

Figure 2: Robb Trend Main-Centre-East Northwest Portion and Erith Corridor Permit Boundary, Potential Zones and Shovel Test Locations.

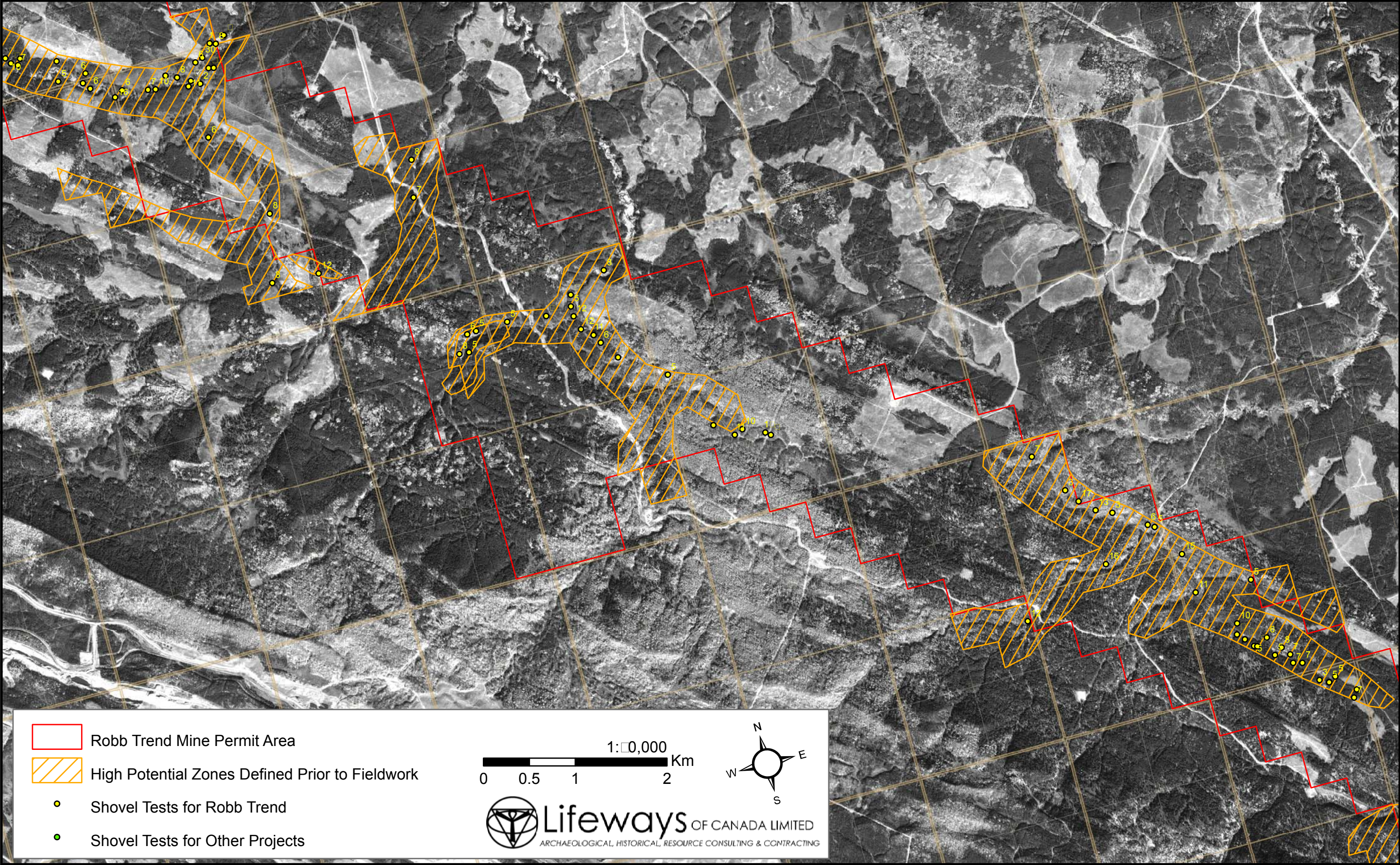


Figure 3: Robb Trend Main-Centre-East Central Portion and Halpenny Corridor Permit Boundary, Potential Zones and Shovel Test Locations.

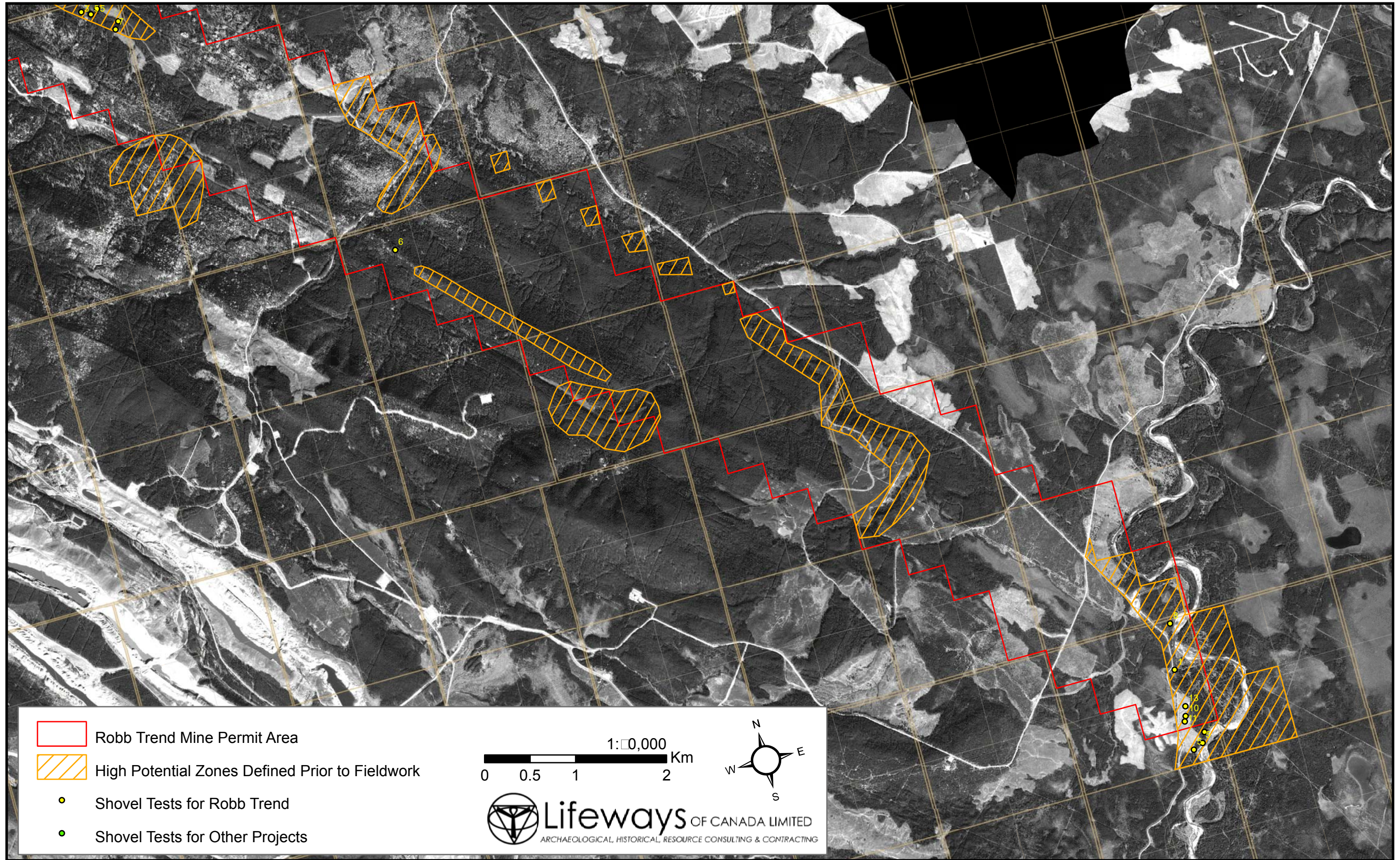


Figure 4: Robb Trend Main-Centre-East Southeast Portion Permit Boundary, Potential Zones and Shovel Test Locations.

