Poor	Moderate	Moderate	Moderate
BL-WC202e-2187	202e	Unnamed Tributary #5 to Armstrong River	Intermittent	1.1	1.01	0.45	0.11	0.3	Fines	SWD	Moderate	Poor	Moderate	N/A	N/A	Moderate	Moderate
BL-WC202e-3441	202e	Unnamed Tributary #5 to Armstrong River	Small Permanent	2.79	2.3	0.85	0.19	0.44	Fines, Gravel		Good	Moderate	Good	Moderate	Moderate	Moderate	High

Notes: (BLANK – No Data Recorded); N/A – Parameter not measurable; NH no habitat

3.1.2 Non-Fish-bearing

Watercourses were identified as being non-fish-bearing drainages during the mapping review or preliminary field surveys if they displayed any of the following characteristics:

- Surface drainage only
- Not contained within a channel
- Had no evidence of scour
- Isolated roadside ditches
- Drainage features with no evidence of fish habitat
- Dry at the time of survey with no identified water input

These features were assessed based only on visible physical characteristics (e.g., substrates, channel size), unless sufficient water was present to allow for water quality measurements. No additional detailed survey was completed for these watercourses.

Of the 49 watercourses in the Study Area determined to be non-fish-bearing watercourses, 31 watercourses were ephemeral, eight were ephemeral with intermittent characteristics, three were intermittent with ephemeral characteristics, and two were small permanent drainage areas. Summary results for non-fish-bearing watercourses are provided in Table 3.2.

Table 3.2 Non-fish-bearing watercourse summary.

Watercourse ID	Quaternary Watershed ID	Watercourse Classification	Avg. Channel Width (m)	Avg. Wetted Width (m)	Avg. Bankfull Depth (m)	Avg. Water Depth (m)	Dominant Substrate	Dominant Instream Cover	Overall Habitat Quality	Potential for Fish Presence
BL-WC102-2198	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-2585	102	Ephemeral with Intermittent Characteristics	0.66	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-2822	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-3948	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-3949	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-3950	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-3951	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-3952	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-815	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-851	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-869	102	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC102-891	102	Ephemeral with Intermittent Characteristics	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC105-3953	105	Ephemeral	N/A	1	1.6	0.1	N/A	N/A	NH	None
BL-WC106d-3955	106d	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None

Watercourse ID	Quaternary Watershed ID	Watercourse Classification	Avg. Channel Width (m)	Avg. Wetted Width (m)	Avg. Bankfull Depth (m)	Avg. Water Depth (m)	Dominant Substrate	Dominant Instream Cover	Overall Habitat Quality	Potential for Fish Presence
BL-WC106f-334	106f	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC106f-3947	106f	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC106g-2084	106g	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC106g-3957	106g	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC106h-2528	106h	Ephemeral	0.9	0.45	0.24	0.07	Fines	N/A	NH	None
BL-WC201a-1338	201a	Intermittent	1.1	N/A	0.3	N/A	N/A	N/A	NH	None
BL-WC201a-1442	201a	Ephemeral with Intermittent Characteristics	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201a-3954	201a	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201a-938	201a	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201a-965	201a	Ephemeral with Intermittent Characteristics	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201a-967	201a	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201a-971	201a	Ephemeral with Intermittent Characteristics	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201b-1420	201b	Small Permanent	1.6	1.1		0.22	N/A	N/A	NH	None
BL-WC201b-2350	201b	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None

Watercourse ID	Quaternary Watershed ID	Watercourse Classification	Avg. Channel Width (m)	Avg. Wetted Width (m)	Avg. Bankfull Depth (m)	Avg. Water Depth (m)	Dominant Substrate	Dominant Instream Cover	Overall Habitat Quality	Potential for Fish Presence
BL-WC201b-3193	201b	Ephemeral with Intermittent Characteristics	1.9	0.83	N/A	0.07	N/A	N/A	NH	None
BL-WC201b-3242	201b	Intermittent with Ephemeral Characteristics	1.6	1.1	N/A	0.22	N/A	N/A	NH	None
BL-WC201c-1062	201c	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201c-2236	201c	Intermittent with Ephemeral Characteristics	1	0.8	0.27	0.14	N/A	N/A	NH	None
BL-WC201c-2834	201c	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201c-2840	201c	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201c-2844	201c	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201c-3177	201c	Intermittent	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC201c-3281	201c	Ephemeral	1.3	1	0.3	0.1	Gravel	N/A	NH	None
BL-WC202a-3956	202a	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC202b-2137	202b	Ephemeral with Intermittent Characteristics	1.8	1.5		0.15	Cobble	N/A	NH	None
BL-WC202b-2553	202b	Intermittent with Ephemeral Characteristics	1.4	1.4	N/A	1.8	N/A	N/A	NH	None
BL-WC202b-576	202b	Ephemeral	1	1		1.5	N/A	N/A	NH	None
BL-WC202c-3224	202c	Ephemeral	1.3	1.2	N/A	N/A	Fines	N/A	NH	None

Watercourse ID	Quaternary Watershed ID	Watercourse Classification	Avg. Channel Width (m)	Avg. Wetted Width (m)	Avg. Bankfull Depth (m)	Avg. Water Depth (m)	Dominant Substrate	Dominant Instream Cover	Overall Habitat Quality	Potential for Fish Presence
BL-WC202d-2810	202d	Small Permanent with Intermittent Characteristics	0.6	0.6	0.2	0.15	N/A	N/A	NH	None
BL-WC202e-2174	202e	Intermittent	1	0.87	N/A	0.14	N/A	N/A	NH	None
BL-WC202e-2209	202e	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None
BL-WC202e-2213	202e	Ephemeral with Intermittent Characteristics	0.37	0.3	N/A	0.07	N/A	N/A	NH	None
BL-WC202e-2980	202e	Intermittent	1.1	0.9	N/A	0.47	N/A	N/A	NH	None
BL-WC202e-3096	202e	Intermittent	1.5	1.5	2	1.8	N/A	N/A	NH	None
BL-WC202g-144	202g	Ephemeral	N/A	N/A	N/A	N/A	N/A	N/A	NH	None

Notes: (BLANK – No Data Recorded); N/A – Parameter not measurable; NH no habitat

3.2 Watercourse Preliminary Survey Summary

Watercourses identified during the initial mapping review as being potential drainages or watercourses were divided into 25 quaternary watersheds within the proposed Project area. The quaternary watersheds and identified watercourses are shown in Appendix A, Figure 2. All identified watercourses within the Study Area were visited during the preliminary survey to determine the likelihood for permanency, fish habitat, and fish presence.

While a total of 61 watercourses were identified during the preliminary survey, a large number of other depressions and possible surface drainages were noted, but not measured. These additional identified undefined drainages did not contain water, had no potential for fish habitat, did not have a defined channel, or were otherwise deemed unlikely to be part of the watershed drainage system, and therefore not assessed. A total of 12 (19.7%) watercourses were determined to be fish-bearing, or likely fish-bearing, and included in the detailed assessment phase of the baseline data collection.

3.3 Watercourse Detailed Assessment Summary

The results from the detailed assessment of the 12 fish-bearing watercourses are provided in the following sections, by quaternary watershed within the Study Area.

All watercourses assessed as part of the detailed assessment are shown on Figure 2, Appendix A. Possibly fish-bearing watercourses were found in eight of the 25 quaternary watersheds within the Study Area. All 10 of the quaternary watersheds with fish-bearing watercourses were tributaries of just two primary watersheds, the Avon River / St. Croix River, which drains to the Bay of Fundy.

The quaternary watersheds identified to have fish-bearing watercourses are as follows:

1. Watershed 105 – Unnamed Tributary #4 to South Branch Avon River
2. Watershed 106f – Unnamed Tributary #6 to Black Brook
3. Watershed 106g – Unnamed Tributary #7 to Black Brook
4. Watershed 201a – Unnamed Tributary #1 to Southwest Brook
5. Watershed 201c – Southwest Brook
6. Watershed 202a – Unnamed Tributary #1 to Armstrong River
7. Watershed 202d – Unnamed Tributary #4 to Armstrong River
8. Watershed 202e – Unnamed Tributary #5 to Armstrong River

A summary of data collected during detailed assessments for fish-bearing watercourses, by watershed, are provided in the following sections.

3.3.1 Watershed 105 – Unnamed Tributary #4 to South Branch Avon River

Within the Unnamed Tributary #4 to South Branch Avon River quaternary watershed, two watercourses were identified as possibly fish-bearing in the Project Study Area during the initial mapping review or during the preliminary survey. These two watercourses were assessed or visited within this watershed during the detailed assessment phase. Of these two, only one watercourse was determined to be likely fish-bearing. Details on the key watercourses found within this watershed are described below.