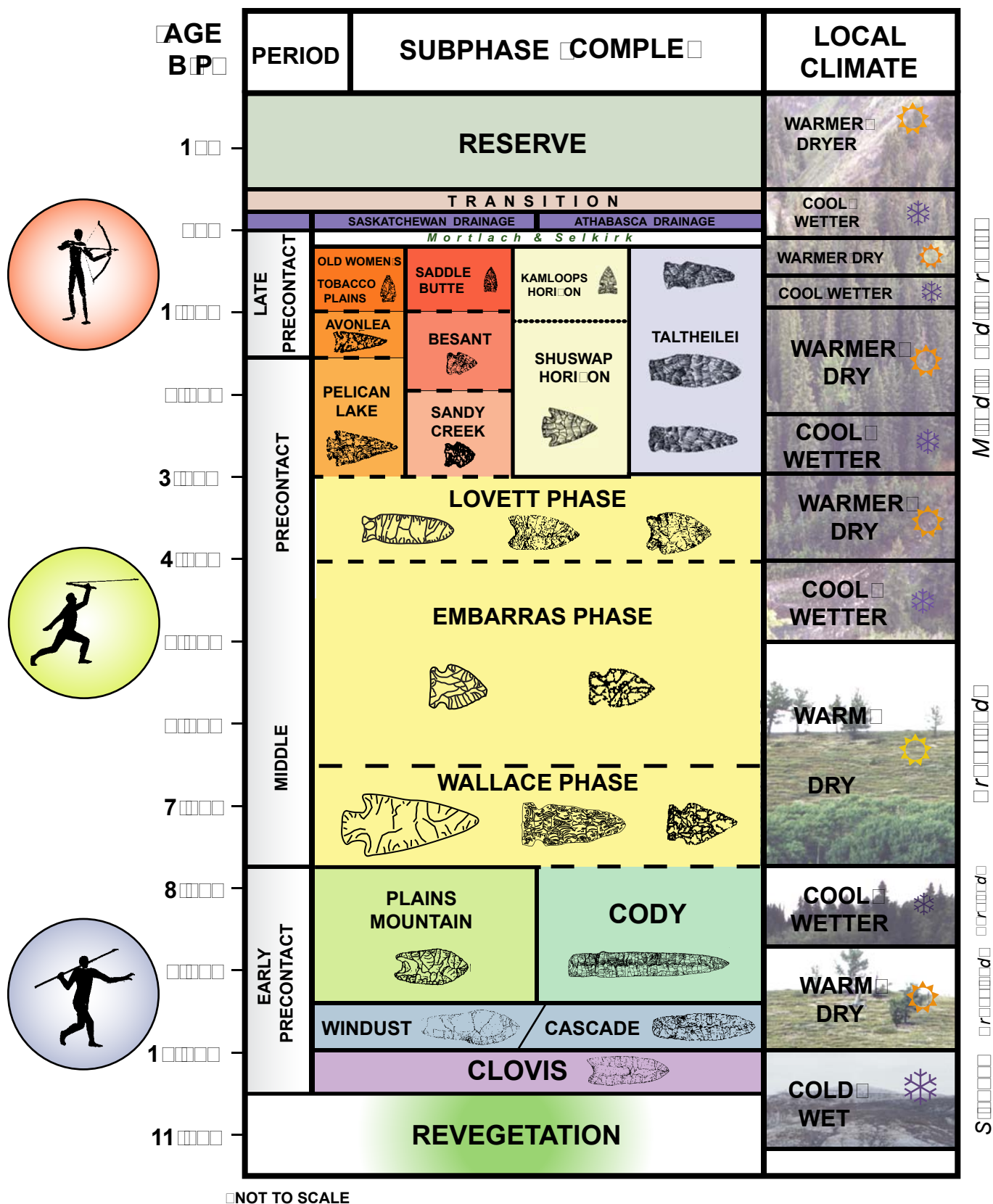
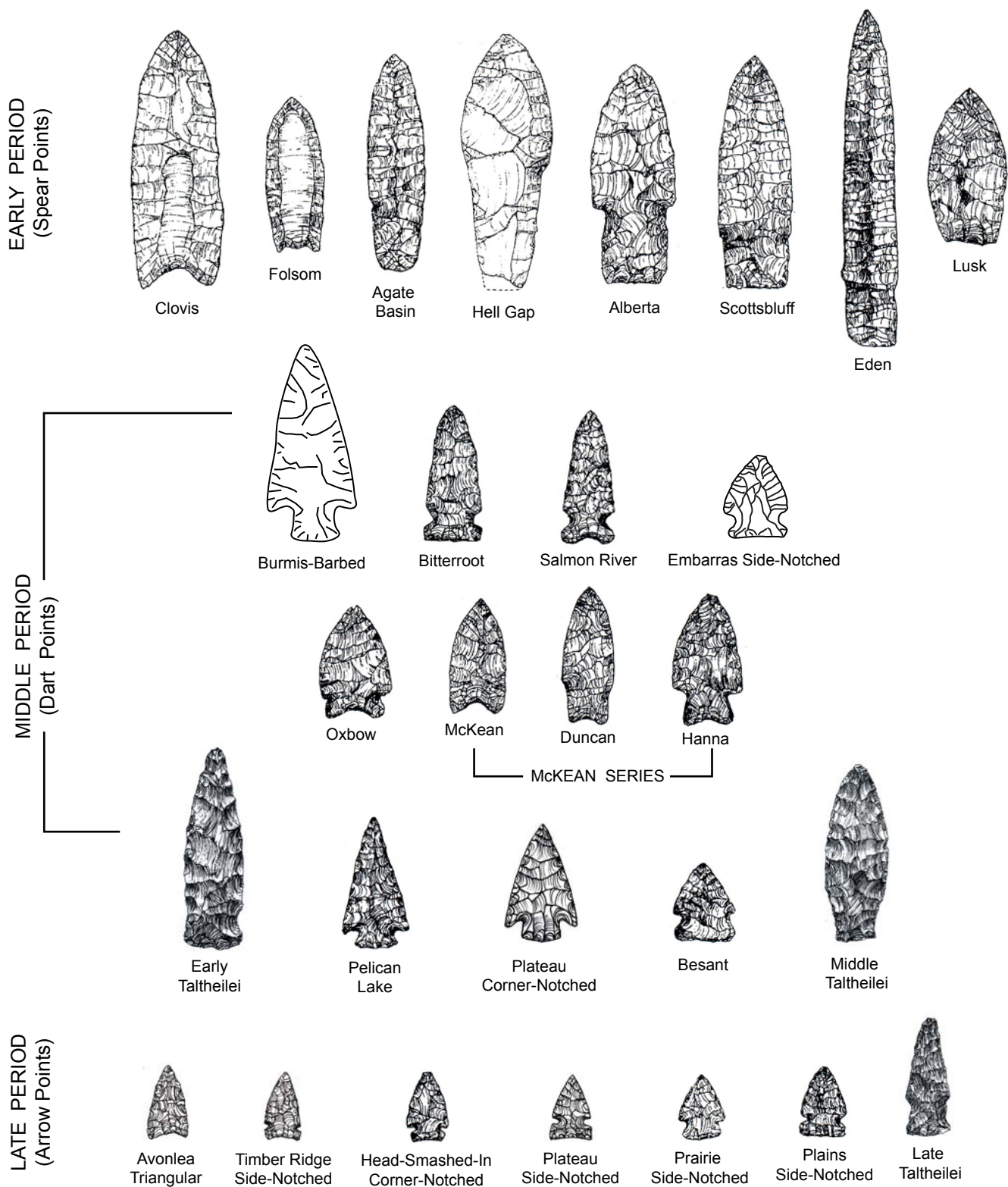


Figure 5: Culture History of West-Central Alberta.



*NOT TO SCALE

Figure 6: Projectile Points of West-Central Alberta.

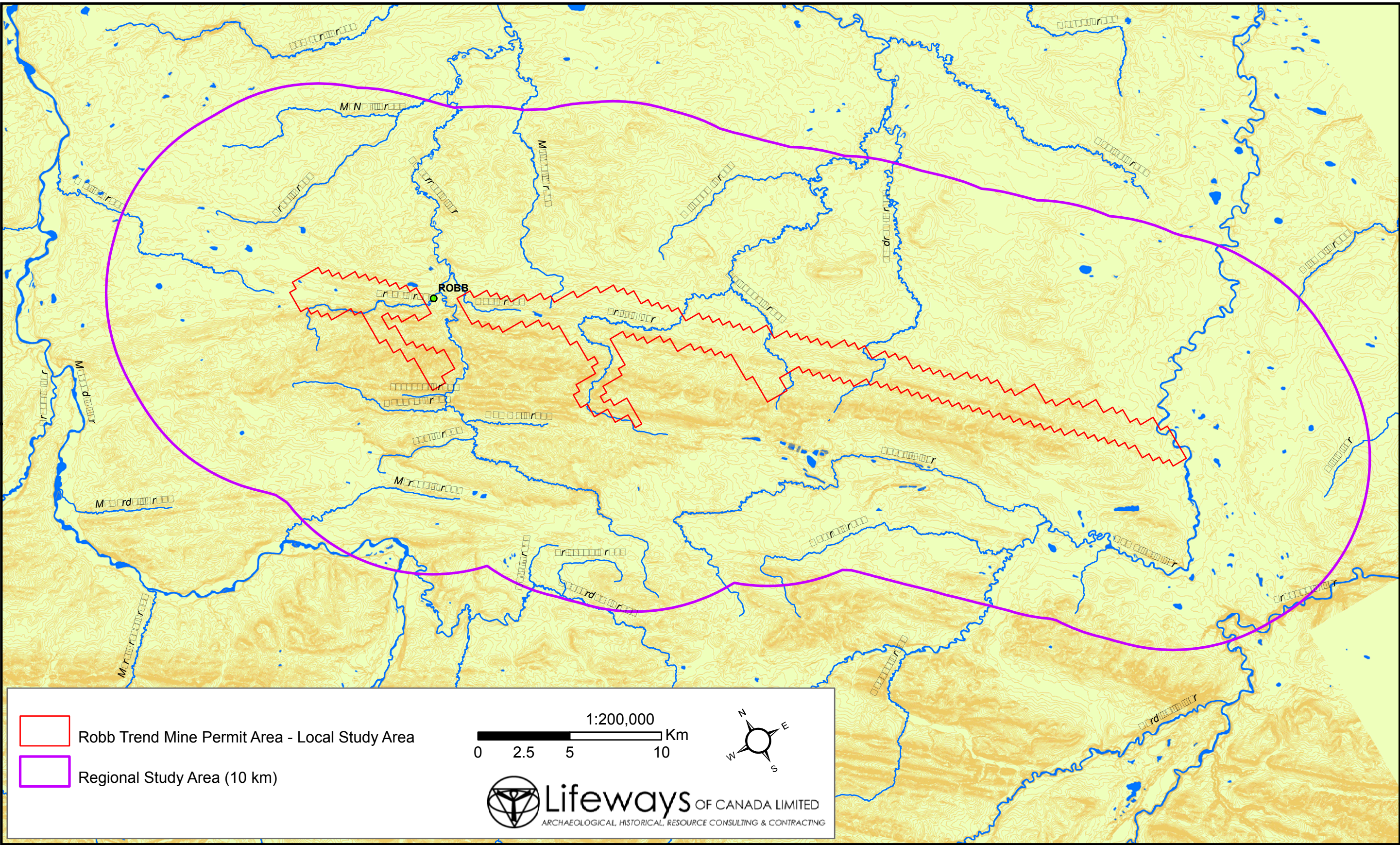


Figure 7: LSA and RSA for Robb Trend Historical Resources.

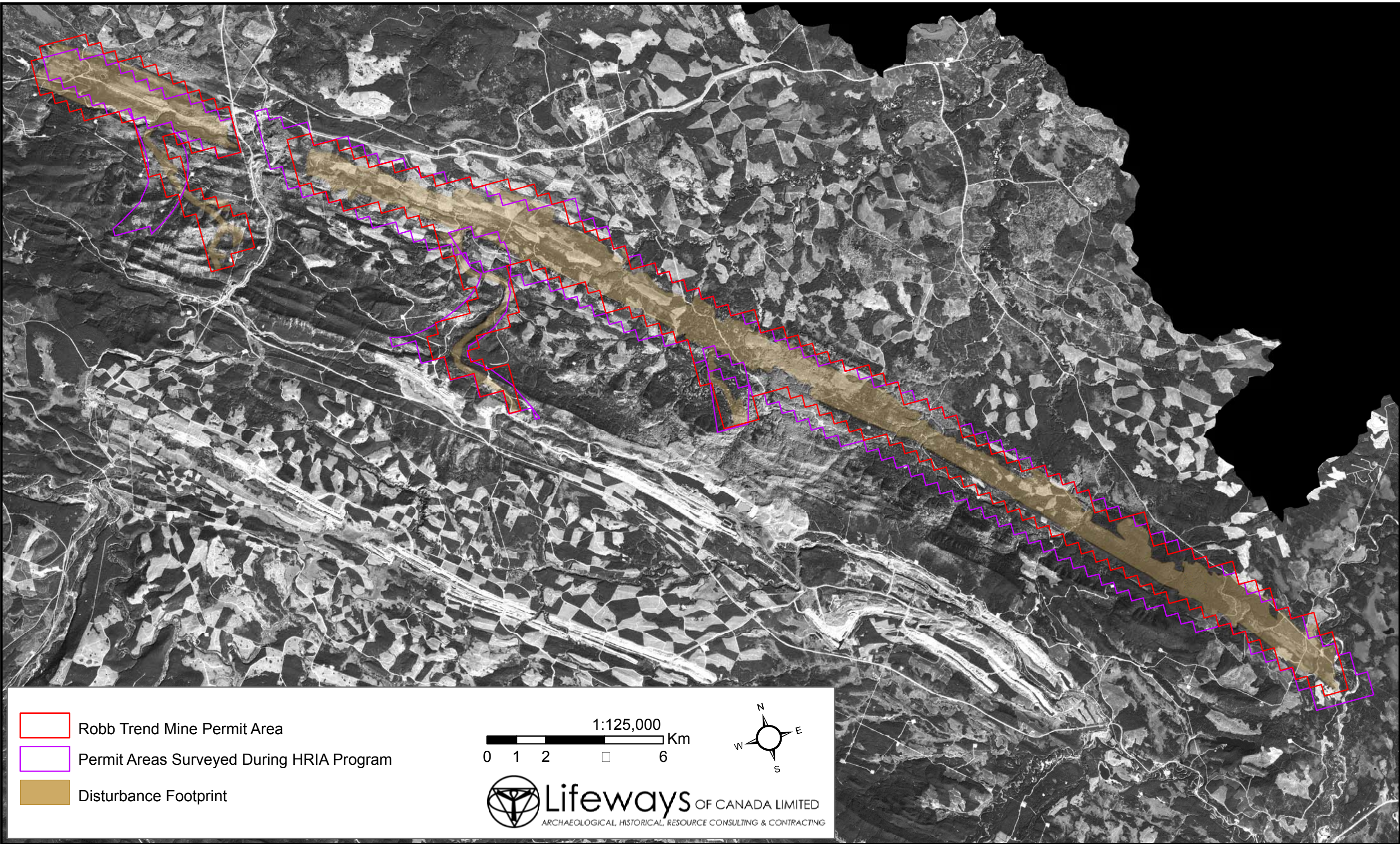


Figure 8: Robb Trend Project Areas Subjected to HRIA Work and the Proposed Development Footprint.