3.3.1.1 BL-WC105-1267

Watercourse BL-WC105-1267, is a small permanent watercourse with intermittent characteristics that is a tributary to the South Branch Avon River. The average channel and wetted widths were both 1.6 m. The dominant substrate was gravels with undercut banks deep pools and overhanging vegetation providing the most instream cover. The riparian areas were composed of mature forest with stable banks. Water quality was within recommended CCME guidelines for the protection of Aquatic Life (CCME, 2016) for dissolved oxygen. The recorded pH values were outside of them CCME guidelines. Water quality details are provided in Table 3.3, below. The watercourse moved along a sinuous path for its assessed length. Upstream of the crossing, the watercourse flows underground, and this poses a potential barrier to fish passage; however, suitable habitat for fish was observed in the Study Area.

Photo 3-1 Looking downstream from crossing at watercourse channel.

3.3.2 Watershed 106f – Unnamed Tributary #6 to Black Brook

Three watercourses within Watershed 106f were identified for detailed assessment. Of these three, only one, BL-WC106f-2773, was determined to be possibly fish-bearing.

3.3.2.1 BL-WC106f-2773

Watercourse BL-WC106f-2773 (tributary to Black Brook; Photo 3-2) was an intermittent with ephemeral characteristics watercourse that generally had poor conditions for fish. The average channel width was 1.7 m, with an average wetted width of 1.4 m. Water depth was on average less than 0.1 m with no deep pools. The dominant substrate was fines, with overhanging vegetation providing the main form of cover. The riparian area was composed of mature forest with stable banks. Water quality was outside of the CCME guidelines for aquatic life for DO and pH.[4] Upstream of the crossing the watercourse loses channelization.

[4] CCME Guidelines for pH are 6.5-9 and DO 6.5 to 9.5 mg/L, anything outside this range (i.e., greater then or less then) is considered outside the CCME guidelines.

No fish were observed during the assessment. However, overall, the likelihood for fish in this section of watercourse was determined to be high.

Photo 3-2 Looking downstream, from crossing, at channel.

3.3.3 Watershed 106g – Unnamed Tributary #7 to Black Brook

Five watercourses were identified as possible fish habitat within this watershed during preliminary surveys. Of these five, only two were determined to be likely fish-bearing.

3.3.3.1 BL-WC106g-2780

Watercourse BL-WC106g-2780 (tributary to Black Brook; Photo 3-3) was an intermittent watercourse with ephemeral characteristics that generally had poor conditions for fish. The average channel width was 1.23 m, with an average wetted width of 1.05 m. Water depth

was on average was 0.14 m with an average deep pool depth of 0.32 m. The dominant substrate was fines, with overhanging vegetation providing the main form of cover. The riparian area was composed of young forest with fairly stable banks. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines. Upstream of crossing the watercourse loses channelization. No fish were observed and overall, the likelihood of fish in this section of watercourse was determined to be moderate.

Photo 3-3 Looking upstream, from crossing at watercourse.

3.3.3.2 BL-WC106g-2958

Watercourse BL-WC106g-2958 was a small, intermittent watercourse (Photo 3-4). Average channel and wetted widths were 1.20 m and 0.90 m, respectively. Average water and pool depths were 0.09 m and 0.13 m. Dominant substrate was gravel with overhanging vegetation as the dominant instream cover type. Watercourse banks were poorly stable and vegetated with young forest. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). Overall, habitat quality within the assessed watercourse was moderate. The likelihood of fish presence was determined to be moderate. A sunken culverts was observed under an existing access road and may limit or prevent fish access upstream.

Photo 3-4 Looking upstream at the watercourse from the crossing location.

3.3.4 Watershed 201a – Unnamed Tributary #1 to Southwest Brook

Eight watercourses were identified in this watershed for detailed assessment; however, only two watercourses, were determined to be permanent and possibly fish-bearing.

3.3.4.1 BL-WC-201a-3333

Watercourse BL-WC-201a-3333 (unnamed Tributary #1 to Southwest Brook) was a small permanent watercourse with intermittent characteristics (Photo 3-5). The watercourse had an average channel and wetted width of 2.2 m and 2.17 m, respectively. Average water depth was 0.18 m with no deep pools. Watercourse morphology was cascade, confined, and had a straight pattern. Dominant substrate was fines, with large woody debris as the dominant instream cover types. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). A small salmonid was observed within the watercourse.

Photo 3-5 Location where small Salmonid was observed.

3.3.4.2 BL-WC201a-3772

Watercourse BL-WC201a-3772 (Southwest Brook) was a frequently confined, small permanent watercourse (Photo 3-6). The watercourse was sinuous with run morphology. Average channel and wetted widths were 3.78 m and 3.20 m, respectively. Average water and pool depths were 0.20 m and 0.45 m, respectively. The dominant instream substrate was cobble; instream vegetation was the dominant instream cover type. Watercourse banks were vegetated with mature forest. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). Overall, fish habitat quality was classified as good, including for spawning, and overwintering was classified as moderate. A possible redd was identified in the watercourse. No barriers were observed within the assessed areas.

Photo 3-6 Upstream of crossing, looking upstream.

3.3.5 Watershed 201c – Southwest Brook

Eight watercourses were identified in this watershed for detailed assessment; however, only one watercourse, BL-WC-201c-3446, was determined to be permanent and possibly fish-bearing.

3.3.5.1 BL-WC-201c-3446

Watercourse BL-WC-201c-3446 was a small permanent watercourse (Photo 3-7). The watercourse moved through an unconfined area with average channel and wetted widths of 2.3 m and 2.10 m, respectively. Average water and pool depths were 0.20 m and 0.33 m. Potential spawning habitat was observed within the assessed reach. Dominant substrate was gravel, with instream vegetation being the dominant type of cover present. Large amounts of blown down was also present in and around the watercourse. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). A possible fish barrier was located downstream of crossing it appears the water course has been partial filled in to aid in crossing.

Photo 3-7 Partial barrier downstream of crossing.

3.3.6 Watershed 202a – Unnamed Tributary #1 to Armstrong River

Three watercourses were identified as possibly fish-bearing within this watershed during preliminary surveys. Of these three, only two were determined to be possibly fish-bearing.

3.3.6.1 BL-WC202a-2795

Watercourse BL-WC202a-2795, a tributary to the Armstrong River, was field identified as an intermittent watercourse (Photo 3-8). The watercourse flows in a straight pattern and is confined. Average channel and wetted widths were 1.77 m and 1.43 m, respectively. Average water and pool depths were 0.33 m and 0.50 m. Dominant substrate was gravel, with overhanging vegetation, providing the majority of available cover. Overall fish habitat quality was moderate, with moderate spawning, rearing, foraging, and overwintering habitat. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). Due to private land the downstream portion of this water course could not be assessed.

Photo 3-8 Looking upstream at crossing location.

3.3.6.2 BL-WC202a-3383

Watercourse BL-WC202a-3383, a tributary to the Armstrong River, was an intermittent watercourse with ephemeral characteristics (Photo 3-9). The watercourse flows in a regular meander pattern and is unconfined. Average channel and wetted widths were 1.6 m and 1.5 m, respectively. Average water and pool depths were 0.3 m and 0.4 m. The dominant instream substrate was gravel, with overhanging vegetation being the dominant cover type. Water quality was outside of the CCME guidelines for aquatic life for pH and DO (Table 3.3). Overall, fish habitat quality in the assessed section of the watercourse was poor; however, rearing and foraging, were noted to be of moderate quality. Likelihood of fish presence potential was high. The watercourse flows underground in the upstream section. Due to private land the downstream portion of this water course could not be assessed.

Photo 3-9 Looking upstream at crossing location.

3.3.7 Watershed 202d – Unnamed Tributary #4 to Armstrong River

Two watercourses were identified as possibly fish-bearing within this watershed during preliminary surveys. Of these two, only one, BL-WC202d-669, was determined to be possibly fish-bearing.

3.3.7.1 BL-WC202d-669

Watercourse BL-WC202d-669, a tributary to the Armstrong River, was an intermittent watercourse with ephemeral characteristics (Photo 3-10). The watercourse had a sinuous morphology and was unconfined within the assessed area. Average channel and wetted widths were 2.03 m and 1.7 m, respectively. Dominant substrate was fines, with subdominant gravel and cobble. The dominant instream cover type was undercut banks. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). Overall, habitat quality was moderate within the assessed area, despite good and poor habitat quality noted for rearing and foraging habitat, respectively. The likelihood for fish presence was moderate. Potential

barriers were noted in the assessed area log debris and a drop and damaged culvert at crossing.

Photo 3-10 Looking downstream at crossing location.