Appendix 17

Estimated Emissions from Industry within 100 km of
Robb Trend

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Angle Energy Inc. Moose Creek 5-26	51	59	49	-	22.3	-	-	-
Angle Energy Inc. Rosevear 7-20	68	71	66	-	173	155	0.57	0.57
Apache Canada Ltd. 7-10-47-14W5	72	39	69	-	70.4	118	0.31	-
Apache Canada Ltd. Amoco Pine 10-12	78	103	79	-	49.0	-	-	-
Apache Canada Ltd. Pine Creek 04-08	85	115	87	-	39.4	-	-	-
Apache Canada Ltd. 10-10-57-19W5	77	104	79	-	102	8.16	0.08	
Apache Canada Ltd. 12-26-057-19W5	83	108	84	46.9	147		0.35	
Apache Canada Ltd. Wildhay	74	108	76	0.05	340	27.1	0.15	0.15
ARC Resources Minehead Comp Stn 05-20	37	19	34	-	59.4	91.7	-	-
ATCO Electric Ltd. Palisades Generating Station	77	101	79	-	902	134	3.73	3.75
ATCO Gas and Pipelines Ltd. ATCO Pipelines - Peers	87	83	85	-	8.81	10.5	-	-
Baytex Energy Ltd Pembina Compressor 05-21-047-10W5	108	76	104	-	42.5	71.5	0.46	-
Bellatrix Exploration Ltd. Brazeau Sour Gas Battery 02-10	108	70	104	-	28.3	26.7	-	-

¹ Source: National Pollutant Release Inventory 2010; www.ec.gc.ca/inrp-npri/ accessed August 15th, 2012

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Blaze Energy Ltd. 02-19 Compressor	84	56	81	-	86.3	29.1	-	-
Blaze Energy Ltd. 11-04 Compressor	88	58	85	-	33.5	-	-	-
Blaze Energy Ltd. 03-15 Compressor	89	60	86	-	141	46.5	-	-
Blaze Energy Ltd. Brazeau Gas Plant	83	56	80	1282	665	930	233	233
Bonavista Energy Corporation Bonavista Pine Creek 12-19-57-18	82	107	83	-	26.4	25.7	-	-
Bonavista Energy Corporation Bonavista Worsley 12-19	82	107	83	-	51.2	-	-	-
Bonavista Energy Corporation South Rosevear Gas Plant	76	79	74	80.9	55.4	49.6	1.18	1.18
Bonavista Energy Corporation South Rosevear Low Pressure	76	80	75	-	-	22.4	-	-
Bonavista Energy Corporation Suncor South Rosevear Unit #1	76	80	75	-	-	22.9	-	-
Bonavista Energy Corporation Vero Rosevear 03-19(06-18)-054-15w5	72	79	71	-	-	-	0.39	-
Bonavista Energy Corporation Ish Rosevear 16-33	78	84	77	-	-	27.5	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Border Paving Ltd. Hinton Batch Plant	42	83	46	0.48	0.65	2.49	0.08	0.34
Canadian Forest Oil Wild River Gas Battery 08-30	88	127	91	-	168	111	-	-
Canadian Natural Resources Limited Berkley Wild River	85	121	87	-	-	-	0.40	-
Canadian Natural Resources Limited Berland 100/09-23-057-25W5/00	88	127	91	-	40.6	-	-	-
Canadian Natural Resources Limited Edson W.01-24 - 2	32	59	33	-	429	105	1.24	1.24
Canadian Natural Resources Limited Galloway Plant 14-14	40	69	41	151	314	138	0.83	0.83
Canadian Natural Resources Limited Minehead 10-12	33	25	30	-	200	42.2	0.44	-
Canadian Natural Resources Limited Novalta Edson West 1-24	32	59	33	-	168	-	1.57	1.57
Canadian Natural Resources Limited Ranger Ansell	40	69	41	-	-	20.1	-	-
Canadian Natural Resources Limited Rio Alto Edson 11-26	46	70	46	65.4	-	-	-	-
Canadian Natural Resources Limited Rio Alto Wild River 11-13	51	89	54	-	-	-	1.08	1.08
Canadian Natural Resources Limited Sundance East 03-29	53	79	53	-	28.4	-	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Canadian Natural Resources Limited Watch 13-26	53	89	55	-	65.5	-	-	-
Canadian Natural Resources Limited Wild Hay 14-36	85	120	87	-	261	88.9	2.02	2.02
Canadian Natural Resources Limited Wild Hay 13-24	72	112	75	-	410	70.2	5.08	5.08
Canadian Natural Resources Limited Wild River 4-3	77	114	80	-	188	198	-	-
Canadian Natural Resources Limited Wild River Compressor Station	77	114	79	-	-	24.5	-	-
CCS Corp. Brazeau	101	68	97	-	-	-	-	-
CCS Corp. West Edson	45	65	45	-	-	-	-	-
Champion Technologies Ltd. Edson	53	66	52	-	-	-	-	-
Chinook Energy Inc. Brazeau Office 01-01	103	65	100	-	71.1	120	0.33	-
Coal Valley Resources Inc. Obed Mine	50	91	53	-	-	-	0.21	1.42
Coal Valley Resources Inc. Coal Valley Mine	21	21	17	-	61.0	-	-	1.95
Compton Petroleum Corporation Niton Comp Stn 16-09	82	82	80	-	147	133	0.33	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Compton Petroleum Corporation Niton Sweet Gas Plant 07-34	86	88	85	-	85.5	108	2.68	2.68
ConocoPhillips Canada Resources Corp. Niton Comp Stn 07-06	98	96	96	-	41.0	23.9	-	-
ConocoPhillips Canada Resources Corp. Basing Comp Station 06-10	2	39	3	-	78.3	121	0.33	-
ConocoPhillips Canada Resources Corp. Brazeau River Comp Station 02-02	72	42	69	-	21.0	32.5	-	-
ConocoPhillips Canada Resources Corp. Drayton Valley Oil Battery 03-01	111	84	108	-	39.2	-	-	-
ConocoPhillips Canada Resources Corp. Edson Comp Stn 11-32	55	62	54	-	22.8	60.8	-	-
ConocoPhillips Canada Resources Corp. Edson Oil Battery 11-11	62	67	61	-	-	-	0.46	-
ConocoPhillips Canada Resources Corp. Ferrier Comp Station 16-12	120	80	116	-	22.1	-	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
ConocoPhillips Canada Resources Corp. Ferrier Comp Stn 13-17	120	81	117	-	104	290	0.78	0.78
ConocoPhillips Canada Resources Corp. Lovett River Comp Station 02-06	21	20	18	-	108	181	0.46	-
ConocoPhillips Canada Resources Corp. Lovett River Comp Stn 03-23	29	12	25	-	49.3	27.4	-	-
ConocoPhillips Canada Resources Corp. McLeod Comp Stn 06-27	90	95	89	-	29.2	-	-	-
ConocoPhillips Canada Resources Corp. McLeod River Valley Gas Plant 16-12	96	101	95	-	161	107	0.30	-
ConocoPhillips Canada Resources Corp. Niton Comp Station 06-10	103	100	101	-	54.4	30.2	-	-
ConocoPhillips Canada Resources Corp. Niton Oil Battery 08-30	101	101	100	-	63.6	42.4	-	-
ConocoPhillips Canada Resources Corp. Niton Sweet Gas Plant	95	92	94	-	230	-	1.02	1.02

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
ConocoPhillips Canada Resources Corp. Nordegg Comp Station 06-22	101	62	98	-	-	27.6	-	-
ConocoPhillips Canada Resources Corp. OChiese Sour Gas Plant	118	82	114	-	27.7	100	0.57	0.57
ConocoPhillips Canada Resources Corp. Peco Comp Station 06-21	48	25	45	-	24.4	37.8	-	-
ConocoPhillips Canada Resources Corp. Peco Comp Station 06-23	31	28	28	-	24.5	-	-	-
ConocoPhillips Canada Resources Corp. Peco Comp Station 07-23	55	22	51	-	-	30.9	-	-
ConocoPhillips Canada Resources Corp. Peco Gas Battery 14-07	55	28	52	-	-	31.0	-	-
ConocoPhillips Canada Resources Corp. Peco Sweet Comp Station 11-12	43	28	40	-	27.1	39.9	-	-
ConocoPhillips Canada Resources Corp. Pembina Comp Station 04-17	113	76	109	-	70.5	70.0	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
ConocoPhillips Canada Resources Corp. Pembina Comp Stn 11-26	99	75	96	-	40.6	108	-	-
ConocoPhillips Canada Resources Corp. Pine Creek Comp Station 11-28	71	101	72	-	71.5	-	-	-
ConocoPhillips Canada Resources Corp. Pine Creek Gas Battery 11-03-057	76	102	77	-	26.5	21.1	-	-
ConocoPhillips Canada Resources Corp. Rocky Comp Station 10-18	81	45	77	-	23.2	24.9	-	-
ConocoPhillips Canada Resources Corp. Solomon Gas Battery 08-28	79	119	82	-	31.7	154	0.42	-
ConocoPhillips Canada Resources Corp. Sunchild Comp Stn 03-07	107	68	104	-	23.2	-	-	-
ConocoPhillips Canada Resources Corp. Sunchild Comp Stn 10-34	113	74	110	-	-	24.6	-	-
ConocoPhillips Canada Resources Corp. Westpem Comp Stn 02-05	67	54	64	-	49.8	98.3	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
ConocoPhillips Canada Resources Corp. Westpem Comp Stn 05-28	68	54	65	-	104	167	0.44	-
ConocoPhillips Canada Resources Corp. Wolf Lake Comp Station 14-32	69	61	66	-	101	170	0.44	-
ConocoPhillips Canada Resources Corp. Wolf Lake Sweet Gas Plant	63	52	60	-	190	367	1.15	1.15
ConocoPhillips Canada Resources Corp. Wolf South Comp Stn 06-20	56	45	54	-	79.3	123	0.33	-
ConocoPhillips Canada Resources Corp. Brazeau River Comp Stn 02-23	74	41	70	-	21.7	28.7	-	-
ConocoPhillips Canada Resources Corp. Brazeau River Comp Stn 07-24	101	68	97	-	42.6	23.1	-	-
ConocoPhillips Canada Resources Corp. Brazeau River Comp Stn 07-26 East	103	64	99	-	56.7	-	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
ConocoPhillips Canada Resources Corp. Brazeau River Gas Battery 11-27	61	30	58	-	24.4	37.7	-	-
ConocoPhillips Canada Resources Corp. Brazeau River Comp Stn 11-30	101	61	98	-	23.9	-	-	-
ConocoPhillips Canada Resources Corp. Brazeau River Comp Stn 07-26 West	103	64	99	-	56.7	-	-	-
Conserve Oil Corporation Conserve Halkirk 2-34-38-16-W4	116	80	113	-	99.4	-	0.47	-
Daylight Energy Ltd. Brazeau Battery 09-16	99	67	96	-	21.5	33.2	-	-
Daylight Energy Ltd. Brazeau Comp Stn 06-29	97	66	94	-	52.8	32.3	-	-
Daylight Energy Ltd. Brazeau Comp Stn 14-34	98	71	95	-	-	94.8	-	-
Pengrowth Energy Corporation McLeod Shiningbk 9-6	96	106	96	-	70.3	-	-	-
Daylight Energy Ltd. Med Lodge Sweet Gas Battery 09-09	27	63	29	-	-	-	0.31	-
Daylight Energy Ltd. Medicine Lodge Gas Plant 09-09	27	63	29	-	-	28.6	-	-
Daylight Energy Ltd. Obed Gas Battery 03-31	55	92	57	-	49.7	76.9	-	-
Daylight Energy Ltd.	85	111	86	-	34.8	-	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Pine Creek Comp Station 07-03								
Daylight Energy Ltd. Pine Creek Oil Battery 16-20	80	109	81	-	-	-	0.32	-
Daylight Energy Ltd. Pine Oil Battery 14-16	78	108	80	-	-	-	0.78	0.78
Devon Canada Corporation Devon Horse 10-15-56-27W5	90	131	94	-	175	52.4	11.5	11.5
Devon Canada Corporation Westpem 03-10	69	51	66	-	-	-	0.56	0.56
E Construction Ltd. P-36 Mobile Plant	107	86	105	-	-	-	-	0.63
Enbridge Pipelines Inc. Edmonton Terminal	63	104	67	-	-	-	-	0.36
EnCana Corporation Carrot Creek Sweet Gas Plant	85	79	83	-	63.0	61.4	-	-
EnCana Corporation Ferrier Sour Gas Battery 12-33	130	90	127	-	27.9	142	0.39	-
EnCana Corporation Westpem Gas Battery 16-28	71	62	69	-	-	31.6	-	-
EnCana Corporation Brazeau River Gas Battery 13-29	102	62	99	-	24.8	31.2	-	-
EOG Resources Canada Inc. Edson Pine Creek Comp Stn 08-33	65	80	64	-	27.5	26.0	-	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
ExxonMobil Canada Ltd Kaybob 03-36	72	107	74	-	54.4	26.5	-	-
ExxonMobil Canada Ltd Kaybob 06-22	79	108	80	-	44.8	35.7	-	-
ExxonMobil Canada Ltd Kaybob 14-05	84	114	86	-	-	-	0.63	0.63
ExxonMobil Canada Ltd Kaybob 6-01	83	114	85	-	24.1	40.9	-	-
Fairborne Energy Ltd. Harlech 16-36-044-15 W5M	78	38	74	-	80.1	111	-	-
Fairborne Energy Ltd. McLeod River 10-28	90	101	89	-	203	165	-	-
Fairborne Energy Ltd. McLeod River 16-36	87	95	86	-	305	173	-	-
Fairborne Energy Ltd. Peco 06-07-046-13 W5M	81	44	78	-	-	30.9	-	-
Harvest Operations Corp. Encal Tenn Niton 10-13	103	96	101	-	-	-	1.22	1.22
Husky Oil Operations Limited Ansell G.P.	28	50	28	-	21.7	-	0.48	-
Husky Oil Operations Limited Blackstone 15-14-046-17W5	52	12	48	-	-	-	0.61	0.61
Husky Oil Operations Limited Galloway G.P.	45	77	47	-	45.0	32.5	0.89	0.89

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Husky Oil Operations Limited Gas Test BTY 07-03-050-19W5	21	34	19	-	-	-	0.35	-
Husky Oil Operations Limited Hanlan 09-09MWB	64	23	61	-	64.1	42.7	-	-
Husky Oil Operations Limited Hastings Coulee G.P.	89	53	86	-	35.1	23.8	-	-
Husky Oil Operations Limited Stolberg Dehy	109	69	106	-	104	56.2	-	-
Husky Oil Operations Limited Strachan G.P.	140	99	136	-	23.4	-	-	-
Iberdrola Canada Energy Services Ltd. Alberta Hub Gas Storage Facility	85	87	84	-	-	29.0	-	-
Imperial Oil West Pembina Gas Plant	96	72	93	-	-	16.1	-	1.81
Imperial Oil Imperial CYN-PEM 6-2	102	86	99	-	-	-	0.77	0.77
Imperial Oil Imperial West Pembina 13-22-049- 10W5	107	82	104	-	58.7	94.5	2.13	2.13
Keyera Corp Bigoray 15-07 Compressor	113	93	111	-	65.7	63.6	-	-
Keyera Corp Bigoray Gas Plant	113	93	111	19.2	133	24.3	1.6	1.6
Keyera Corp Brazeau 15-9 Compressor	71	37	67	-	228	-	0.39	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Keyera Corp Brazeau Sweet Gas Plant	91	64	88	-	221	31.2	0.47	0.47
Keyera Corp Nordegg River Gas Plant	103	64	100	51.1	476	98.3	3.99	3.99
Keyera Corp Pembina North Gas Plant	88	64	85	25.5	302.61	44.6	2.64	2.64
Keyera Corp Sunchild 08-04 Compressor	112	72	108	-	135	105	-	0.36
Keyera Corp West Pembina GP	69	40	66	2209	42.1	48.6	6.34	6.34
Keyera Corp Bigoray West 16-07 Compressor	114	93	111	-	6.83	2.29	-	-
Keyera Corp Brazeau 10-18 Compressor Site	81	45	77	-	21.1	-	0.29	-
Keyera Corp Brazeau River Gas Plant	80	43	76	33.2	491	74.7	3.94	-
Lehigh Hanson Materials Ltd. Cadomin Quarry	34	53	34	0.22	1.76	7.47	0.46	0.58
ConocoPhillips Canada Resources Corp. Lodgepole Sweet Gas Plant	110	80	107	-	34.6	315	1.12	1.12
Mancal Energy Inc. 14-12-55-19W5 Comp/Dehy Station	60	84	61	-	44.9	75.3	-	-
ConocoPhillips Canada Resources Corp. McLeod Valley Sweet Gas Plant 07- 26	91	95	90	-	21.9	115	0.32	-