3.3.8 Watershed 202e – Unnamed Tributary #5 to Armstrong River

Seven watercourses were identified as possibly fish-bearing within this watershed during preliminary surveys. Of these seven, only two were determined to be likely fish-bearing.

3.3.8.1 BL-WC202e-2187

Watercourse BL-WC202e-2187 (Tributary to Armstrong River) is an intermittent watercourse (Photo 3-11). The watercourse was frequently confined along the assessed length. Average channel and wetted widths were 1.1 m and 1.01 m, respectively. Average water and pool depths were 0.11 m and 0.3 m. Dominant substrate was fines; instream cover was dominated by small woody debris. Riparian area was vegetated with mature, mixed forest. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). Overall, likelihood of fish presence was assessed as moderate. The downstream section is also fed by roadside ditch. Due to private property only the upstream portion of the crossing could be assessed.

Photo 3-11 Small cascade feature upstream.

3.3.8.2 BL-WC-202e-3441

Watercourse BL-WC-202e-3441 (Tributary to Armstrong River) was a confined, small permanent watercourse (Photo 3-12). The watercourse was sinuous with run morphology. Average channel and wetted widths were 2.79 m and 2.3 m, respectively. Average water and pool depths were 0.19 m and 0.44 m. Dominant instream substrates were fines and gravel, with deep pools, undercut banks, small/large woody debris, boulder, and overhanging vegetation as the trace instream cover type. Watercourse banks were vegetated with mature forest. Water quality was outside of the CCME guidelines for aquatic life for pH. However, DO values were within CCME guidelines (Table 3.3). Overall, fish habitat quality was classified as good, with spawning, foraging, migration, and overwintering classified as moderate. Blocked culvert is washing out road at crossing and may be a barrier to fish. A cascade feature downstream may also be a potential barrier to small fish. A waterfall was noted downstream as a potential full barrier to fish passage in the assessed area of the watercourse.

Photo 3-12 Downstream habitat.

3.4 Water Quality Analysis Summary

3.4.1 In Situ Surface Water Quality Sampling

Surface water quality was collected during the detailed assessments at the 12 likely fish-bearing watercourses in the Study Area. The water quality parameters that were measured are detailed in Section 2.4.1 of this report. In-situ measurements collected during the detailed assessments are provided, by watercourse, in Table 3.3.

Table 3.3 In Situ Water Quality Measurements at Detailed Assessment Sites

Watercourse ID	Temperature (°C)	pH	Dissolved Oxygen		Conductivity (µs/cm)	Salinity (ppt)	Total Dissolved Solids (g/L)	Turbidity (NTU)
			mg/L	%				
BL-WC105-1267	6.8	4.01	6.89	NA	50	0.02	0.032	6.7
BL-WC106f-2773	4.86	5.06	4.89	NA	24	0.01	0.016	45.7
BL-WC106g-2780	4.91	4.22	7.63	NA	38	0.02	0.024	4.1
BL-WC106g-2958	4.07	4.59	10.6	NA	30	0.01	0.019	NA
BL-WC201a-3333	8.7	4.7	9.80	84.9	29.7	0.02	NA	NA
BL-WC201a-3772	8.1	4.6	12.65	108	33.33	0.02	NA	NA
BL-WC201c-3446	9.61	4.59	12.03	NA	32	NA	0.021	5.8
BL-WC202a-2795	4.25	4.84	8.45	NA	24.0	0.01	0.016	2.5
BL-WC202a-3383	4.26	4.88	6.15	NA	22	0.01	0.014	3.0
BL-WC202d-669	2.3	6.3	10.16	75.2	26.7	0.01	0.018	NA
BL-WC202e-2187	7.23	4.75	9.21	NA	42	0.02	0.027	8.5
BL-WC202e-3441	6.47	4.14	9.9	NA	42.0	0.02	0.027	4.5

Water quality measurements were used to inform fish habitat quality and likelihood of fish presence classifications at each watercourse. Water quality measurements for pH ranged between 4.01 (low) and 6.30 (high). Dissolved oxygen (mg/L) ranged between 4.89 (low) and 12.65 (high). Although not sampled at every site, turbidity ranged from 2.5 to 45.7 Nephelometric Turbidity Units (NTU). The turbidity measurement at BL-WC106f-2773 (45.7 NTU), was an outliner and was approximately five times greater than the second highest measurement. All sites had low salinity of between 0.01 and 0.02 parts per thousand (ppt), along with low conductivity (≤ 50 μS/cm) and low total dissolved solids (TDS) of between approximately 0.014 and 0.032 g/L.

3.4.2 Laboratory Analysis

CBCL collected surface water samples for laboratory analysis from a total of 13 sites, as per the parameters listed in Section 2.4.2, during the detailed watercourse assessments. The results, by sampling location are presented in table format, by sampling location and parameter measurement in Appendix C.

Results were compared against Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Surface Water for Fresh Water Receptor Pathway (NSE Tier 1 EQS Freshwater) and CCME guidelines. Exceedances of guidelines are presented below:

- All samples were less than NSE Tier 1 EQS Freshwater and CCME guidelines for pH with a range of 4.14 to 6.06.
- Three samples—WQ-6, WQ-8, and WQ-10—were less than the CCME guidelines for dissolved oxygen.
- All samples exceeded NSE Tier 1 EQS Freshwater and CCME guidelines for total aluminum.
- All samples, except for WQ-13 and WQ-14, exceeded NSE Tier 1 EQS Freshwater and CCME guidelines for total iron.
- Three samples WQ-1, WQ-3, and WQ-7 exceeded NSE Tier 1 EQS Freshwater and CCME guidelines for total lead.
- Four samples WQ-6, WQ-7, WQ-11, and WQ-15 exceeded CCME guidelines for total zinc.
- One sample, WQ-15, exceeded the CCME guidelines for total cadmium.

3.5 Aquatic Invertebrates

Aquatic invertebrates were investigated at the centreline / crossing location for each of the detailed watercourse assessment locations. The presence of aquatic invertebrates was noted throughout the detailed assessment area and varied in abundance from none or trace to abundant. Generally, aquatic invertebrates were present at few sites where there was good cobble and/or boulder substrates. Identified aquatic inverts included caddisflies, alderflies and stoneflies other invertebrates may be present during other times of the year. Abundance of aquatic invertebrates was used in determining classification of fish habitat, including foraging habitat.

3.6 Fish Species Identified

Fish capture studies were not completed as part of the baseline aquatic studies and any observations of fish within the watercourses, in the Study Area, as part of the preliminary survey or detailed assessment were recorded, identified if possible, and noted.

Fish were observed in one watercourse during the detailed assessments. The fish observed in WC-BL-201a-3333 was identified as a likely salmonid, most likely a Brook Trout (*Salvelinus fontinalis*).

Possible spawning nests (redds) were identified in three watercourses (BL-WC202a-2795, BL-WC201c-3446, and BL-WC201a-3772), likely from spawning salmonids.

The likelihood for fish species presents in the area was determined from the background information review, as no fish capture studies were completed for the Project. Based on the available background information, the fish species that had the likelihood to be present in, or near, the Project Area are presented in Table 3.4. This is not a complete list, but based on known information about fish presence in, or near, the general area of the Project.

Table 3.4 Fish Species Observed or Possibly Present in Project Area

Species Name	Scientific Name	Observed In Project Area
American eel	*Anguilla rostrata*	No
Atlantic Salmon	*Salmo salar*	No*
Brook Trout	*Salvelinus fontinalis*	Yes*
Brown Bullhead	*Ameiurus nebulosus*	No
Gaspereau (Alewife)	*Alosa pseudoharengus*	No
Smallmouth Bass	*Micropterus dolomieu*	No
White Sucker	*Catostomus commersonii*	No
Lake Chub	*Couesius plumbeus*	No
Creek Chub	*Semotilus atromaculatus*	No
Common Shiner	*Luxilus cornutus*	No
Golden Shiner	*Notemigonus crysoleucas*	No
Threespine Stickleback	*Gasterosteus aculeatus*	No
Ninespine Stickleback	*Pungitius pungitius*	No

Note: *One salmonid identified most likely Brook trout, negligible chance of it being an Atlantic salmon.

Brief descriptions of the species that were observed or likely present in the Project area are provided below.

Brook Trout (*Salvelinus fontinalis*)
Brook Trout is a freshwater char, a salmonid and a relative of the Atlantic Salmon. They are found in a variety of watercourse types, but prefer cold, clear waters with sections of good flow, and cover. They are, however, found in a wide range of habitats, including beaver ponds, as they are more tolerant of less-than-optimal conditions compared to other salmonids (Raleigh, 1982). They are known to tolerate a pH as low as 4.0. Brook Trout are carnivorous and opportunistic feeders and will eat a variety of other smaller fish, insects, invertebrates, and small vertebrates. Brook Trout are found in many areas of Nova Scotia since they are often stocked in lakes for sport fisheries. Despite this, they are listed as S3 in Nova Scotia and vulnerable by the AC CDC.