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	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
NAL Resources Management Pine Creek 06-20-57-18W5M Battery	82	106	82	-	38.1	-	-	-
NAL Resources Management Pine Creek 11-22-55-19W5M Battery	62	88	63	-	37.3	-	-	-
Newalta Corporation Niton Junction	96	89	94	-	-	-	0.03	0.03
NuVista Energy Ltd. Ferrier Comp Station 09-03	132	92	128	-	-	58.3	-	-
NuVista Energy Ltd. Pembina Oil Battery 14-09	97	68	94	-	-	-	0.43	-
NuVista Energy Ltd. Ferrier Comp Stn 07-16	123	84	119	-	-	20.0	-	-
NuVista Energy Ltd. Pembina Oil Battery 01-36	84	66	81	-	-	-	0.95	0.95
NuVista Energy Ltd. Wolf Comp Stn 05-28	68	53	65	-	25.9	40.1	-	-
OMERS Energy Inc. Cabin Creek Compressor Station 13-12-53-01W6	78	118	81	-	112	82.7	0.33	-
Open Range Energy Corp. Ansell 10-11	48	76	49	-	19.4	14.9	-	-
Open Range Energy Corp. Ansell 9-34	44	74	46	-	44.1	76.7	-	-
Open Range Energy Corp. Edson 6-3	49	73	49	-	-	-	0.31	-

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
ConocoPhillips Canada Resources Corp. Peco Comp Station 08-02	54	25	50	-	44.8	65.7	-	-
Pengrowth Energy Corporation McLeod River 13-30 CS	93	103	93	-	42.9	-	-	-
Pengrowth Energy Corporation McLeod River 2-20 Comp.	100	110	100	-	79.4	-	-	-
Pengrowth Energy Corporation McLeod River GP/BT	96	101	95	-	268	-	0.47	-
Penn West Petroleum Ltd Amoco Pembina D-2 16-19	114	85	111	-	-	21.5	-	-
Penn West Petroleum Ltd Brazeau Battery 10-5-47-14W5	70	36	67	-	23.2	-	-	-
Penn West Petroleum Ltd Granada Compressor Station 2-18-52-11W5	97	83	94	-	-	-	0.31	-
Penn West Petroleum Ltd Pembina 01-32-050-10W5	106	85	103	35.9	-	-	1.07	1.07
Penn West Petroleum Ltd Pembina Area 8 05-05-049-09W5	114	86	111	-	34.1	49.0	0.41	-
Penn West Petroleum Ltd Pennwest Pembina 03-07-049-11W5	93	67	90	-	-	-	0.53	0.53

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Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Penn West Petroleum Ltd Pennwest Pembina 02-07 ABBT0112406	94	67	90	-	-	-	0.40	-
Penn West Petroleum Ltd Pennwest Pembina 02-07-049-11W5	94	68	91	-	-	-	0.94	0.94
Penn West Petroleum Ltd Pennwest Pembina 05-22-047-11W5	100	68	96	-	46.7	60.0	0.54	0.54
Penn West Petroleum Ltd Chevron Bigoray 10-7	114	93	111	-	36.5	64.4	2.69	2.69
Perpetual Energy Inc. Cork 12-27-51-14 W5 Separator Bty	71	61	69	-	21.1	25.7	-	-
Perpetual Energy Inc. Cork Peco 16-36-48-15 W5/03	63	39	60	-	-	-	0.45	-
Perpetual Energy Inc. Crew Edson 16-10	64	61	62	-	192	-	0.35	-
Perpetual Energy Inc. Pfi Carrot Creek 08-36-051-14w5 Ggs	75	65	73	-	62.5	186	-	-
Perpetual Energy Inc. Cork Peco 00/02-21-048-15w5/02	58	32	55	-	-	-	0.53	0.53
PetroBakken Energy Ltd Berland Westpem 4-23-49-13w5m Ellers	80	57	77	-	-	-	0.39	-
PetroBakken Energy Ltd Pbn Hz 12-15-48-11 Oil Swb	100	71	97	-	-	-	0.35	-

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
PetroBakken Energy Ltd Pbn Hz 13-23-49-13 Oil Swb	81	58	78	-	-	-	0.36	-
PetroBakken Energy Ltd Pbn Hz 4-3-48-11 Oil Swb	100	70	97	-	-	-	0.35	-
PetroBakken Energy Ltd Pbn Hz Brazr 1-18-47-11 Oil Swb	95	62	92	-	-	-	0.45	-
PetroBakken Energy Ltd Pbn Pembina Hz 1-18-50-9 Oil Swb	114	90	111	-	-	-	0.49	-
Peyto Exploration and Development Corporation Nosehill 11-21-55-20W5	60	90	61	-	69.0	65.5	-	-
Peyto Exploration and Development Corporation Peyto Oldman Gas Plant 11-17-055-21W5M	58	93	60	-	132	337	-	-
Peyto Exploration and Development Corporation Wildhay	64	102	66	-	44.5	42.1	-	-
Sabre Energy Ltd. 8-01 Booster Compressor	112	87	109	-	0	0	-	-
SemCams ULC Obed Battery	55	93	58	23.9	56.9	-	0.21	0.21
SemCams ULC Pine Creek 3-3	84	111	86	8.25	174	32.0	3.57	3.57

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
SemCams ULC Pine Creek Dehydrator Battery 11-14	80	105	81	10.2	-	-	0.17	-
Shell Canada Upstream Cecilia 15-4	87	123	90	-	763	276	1.15	1.15
Shell Canada Upstream Medicine Lodge 14-03	38	73	40	-	273	177	0.46	-
Shell Canada Upstream Obed 01-21	63	101	66	-	338	234	0.46	-
Shell Canada Upstream Oldman 10-24	69	101	71	-	338	134	0.72	0.72
Shell Canada Upstream South Cecilia 09-29	81	113	83	-	181	138	0.49	-
Shell Canada Upstream Sundance 15-07	47	83	50	-	973	496	0.78	0.78
Shell Canada Upstream Wild Hay 11-22	68	107	71	-	350	254	-	-
Shell Canada Upstream Wroe 8-12	85	124	88	-	656	468	-	-
Suncor Energy Inc. Bighorn 02-24-043-17 W5M	73	34	70	-	-	25.0	-	-
Suncor Energy Inc. Brown creek 14-03-044-17 W5M	66	27	63	-	411	377	0.96	0.96
Suncor Energy Inc. Stolberg 05-01-042-15 W5M	97	56	93	-	-	25.7	-	-