3.7 Fish Species at Risk

There is the possibility for the following fish SAR to occur near the Project Area none of which were observed during the preliminary or detailed field assessments:

Common Name	Species Name	COSEWIC / SARA/ NS ESA	NS S-Rank
Atlantic Salmon iBoF Pop. DU1[5]	*Salmo salar*	Endangered – Schedule 1	S1
American Eel[6]	*Anguilla rostrata*	Threatened	S3N (Non-Breeding Pop.)
Alewife (Gaspereau)	*Alosa pseudoharengus*	Vulnerable	S3B

Although Brook Trout has been listed as Vulnerable (S3) in Nova Scotia it is not considered a species at risk federally (AC CDC, 2023).

3.8 Turtle Habitat Assessment Results

Results of the desktop review and habitat assessment for turtles are described in the following subsections.

3.8.1 Desktop Review

Nova Scotia is home to four species of freshwater turtles, all of which are now considered a species at risk under SARA and/or the NS ESA or a species of conservation concern. Of these four, three have distribution ranges within Nova Scotia that encompass the Bear Lake Study Area (Table 3.5). Turtle species expected to occur in the Study Area are similar

[5] DFO 2010.
[6] COSEWIC 2012

to those encountered throughout much of the Southwest Nova Scotia Uplands ecoregion (Zone 124 in McAlpine and Smith (2010)). McAlpine lists three turtle species from this ecoregion (Common Snapping Turtle, Eastern Painted Turtle, and Blandings Turtle), with the fourth, the Wood Turtle, being of uncertain presence. Blandings Turtle in Nova Scotia exists in small relict populations restricted to a few watersheds in central southwestern area of the province, which are geographically isolated from the rest of the species' range (Herman et al.1995). They have not been reported from within Hants County and so are not expected to occur in the vicinity of the Bear Lake Study Area.

No turtle species were reported within 5 km by the AC CDC (AC CDC, 2023); though three of the four potential species listed in McAlpine (2010) were reported within 20 km by the AC CDC (Table 3.5). iNaturalist hosts a record of a Common Snapping Turtle reported nesting in nearby Martock, which is less than 8 km from the Bear Lake Study Area. Species and occurrence records are listed in Table 3.5.

Table 3.5 Turtle Species Reported in Southern Nova Scotia Uplands, NS (McAlpine, 2010, AC CDC, 2023).

Common Name	Species Name	COSEWIC / SARA/ NS ESA	NS S-Rank	Nearest AC CDC Record (km)
Wood Turtle	*Glyptemys insculpta*	T/T/ T	S2	18.2 ± 5.0
Snapping Turtle	*Chelydra serpentina*	SC/SC/V	S3	14.2 ± 0.0
Eastern Painted Turtle	*Chrysemys picta picta*	SC/SC/-	S4	10.8 ± 0.0

T= Threatened – A species likely to become endangered if limiting factors are not reversed.
V= Vulnerable – a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
SC- Special Concern - A species that has characteristics that make it particularly sensitive to human activities or natural events

General descriptions of each species and their habitat requirements are provided in the following subsections.

3.8.1.1 Wood Turtle (*Glyptemys insculpta*)

The Wood Turtle (*Glyptemys insculpta*) is a medium-sized turtle with an adult carapace length of up to 25 cm (COSEWIC, 2007). Occurring only in eastern North America, Wood Turtles are patchily distributed within the Canadian provinces: Nova Scotia, New Brunswick, southern and eastern Québec, and south-central Ontario (COSEWIC, 2007). Within Nova Scotia, the number of adult individuals has been estimated to be 2,000-7,000; however, on a local scale, populations typically consist of less than 100 individuals (Environment Canada, 2016). Wood Turtles have been reported in 31 watersheds throughout Nova Scotia (MacGregor and Elderkin, 2003), with concentrations in Guysborough and Annapolis Counties (Mersey Tobeatic Research Institute, 2008). Table 3.6 provides a summary of their known seasonal habitat requirements.

Table 3.6 Habitat Requirements of Wood Turtles in Eastern Canada (COSEWIC, 2007).

Summering and Basking Habitat (Active Season):	• Wood Turtles are semiaquatic and considerably more terrestrial than other turtle species in NS. • Strongly associated with permanent meandering rivers and streams with moderate current and sand or gravel substrates. • During spring, summer, and early fall, Wood Turtles use riparian habitats and upland forests surrounding their home rivers. • Forest mosaics and open-canopy areas are the most commonly used/ preferred terrestrial habitats. • May disperse up to several hundred metres from a watercourse and several kilometres up or downstream from overwintering sites. • May bask on large boulders, and fallen logs along rivers, especially early in the season when temperatures are cooler.
Nesting Habitat:	• Nesting occurs in June and July. • Natural nesting habitat consists of sand or gravel-sand beaches or banks of streams that receive moderate to intense exposure to sun. • Females lay a single clutch of eggs annually in areas containing loose substrate (i.e., sand and small to large gravel), such as sidebars, over-washed areas, and in-stream sand-gravel bars. • May also nest in open anthropogenic sites such as gravel pits, road shoulders, and decommissioned railway beds. • Hatchlings emerge in fall and move to water.
Overwintering Habitat	• Overwinter underwater in streams, rivers, and occasionally ponds. • May use deep pools (>0.5 m), or under root masses of large trees; undercut or overhanging banks; oxbows; large woody debris; log jams; or boulders as suitable overwintering sites.
Foraging Habitat & Diet	• Forage in terrestrial or wetland habitats within close proximity to their river/stream, such as bogs, marshy pastures, oxbows, beaver ponds, shrubby cover, meadows, coniferous forests, mixed forests, hay and agricultural fields and pastures. • Dietary plants include strawberries, blackberries, hawthorne, cinquefoil, violets, algae, moss, willow, algae, and mushrooms, as well as alder leaves and grasses. • Protein sources include molluscs, insects, tadpoles, earthworms, newborn mice, and possibly eggs (MacGregor and Elderkin, 2003, COSEWIC, 2007).

3.8.1.2 Common Snapping Turtle (*Chelydra serpentina*)

The Common Snapping Turtle (*Chelydra serpentina*) is a well-known, large freshwater turtle with a distinctive keeled carapace which has been reported to reach 50 cm in length. Snapping Turtles occur throughout the United States and Canada east of the Rocky Mountains. In the Maritimes, the Common Snapping Turtle occurs throughout mainland Nova Scotia (Scott, 2002) and has recently been confirmed to have a population on Cape Breton Island (Power and Gilhen, 2018).

This species' long lifespan, slow maturity, and low rate of reproduction result in snapping turtles being particularly vulnerable to threats (COSEWIC, 2008). Some populations appear to be declining and local populations are very sensitive to increased adult mortality (Environment Canada, 2016). Table 3.7 provides a summary of the known seasonal habitat requirements in eastern Canada.

Table 3.7 Habitat Requirements of Snapping Turtles in Eastern Canada (COSEWIC, 2008).

Summering and Basking Habitat (Active Season):	• Slow-moving water with a soft mud bottom and dense aquatic vegetation. • Established populations are most often located in ponds, sloughs, shallow bays or river edges and slow streams, or areas combining several types of wetland habitat (Harding, 1997). • While they generally only go on land to nest or move to a larger water body, Snapping Turtles may bask on offshore logs and rocks, depending on environmental temperature (Obbard and Brooks, 1979; Brown et al., 1990).
Nesting Habitat:	• Nesting takes place in June and July. • Females generally nest on sand and gravel banks along waterways, including artificial dam and railway embankments, but muskrat houses, abandoned beaver lodges, road shoulders, fissures in rocky shorelines, sawdust heaps, freshly dug soil, gardens, lawns and forest clearings have all been selected as nest sites with unknown success (Obbard and Brooks, 1980; Ernst et al., 1994; Congdon et al., 2008). • Hatchlings emerge in fall, move to water, and bury themselves under leaf litter or debris.
Overwintering Habitat	• Three types of hibernacula have been documented for adult Snapping Turtles in Ontario (Brown and Brooks, 1994): o ***Stream sites*** - Turtles bury themselves beneath logs, sticks, or overhanging banks in small streams that flow continuously throughout the winter.

	o ***Lakeshore sites*** - Turtles wedge beneath or beside submerged logs and stumps, sometimes covered in silt, within 5 m of the shoreline. o ***Muddy sites*** - turtles are buried in deep anoxic mud in marshy areas or beneath floating mats of vegetation.
Foraging Habitat & Diet	• Diet is more plant than protein-based, though they will scavenge recently dead animals. • May eat water shield (Brasenia schreberi spp.), filamentous algae (*Spirogyra* spp.), duckweed (*Lemna* spp.), pondweed. (*Potamogeton* and *Elodea* spp.), cattail (*Typha*), sedge (*Carex* spp.) and water lily (*Nymphaea* spp.). • Protein sources include invertebrates, fish, frogs, reptiles (including snakes and smaller turtles), unwary birds, and small mammals (Bergeron et al., 2007). • Young Snapping Turtles actively forage for food, whereas older individuals tend to be ambush predators.