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Suncor Energy Inc. Stolberg 07-29-041-14 W5M	102	61	98	-	-	27.3	-	-
Suncor Energy Inc. Cordel 03-18-043-16 W5M	75	36	72	-	-	23.2	-	-
Suncor Energy Oil and Gas Partnership 09-16-46-19 W5M	36	11	33	-	248	-	-	-
Suncor Energy Oil and Gas Partnership 10-09-45-18 W5M	51	14	47	-	133	30.9	-	-
Suncor Energy Oil and Gas Partnership 10-10-47-17 W5M	45	10	42	-	356	42.1	-	-
Suncor Energy Oil and Gas Partnership 10-26-45-19 W5M	43	11.6	39.8	-	28.3	-	-	-
Suncor Energy Oil and Gas Partnership 15-02-49-21W5	5	36	2	-	44.9	-	-	-
Suncor Energy Oil and Gas Partnership 2-20-47-19 W5M	30	23	28	-	88.8	-	-	-
Suncor Energy Oil and Gas Partnership 2-28-48-21 W5M	8	38	8	-	143	238	0.65	0.65
Suncor Energy Oil and Gas Partnership Hanlan Robb Gas Plant	13	30	10	2513	90.6	87.1	5.55	5.55
Suncor Energy Oil and Gas Partnership Redcap Compressor 10-30-46-19	10	48	12	-	89.5	-	-	-

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Suncor Energy Oil and Gas Partnership Talisman-Cmpr-05-36-046-19W5	27	21	24	-	-	-	-	-
Suncor Energy Oil and Gas Partnership 08-08-48-20 W5M	14	28	11	-	123	-	-	-
Suncor Energy Oil and Gas Partnership 08-11-47-16W5	56	22	53	-	119	-	-	-
Suncor Energy Oil and Gas Partnership 10-17-45-18 W5M	48	12	45	-	166	32.5	-	-
Suncor Energy Oil and Gas Partnership 11-6-45-17 W5M	56	16	52	-	143	-	-	-
Suncor Energy Oil and Gas Partnership 12-02-47-19 W5M	31	11	28	-	31.1	-	-	-
Suncor Energy Oil and Gas Partnership 12-18-48-20 W5M	11	31	9	-	53.4	89.8	-	-
Suncor Energy Oil and Gas Partnership 6-21-47-17 W5M	42	11	38	81.2	124	53.2	1.26	1.26
Suncor Energy Oil and Gas Partnership 6-01-47-17 W5M	49	12	45	-	-	23.8	-	-
Suncor Energy Oil and Gas Partnership 6-14-41-14 W5M	107	66	104	-	33.3	-	-	-
Suncor Energy Oil and Gas Partnership 15-06-46-19 W5M	37	15	34	-	191	21.7	-	-

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Suncor Energy Oil and Gas Partnership 06-06-46-19 W5M	37	16	34	-	46.1	-	-	-
Suncor Energy Oil and Gas Partnership 05-05-47-20 W5M	24	25	22	-	204	-	-	-
Suncor Energy Oil and Gas Partnership 05-25-51-22 W5M	23	63	26	-	55.5	-	-	-
Suncor Energy Oil and Gas Partnership 9-27-48-21 W5M	8	35	7	-	-	28.2	-	-
Sundance Forest Industries Ltd. Sundance Forest Industries Ltd.	46	64	46	-	50.9	1974	13.5	28.3
Talisman Energy Apetowun Comp Station 02-22	31	70	34	-	28.8	44.5	-	-
Talisman Energy Oldman 11-29 Compressor Station	71	105	73	-	22.3	-	0.50	-
Talisman Energy Pine Creek Compressor 7-14-56-19	70	95	71	-	-	21.3	-	-
Talisman Energy Talisman Med Lodge	53	87	55	-	46.4	44.2	-	-
Talisman Energy Talisman Renata Apetowun 1-3	27	66	30	-	30.8	30.2	-	-
Talisman Energy Talisman-Cmpr-03-23-042-16W5	66	25	63	-	233	375	1.02	1.02
Talisman Energy TLM 04-17-052-20W5	28	61	30	-	31.9	28.9	-	-

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Talisman Energy Tlm 10-16	47	66	46	-	31.9	-	0.63	0.63
Talisman Energy Tlm Edson 12-25 Comp	52	69	51	-	21.3	35.9	-	-
Talisman Energy TLM Sundance Comp Station 05-31	55	93	58	-	94.7	-	-	-
Talisman Energy TLM Wild River Gas Plant	28	61	30	-	240	247	0.66	0.66
Talisman Energy Westcoast Pine Creek 6-16	47	66	46	-	25.3	38.9	-	-
Talisman Energy Wild River 2-2 Compressor	52	69	51	-	-	25.5	-	-
Talisman Energy Encor Sundance 6-25-54-21	79	115	81	-	115	188	0.49	-
Talisman Energy Inc. Edson Gas Plant	47	63	46	1259	666	161	11.6	11.6
Tall Pine Timber Co. Ltd. Tall Pine Timber - Lodgepole	113	83	110	-	-	248	-	-
TAQA North Ltd. Blue_Rapids_Plant (4-08)	116	84	113	-	61.6	34.8	0.92	0.92
TAQA North Ltd. Brewster 3-17-043-14 W5	89	48	86	-	22.3	-	-	-
TAQA North Ltd. Find Et Al Pembina 00/06-36-046-10w5	115	81	111	-	-	-	0.56	0.56
TAQA North Ltd. Find Pembina 16-15-46-10W5	113	79	110	-	-	-	0.35	-

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
TAQA North Ltd. Niton (6-28)	99	95	97	-	48.7	-	-	-
TAQA North Ltd. NRK Sunchild 11-18 Compressor	120	80	116	72.0	0.34	-	178	-
TAQA North Ltd. Peco Comp 16-33-46-16W5	55	19	52	-	278	29.7	0.54	0.54
TAQA North Ltd. 02-26-52-12 W5	97	85	95	-	67.6	-	-	-
TAQA North Ltd. TNO Gas Test Battery	125	86	121	-	-	-	2.68	2.68
TAQA North Ltd. 13-31-040-09 W5	141	100	138	-	109	-	-	-
Teck Coal Limited Cheviot Mine (Cardinal River Operations)	33	59	35	-	60.7	-	12.7	205
Tourmaline Oil Corp Hinton 06-29-51-25 W5	49	89	52	-	20.7	-	-	-
Tourmaline Oil Corp Hinton 06-32-51-25 W5	50	90	53	-	37.9	25.9	-	-
TransCanada PipeLines Ltd. Knight	88	108	89	-	114	29.6	0.68	0.68
TransCanada PipeLines Ltd. Nordegg	104	63	100	-	21.6	-	0.38	-
TransCanada PipeLines Ltd. Swartz Creek	43	54	41	-	116	23.4	1.50	1.50
TransCanada PipeLines Ltd. Wolf Lake	51	35	48	-	244	87.9	1.41	1.41

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Vermilion Energy Inc. Eta Lake Gas Plant	94	76	91	-	217	364	2.39	2.39
Vermilion Energy Inc. Granada Gas Plant	97	83	94	-	147	245	1.37	1.37
Vermilion Energy Inc. Sunchild Battery and Compressor	116	76	112	-	23.1	38.9	-	-
Vermilion Energy Inc. West Pembina 16-09 Single Wellsite	88	67	85	-	-	-	0.54	0.54
Vermilion Energy Inc. West Pembina Battery and Compressor	78.0	58	75	-	95.6	161	0.46	-
Vermilion Energy Inc. West Pembina Compressor	68	46	65	-	-	23.4	-	-
Vermilion Energy Inc. Carrot Creek 04-14 Single Wellsite	102	87	99	-	-	-	0.77	0.77
Vero Energy Inc. Edson 12-15 Gas Plant	69	71	67	-	50.9	41.5	-	-
Vero Energy Inc. Pine Creek 13-11-56-19W5	69	94	70	-	28.8	-	-	-
Vero Energy Inc. Rosevear 3-10	74	78	72	-	33.0	-	-	-
Wapiti Gravel Suppliers Ltd. CMI 500 Mobile Plant	46	85	49	-	-	-	-	0.63
West Fraser Mills Ltd. Hinton Pulp	43	84	47	2072	664	852	261	313
West Fraser Mills Ltd. Hinton Wood Products	44	85	48	-	70.2	148	1.95	6.53