3.8.1.3 Eastern Painted Turtle (*Chrysemys picta picta*)

The Painted Turtle (*Chrysemys picta*) is a well-known, relatively colourful small to medium-sized freshwater turtle. It is the most widespread native turtle in North America. In eastern North America, the Eastern Painted Turtle (subspecies *picta)* occurs in New Brunswick, and mainland Nova Scotia, extending south to the Atlantic coastal states east of the Appalachian Mountains. This species is subject to a suite of continuing threats, including habitat loss and road mortality, which are unlikely to diminish in the future. Although data on declines of this species are limited (particularly in Nova Scotia where overall life history knowledge s rather limited) the 'slow' life history of turtles increases vulnerability and constrains population resilience to these threats (COSEWIC, 2018). The Eastern Painted Turtle is currently ranked as Special Concern under both COSEWIC and SARA but is not listed under the NS ESA. The AC CDC ranks the Eastern Painted Turtle as S4 in Nova Scotia.

Table 3.8 provides a summary of the known seasonal habitat requirements of Eastern Painted Turtles in Nova Scotia, some of which has been extrapolated from eastern Canadian areas within its range due to lack of local data.

Table 3.8 Habitat Requirements of Eastern Painted Turtles in Eastern Canada (COSEWIC, 2018).

Summering & Basking Habitat (Active Season)	• Prefers slow moving, relatively shallow and well-vegetated wetlands (e.g., swamps, marshes, ponds, fens, bogs, and oxbows) and water bodies (e.g., lakes, rivers, creeks, and streams) with abundant basking sites and organic substrates which support emergent plant species (COSEWIC, 2018). • Juveniles prefer shallower water, perhaps for foraging and the avoidance of aquatic predators, transitioning to deeper water as they grow larger (Congdon et al., 1992). • Often associated with submergent aquatic plants including *Nuphar, Nymphaea, Potamogeton,* and *Pontederia* spp. (Bleakney, 1958; Gilhen, 1984), which offer cover and feeding opportunities (Moldowan et al., 2015). • Adults may spend half the year submerged in wetlands with very low dissolved oxygen. • Bask frequently on sunny fallen trees, logs, lily tubers, and rocks in water bodies or along shorelines, often in groups.
Nesting Habitat	• Nesting occurs in May to June. • Nest in areas of open canopy, often with southern exposure, such as the shorelines of lakes and wetlands, beaver dams, sand dunes, and areas with sandy-loamy and/or gravel substrates (Ernst and Lovich, 2009; COSEWIC, 2018). • Eggs are laid in usually within 1,200 m of their aquatic habitats (COSEWIC, 2018). • Females appear to prefer sloped nest sites, although the degree of canopy and ground vegetation coverage varies widely (Schwarzkopf and Brooks, 1987). • Preferred nesting substrate is sand, loam, clay, and/or gravel (Christens and Bider, 1987; Ernst and Lovich, 2009). • Hatchlings generally emerge in fall and move to water.
Overwintering Habitat	• Overwinter in shallow water (<0.5) with deep sediment (Taylor and Nol, 1989; COSEWIC, 2018). • Hatchlings are known to overwinter within the nest elsewhere in Canada.
Foraging Habitat & Diet	• Consume a wide variety of invertebrate and vertebrate prey, as well as algae, and aquatic vascular plant species. • Diet changes as they mature, with young turtles eating more protein and adults relying more on vegetation.

3.8.2 Field Surveys

As discussed in depth in Section 3, a total of 12 watercourses were assessed in detail as part of the watercourse assessment task. The distribution by size category (large permanent, small permanent, intermittent, and ephemeral) is provided in Table 3.9.

Table 3.9 Bear Lake Study Area Watercourses, by Category

Watercourse Category	Number in Study Area
Ephemeral / Ephemeral with Intermittent Characteristics	39
Intermittent / Intermittent with Ephemeral Characteristics	14
Small Permanent / Small Permanent with Intermittent Characteristics	8
Total	**61**

Of the 61 water courses assessed, 53 were ephemeral or intermittent watercourses that were deemed too small to be suitable aquatic habitat for turtles, though the occasional use of some of these features by turtles (particularly juvenile Common Snapping Turtles moving between waterbodies or breeding female Eastern Painted Turtles moving to or from nesting habitat) cannot be ruled out.

The remaining eight watercourses were all small permanent watercourses. These are summarized in Table 3.10 and depicted on Figure 3, Appendix A.

Table 3.10 Permanent Watercourses within the Bear Lake Study Area.

Watercourse Type	Watercourse ID	Dominant Substrate
Small Permanent	BL-WC201a-3772	Cobble
	BL-WC201b-1420	Fines
	BL-WC201c-3446	Gravel
	BL-WC202d-669	Fines
	BL-WC202e-3441	Fines, Gravel
Small Permanent with Intermittent Characteristics	BL-WC201a-3333	Fines
	BL-WC105-1267	Gravel
	BL-WC202d-2810	Fine

3.8.2.1 Wood Turtle Potential Habitat

No Wood Turtles were encountered by CBCL field staff during any of the vegetation inventory activities, wetland and watercourse reconnaissance, detailed wetland assessment, or detailed watercourse surveys conducted for the Bear Lake Project between August and December 2022. A total of four watercourse(s) within the Study Area are considered to support potentially suitable habitat for Wood Turtles, based on their size and dominant substrate type. These are as follows:

- Small Permanent
  - BL-WC201a-3772 Cobble
  - BL-WC201c-3446 Gravel
  - BL-WC202e-3441 Fines, Gravel
  - BL-WC105-1267 Gravel

Much of this could be summering (foraging and basking) habitat. Foraging may occur in these watercourses in late spring and fall, just after and prior to hibernation. Summer foraging for this species is primarily terrestrial, and considerable riparian habitat along these watercourses is suitable foraging habitat, as Wood Turtles are quite terrestrial and active during the summer months. It is unlikely that hibernating habitat is present within these watercourses, as they are generally not very large and are quite shallow. Nesting habitat is unlikely to be present, as large gravel sidebars were not observed within these watercourses.

Armstrong River is a permanent watercourse just outside of the Study Area. A number of smaller watercourses within the Study Area feed into it. As this watercourse does not occur within the Study Area, it was not assessed by CBCL ecologists, however, it is a permanent watercourse with gravelly or rocky substrates and may support suitable summering or overwintering habitat for Wood Turtles in some areas along its length. Nesting habitat is unlikely to be present, as the watercourse is likely too small, and the surrounding topography too hilly, for such features to develop, at least in the vicinity of the Study Area.

Photographs of these watercourses within the Study Area, with the exception of the main Armstrong River, are provided in the Watercourse Fact Sheets for each watercourse in Appendix B. Figure 3 In Appendix A depicts small permanent watercourses within the Bear Lake Study Area that could provide suitable, but limited, habitat for Wood Turtles (no large permanent watercourses are present).

3.8.2.2 Eastern Painted Turtle Potential Habitat

No live Eastern Painted Turtles were encountered by CBCL field staff during any of the vegetation inventory activities, wetland and watercourse reconnaissance, detailed wetland assessment, or detailed watercourse surveys conducted for the Bear Lake Study Area between August and December 2022. None of the watercourses intersecting the Study Area were deemed suitable habitat for summering, overwintering, or foraging for Eastern Painted Turtles, as this species generally prefers larger slow-moving watercourses or waterbodies with soft organic substrates and abundant aquatic vegetation, which are not present within the Study Area.

However, suitable waterbodies and wetlands with vegetated open water habitat are present in the vicinity of the Study Area, particularly in the northern portion of the Study Area. Suitable nesting habitat may also occur along naturally occurring sandy loam or gravelly areas, or along gravel roads or other disturbed areas within the Study Area. As

Eastern Painted Turtles usually nest within 1,200 m of their aquatic habitats (COSEWIC, 2018), it is possible they are nesting within the Study Area.

A carapace from a mature Eastern Paint Turtle was found by CBCL Staff during wetland survey on October 29, 2022, near a disturbed gravelly area midway between two considerable wetland areas with suitable summering and overwintering habitat, the closest of which was just under 200 m away. This location is indicated on Figure 3 in Appendix A. This specimen appeared to be a mature female and it is possible that it was predated on while visiting the gravelly area for nesting purposes.

Photo 3-13 Dorsal and ventral views of an Eastern Painted Turtle carapace detected in northern portion of Study Area by CBCL ecologists on 29 October 2022.

Lakes and wetlands with suitable vegetated open water habitat for Eastern Painted Turtles are present within and adjacent to the initial Study Area (particularly in the northern portion) and may support summering and overwintering of this species. The finding of a carapace of an Eastern Painted Turtle within the Study Area confirms their occurrence onsite. There are several lakes within the initial Study Area that likely provide summering and/or overwintering habitat for Eastern Painted Turtles, as well as associated nesting habitat. These lakes (Middle, Armstrong, Little Armstrong, Anderson, and Bear Lakes) are depicted on Figure 3 in Appendix A, as are additional lakes in near proximity to the Study Area (Burnt Lake, Island Lake). Suitable habitat is likely present in all of these lakes for adult and juvenile Eastern Painted Turtles. Suitable nesting habitat for this species may occur throughout much of the site, given than Eastern Painted Turtles may travel up to 1,200 m from their aquatic habitats to

nest. Much of the existing gravelly or sandy loamy roadsides could serve as nesting habitat for this species.

3.8.2.3 Common Snapping Turtle Potential Habitat

No Common Snapping Turtles were encountered by CBCL field staff during any of the vegetation inventory activities, wetland and watercourse reconnaissance, detailed wetland assessment, or detailed watercourse surveys conducted for the Bear Lake Project between August and December 2022. None of the watercourses intersecting the Study Area were deemed suitable summering or overwintering habitat for Common Snapping Turtle, as this species generally prefers larger slow-moving watercourses or waterbodies with soft substrates and abundant aquatic vegetation, which are not present within the Study Area.

It is possible that some suitable nesting habitat is present along the watercourses within the Study Area, but without suitable foraging or overwintering habitat to support adult Snapping Turtles, it is unlikely that they are utilizing these areas for nesting purposes, as this species generally does not travel more than a few hundred metres from water to nest. However, juvenile Common Snapping Turtles could occasionally utilize habitats within wetlands or small permanent watercourses within the Study Area for summering purposes. Juvenile Snapping Turtles that hatched offsite could potentially use habitats within Study Area.

Figure 2 In Appendix A depicts watercourses classified as small permanent, or small permanent with intermittent characteristics, wetlands, and waterbodies within the Study Area which may provide occasional suitable habitat for juvenile Snapping Turtles. Photographs of these watercourses within the Study Area, with the exception of the main branch of Armstrong River, are provided in the Watercourse Fact Sheets provided for each watercourse in Appendix B.

However, lakes and wetlands with vegetated open water habitat are present within and adjacent to the initial Study Area and may support summering and overwintering of Common Snapping Turtles. There are reports of Common Snapping Turtle nesting in nearby Martock (iNaturalist, 2020). There are several lakes within the initial Study Area that likely provide summering and/or overwintering habitat for Snapping Turtles, as well as associated nesting habitat. These lakes (Middle, Island, Burnt, Armstrong, Little Armstrong, Anderson, and Bear Lakes) are depicted on Figure 2 in Appendix A. With the exception of Bear Lake, none of these lakes are within close proximity to the proposed Study Area, and Common Snapping Turtles within these lakes should not be disturbed by the project. Bear Lake is a small lake with abundant aquatic vegetation around its shore, which is situated along a proposed access road to a turbine location. It is possible the existing roadway, which is approximately 100 m from the lakeshore, may provide suitable nesting habitat for nesting Common Snapping Turtles. Much of the proposed extension this roadway, which will be required to access proposed turbine location, will also be within 100 m of the Bear Lake shoreline and may also provide suitable nesting habitat for this species. The Study Area is likely too far from the remaining lakes to potentially impact any Common Snapping Turtles undertaking nesting forays.

4 Limitations of Study

4.1 Fish Habitat and Water Quality

The baseline data collection for the majority of the watercourses assessed was completed during a period of relatively dry weather in the fall of 2022. Weather conditions can have direct effects on habitat quality and availability in watercourses. Periods of low precipitation can create seasonal barriers and affect water quality. As such, the lower water levels may have also impacted habitat quality in watercourses, and the permanent watercourses with shallow depths and few deep pools may not have resembled their typical seasonal habitat Water quality measurements were dependent upon being able to completely submerge the probe into flowing water, where this was not possible, including in deep, but stagnant water, the readings obtained will not necessarily be representative of the actual conditions of the site.

Additionally, the timing of some of the detailed assessments overlapped with late winter snowfall, changing the ability of the assessors to distinguish smaller ephemeral or intermittent watercourses, as well as the riparian habitats associated with the watercourses.

To assess the likelihood for fish presence within watercourses, assessments should be conducted during multiple seasons, along with fish sampling. Since neither of these conditions were met, the streams where fish were not observed cannot conclusively eliminate fish presence without the presence of an impassible barrier. These locations may require additional assessment and sampling to meet the requirements of future permitting.

4.2 Turtle Assessments

As with the fish habitat assessment, access to the upstream or downstream sections of a number of watercourses was limited in many areas due to the effects of post-tropical storm Fiona in the fall of 2022. This limited the ability to survey some watercourse sections for potential turtle presence.

The turtle habitat assessment occurred in fall of 2022 and was limited to identifying areas of suitable habitat for the three turtle species, and not confirmation of presence. To fully

assess the likelihood for turtle presence within watercourses, targeted turtle surveys should be conducted in identified areas of potentially suitable aquatic turtle habitat during the appropriate season. The preferred timing window for Visual Encounter Survey (VES) for Wood Turtles in Nova Scotia is late April to late May (McLean, 2018) when air temperatures are above 9°C, and the weather is generally sunny. For construction projects, NS DNRR recommends Wood Turtle VES in May, prior to leaf emergence, and another immediately prior to the commencement of site clearing and construction activities (Laverty, Pers comm, 2020). No turtle survey methods have been specified for Snapping Turtles or Eastern Painted Turtles by NS DNRR, but the spring Wood Turtle survey method is generally considered sufficient for these species.

5 Mitigation Measures

Works that occur within or near water are required to prevent or minimize adverse effects to the existing instream and riparian habitat, unless applicable permits, approvals, notices, or authorizations are acquired.

Industry standard mitigation measures are those that are known to be effective at controlling adverse effects of low or moderate risk works, including construction works. These measures are used where the effects to the environment, from the works, are known to have low or moderate risk, to the applicable environmental aspect or area, and are relatively straightforward to implement and maintain. These may include measures that place limits or boundaries (e.g., spatial, temporal, or physical) on activities, measures that remove or relocate potential effects to less sensitive areas, or measures that recommend additional equipment or methods in order to carry out the works according to the applicable regulations.

Example industry standard mitigation measures and best management practices (BMPs) that are applicable to the Project and the aquatic environment may include the following:

- Spill prevention, spill response measures and equipment
  - Refueling equipment > 30 m away from any waterbody, wetland, or watercourse
  - Using biodegradable fluids in all equipment used near water
  - Spill kits in all machines and larger spill kit on site
  - All petroleum-based products on site are stored away from water
  - Machinery is clean and free of leaks prior to use on site
  - Drip trays are placed under all parked machinery when not in use
- Erosion and Sediment Control (ESC)
  - An ESC Plan (ESCP) will be required for all instream works where ground disturbance occurs. The ESCP will be designed by a qualified professional (e.g., Engineer, CPESC)
  - Implement appropriate measures near water or wetlands to prevent sedimentation
- Staging of construction activities
  - Clearing and construction works to be staged to minimize adverse effects, including erosion and sedimentation, during the Project works
- Work Windows (Temporal)
  - Adhere to applicable working windows to protect existing flora and fauna in the riparian and instream habitats

- Instream construction in fish-bearing watercourses between June 1 and September 30, unless otherwise authorized

Throughout the Project lifecycle, mitigation measures should be implemented to reduce the potential environmental effects to turtles. The mitigation measures that have been selected include, but are not limited to, the following:

- Wood Turtle VES should be conducted in May prior to leaves emerging and again immediately prior to site preparation and construction activities in areas identified as suitable turtle habitat (for any species).
- Onsite monitoring for turtles should be conducted during site preparation and construction activities in areas identified as suitable turtle habitat.
- Permanent and temporary road and water crossings should be planned in advance to help prevent turtle mortality and protect water quality.
- Known sensitive Wood Turtle habitat sites (e.g., suitable nesting areas) should be identified and avoided when building new roads and water crossings.
- The amount of road that parallels a watercourse should be minimized.
- If a turtle or nest is encountered during construction activities, work should cease, and the local Regional Biologist contacted for direction.

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6.2 Personal Communications

Jolene Laverty, NS DNRR Regional Biologist, 2020.

Maureen Cameron-MacMillan, NS DNRR Regional Biologist March 2023.

7 Closure

This report has been prepared for the sole benefit of Nova Scotia Power Inc. and may not be relied upon, in whole or in part, by any other entity or person without the express written consent of CBCL Limited and NSPI.

Any use of this report by a third party, or any reliance on decisions made based on it, are the responsibility of such third parties. CBCL Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this report.

The conclusions presented in this report represent the best judgement of the assessors based on the observed site conditions at the time of assessment. Due to the nature of the assessment, the assessors cannot warrant against undiscovered environmental conditions or liabilities.

Should additional information become available, CBCL Limited requests that this information be brought to our attention so that we may re-assess the conclusions presented herein. Any changes to the Project alignment may result in a requirement to replicate or supplement the field program to capture any new information.

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APPENDIX A

Watercourse Location Maps

Quaternary Watersheds

- S. Branch Avon - 101: Unnamed Tributary to Smeltzer Brook
- S. Branch Avon - 102: Unnamed Tributary to South Branch Avon River 1
- S. Branch Avon - 103: Unnamed Tributary to South Branch Avon River 2
- S. Branch Avon - 104: Unnamed Tributary to South Branch Avon River 3
- S. Branch Avon - 105: Unnamed Tributary to South Branch Avon River 4
- S. Branch Avon - 106a: Unnamed Tributary to Black Brook 1
- S. Branch Avon - 106b: Unnamed Tributary to Black Brook 2
- S. Branch Avon - 106c,: Unnamed Tributary to Black Brook 3
- S. Branch Avon - 106d: Unnamed Tributary to Black Brook 4
- S. Branch Avon - 106e: Unnamed Tributary to Black Brook 5
- S. Branch Avon - 106f: Unnamed Tributary to Black Brook 6
- S. Branch Avon - 106g,: Unnamed Tributary to Black Brook 7
- S. Branch Avon - 106h: Unnamed Tributary to Black Brook 8
- St. Croix - 201a: Unnamed Tributary to South West Brook 1
- St. Croix - 201b: Unnamed Tributary to South West Brook 2
- St. Croix - 201c: Southwest Brook
- St. Croix - 202a: Unnamed Tributary to Armstrong River 1
- St. Croix - 202b: Unnamed Tributary to Armstrong River 2
- St. Croix - 202c: Unnamed Tributary to Armstrong River 3
- St. Croix - 202d: Unnamed Tributary to Armstrong River 4
- St. Croix - 202e: Unnamed Tributary to Armstrong River 5
- St. Croix - 202f: Unnamed Tributary to Armstrong River 6
- St. Croix - 202g: Armstrong River
- St. Croix - 202h: Armstrong River Direct
- East River - 300a: Unnamed Tributary to Melvin Meadow Brook

Moses Mountain
Froth Hole Hill
Black Brook Lake
106a
Hemlock Hill
106b
106c
Smiths Corner
106d
202g
ddle Lake
106e
106f
106g
106h
Panuke Lake
Mockingigh Lake
Leminster
202a
Wile Settlement
101
202b
202h
202c
Upper Vaughan
202d
Panuk
102
202e
202f
103
104
201c
201a
14
Joe Long Lake
201b
Bag Lake
105
Card Lake Hill
300a
Golf Club
Card Lake
Sherwood
Card Lake Provincial Park

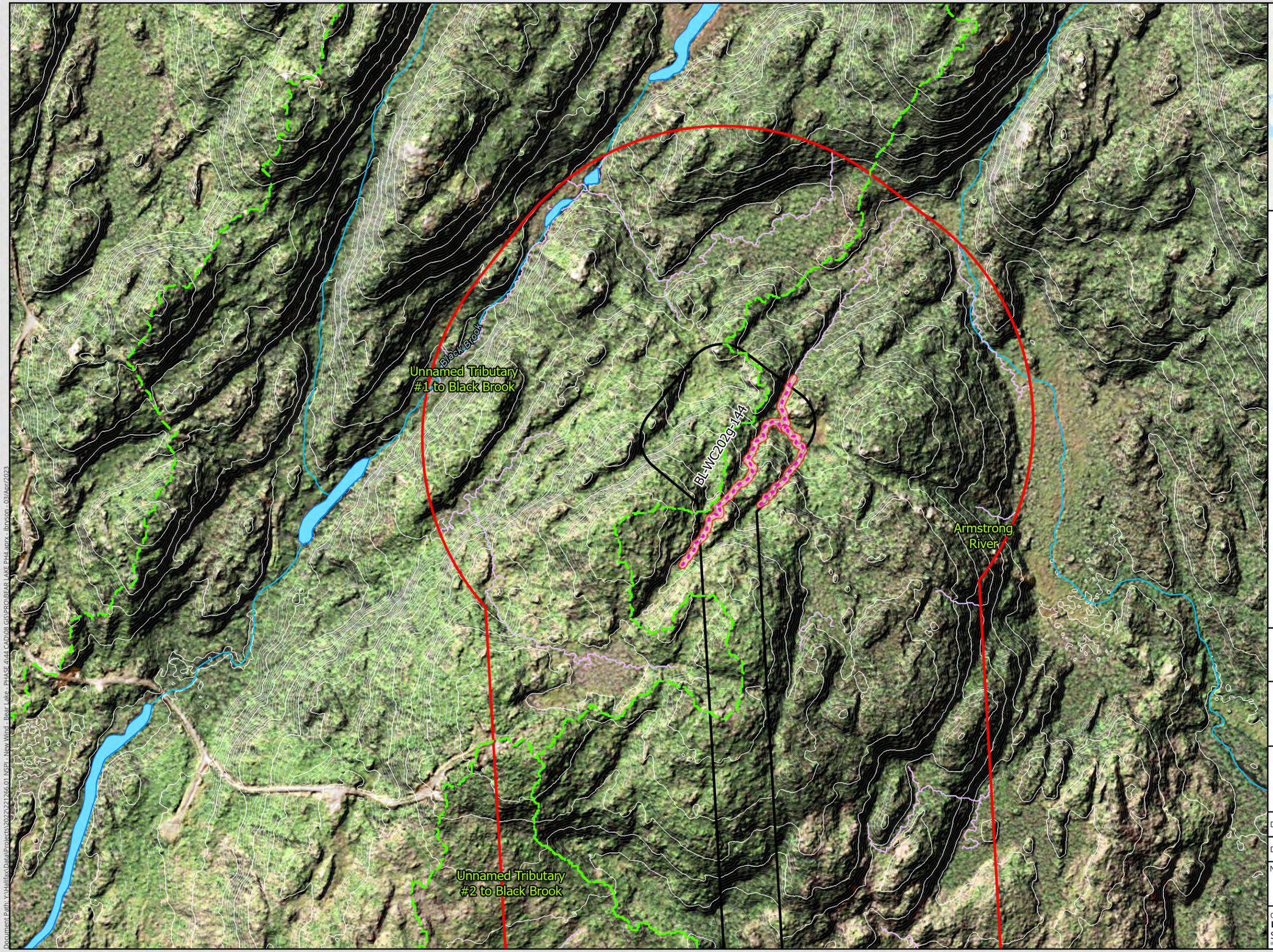
FIGURE: 1	Nova Scotia POWER An Emera Company; CBCL
DATE: 2023-04-03	NSPI NEW WIND BEAR LAKE
PROJ N°: 221266.01	**WATERSHED OVERVIEW**
DRAWN BY: NH	
CHECKED BY: CT	SCALE:1:57,000 @ 11 X 17 — Coordinate System: NAD 1983 (CSRS) v6 UTM Zone 20N — Units: Meter

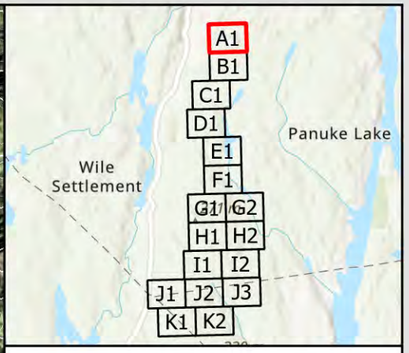
Assessment Area
Secondary Watersheds

Metres 0 500 1,000 2,000

NOVA SCOTIA
Map Extent
Halifax

Document Path: Y:\Halifax\Data\Projects\2022\221266.01 NSPI - New Wind - Bear Lake - PHASE AVAILABILITY\CAD\08 GIS\PROJ\BEAR LAKE PH1.aprx - jbyson - 03/Apr/2023





- Assessment Area (Phase 4)
- Preliminary Assessment Area
- Quaternary Watersheds
- Possible Fish Bearing Watercourse (CBCL 2022)
- Non-Fish Habitat Watercourse (CBCL 2022)
- Predicted Water Flow Path (CBCL 2022)
- Provincially Mapped Watercourse

Assessed Watercourses (CBCL 2022)

- Small Permanent
- Small Permanent with Intermittent Characteristics
- Intermittent
- Intermittent with Ephemeral Characteristics
- Ephemeral with Intermittent Characteristics
- Ephemeral

Nova Scotia POWER An Emera Company

CBCL

NSPI NEW WIND BEAR LAKE

Watercourse Classification and Field Results

DATE: 2023-04-03	PROJ N°: 221266.01	FIGURE: **2-A1**
DRAWN BY: NH	CHECKED BY: CT	APPROVED: IB

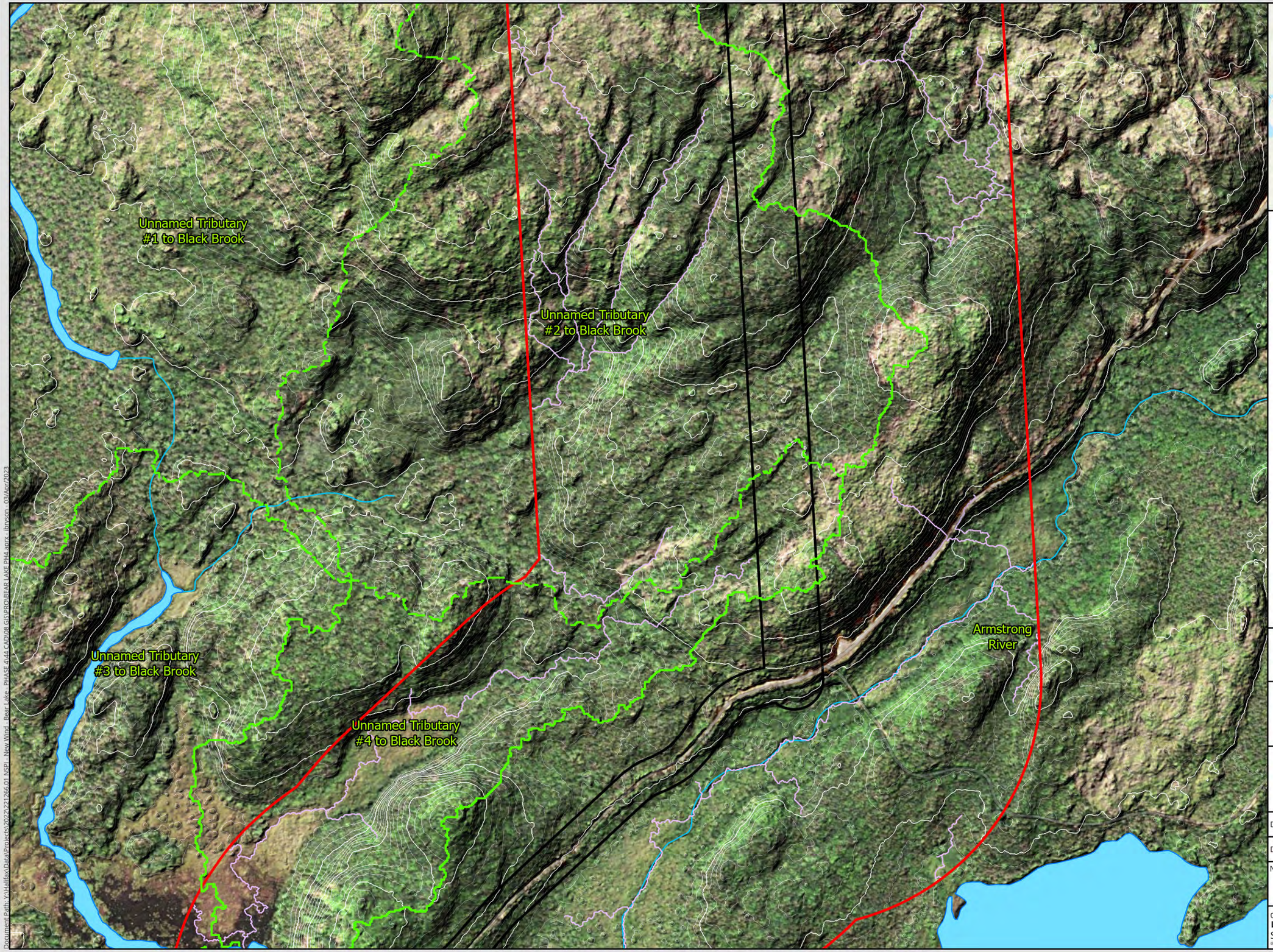
NOTES:

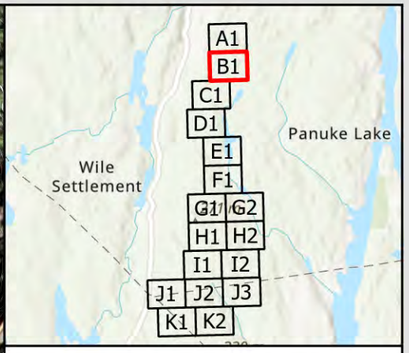
0 65 130 260 m

SCALE: 1:5,000 @ 11 X 17

Coordinate System: NAD 1983 (CSRS) v6 UTM Zone 20N
Units: Meter

Document Path: Y:\Halifax\Data\Projects\2022\221266.01 NSPI - New Wind - Bear Lake - PHASE 4\44 CAD\08 GIS\PRO\BEAR LAKE PH4.aprx - lbnson - 03/Apr/2023





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- Predicted Water Flow Path (CBCL 2022)
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- Intermittent
- Intermittent with Ephemeral Characteristics
- Ephemeral with Intermittent Characteristics
- Ephemeral

Nova Scotia POWER An Emera Company

CBCL

NSPI NEW WIND BEAR LAKE

Watercourse Classification and Field Results

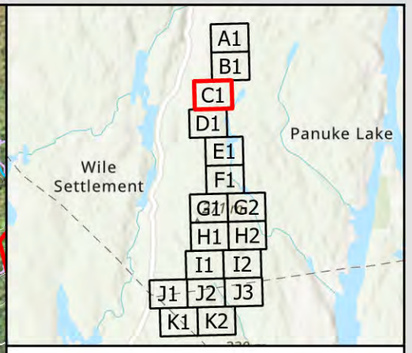
DATE: 2023-04-03	PROJ N°: 221266.01	FIGURE: **2-B1**
DRAWN BY: NH	CHECKED BY: CT	APPROVED: IB

NOTES:

0 65 130 260 m

SCALE: 1:5,000 @ 11 X 17

Coordinate System: NAD 1983 (CSRS) v6 UTM Zone 20N
Units: Meter



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Nova Scotia POWER An Emera Company

CBCL

NSPI NEW WIND BEAR LAKE

Watercourse Classification and Field Results

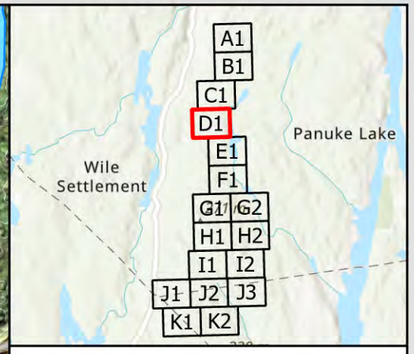
DATE: 2023-04-03	PROJ N°: 221266.01	FIGURE: **2-C1**
DRAWN BY: NH	CHECKED BY: CT	APPROVED: IB

NOTES:

0 65 130 260 m

SCALE: 1:5,000 (@ 11 x 17)

Coordinate System: NAD 1983 (CSRS) v6 UTM Zone 20N
Units: Meter



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- Intermittent with Ephemeral Characteristics
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- Ephemeral

Nova Scotia POWER An Emera Company

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NSPI NEW WIND BEAR LAKE

Watercourse Classification and Field Results

DATE: 2023-04-03	PROJ N°: 221266.01	FIGURE: **2-D1**
DRAWN BY: NH	CHECKED BY: CT	APPROVED: IB

NOTES:

0 65 130 260 m

SCALE: 1:5,000 @ 11 X 17

Coordinate System: NAD 1983 (CSRS) v6 UTM Zone 20N
Units: Meter

Document Path: Y:\Halifax\Data\Projects\2022\221266.01 NSPI - New Wind - Bear Lake - PHASE 4\44 CAD\08 GIS\PRO\BEAR LAKE PH4.aprx - ibnsom - 03/Apr/2023