Appendix 17 Estimated Emissions from Industry within 100 km of Robb Trend ¹

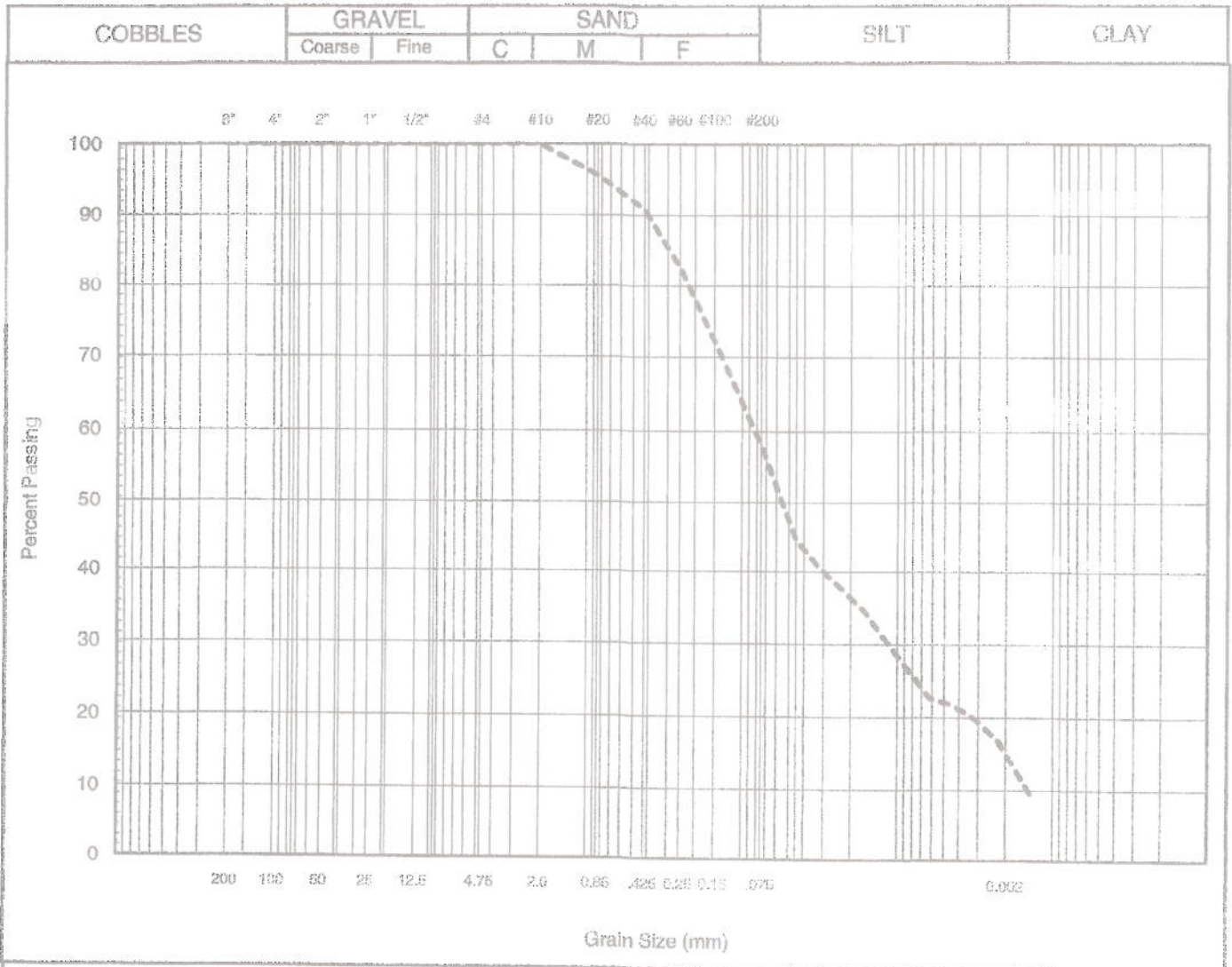
Facility Name	Distance to Robb Trend (km)			Emissions (t/yr)				
	West Mine	East Mine	Main Mine	SO ₂	NO _x	CO	Dust	
							PM _{2.5}	PM ₁₀
Weyerhaeuser Company Limited Edson O.S.B.	55	67	54	-	83.1	653	82.7	98.1
Zargon Oil and Gas Ltd. Pembina (Rat Creek) 09-35-048-11W5	101	73	98	-	23.6	39.7	-	-

Appendix 38

Lab Results of a Typical Dirt Sample from a Typical
CVM Haul Road Surface Material

PARTICLE SIZE ANALYSIS

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited



Remarks:

Summary			
D10 =	0.0015 mm	Gravel	0 %
D30 =	0.0115 mm	Sand	42 %
D60 =	0.0849 mm	Silt	43 %
Cu =	58.14	Clay	15 %
Cc =	1.06		

Project No: CA18048
Bore Hole: -
Depth (m): -

Project: Laboratory Testing
Sample: Pit 29 and Pit 124 Mix
Date: May 28, 2012 Tech: JCS/Nicole

Appendix 43

Monthly Climatological Summary for January 2011

MONTHLY CLIMATOLOGICAL SUMMARY for JAN. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	-10.2	-1.6	7:30p	-19.1	2:30a	28.5	0.0	0.0	2.3	29.0	11:15p	SW
2	-6.8	-2.4	12:15a	-17.6	12:00m	25.1	0.0	0.0	4.7	35.4	3:30a	SW
3	-12.3	0.5	3:15p	-20.1	5:15a	30.6	0.0	0.0	0.0	8.0	3:00p	SW
4	-3.1	2.8	12:00m	-13.9	12:30a	21.4	0.0	0.0	1.1	24.1	8:30p	SW
5	2.0	4.4	9:00p	-0.2	8:45a	16.3	0.0	0.3	3.2	37.0	12:00m	SW
6	-2.3	4.0	12:15a	-9.2	11:45p	20.6	0.0	0.0	6.0	41.8	12:30a	SW
7	-5.1	-2.6	2:45p	-8.8	12:15a	23.4	0.0	0.0	2.4	20.9	8:45p	SSE
8	-13.8	-7.2	12:15a	-18.2	11:45p	32.1	0.0	0.0	7.2	25.7	6:30a	WSW
9	-18.4	-17.5	3:00p	-19.2	8:30a	36.7	0.0	0.0	3.4	16.1	1:30a	WSW
10	-23.3	-16.7	3:00p	-29.8	12:00m	41.6	0.0	0.0	0.2	6.4	12:45a	SW
11	-25.5	-14.3	2:00p	-31.6	6:30a	43.8	0.0	0.0	0.2	11.3	2:00p	SW
12	-22.9	-21.1	5:15a	-26.6	12:15a	41.2	0.0	0.0	1.4	12.9	12:30p	WNW
13	-24.8	-23.5	1:15p	-27.3	2:00a	43.1	0.0	0.0	0.8	9.7	1:45p	NNE
14	-26.6	-25.3	12:30a	-27.5	4:45p	44.8	0.0	0.0	0.8	8.0	12:15a	W
15	-22.4	-10.7	12:00m	-26.6	10:00a	40.8	0.0	0.0	0.5	9.7	2:30a	NNE
16	-20.6	-8.6	12:45a	-24.7	12:00m	38.8	0.0	0.0	1.4	16.1	4:45a	WNW
17	-17.8	-10.4	4:00p	-24.9	1:00a	36.1	0.0	0.0	1.0	9.7	4:00p	NNE
18	-10.9	-6.1	1:00p	-18.4	4:45a	29.2	0.0	0.0	1.1	22.5	1:00p	SW
19	-9.3	-5.3	12:00p	-14.2	11:15p	27.6	0.0	0.0	2.1	25.7	5:30a	SW
20	-2.8	0.6	3:15p	-13.8	12:45a	21.1	0.0	0.0	3.1	38.6	12:45p	SW
21	-0.4	2.1	1:15p	-4.6	8:45a	18.7	0.0	0.3	1.4	24.1	4:45a	SW
22	1.1	4.8	1:15p	-9.4	3:45a	17.2	0.0	0.0	6.3	45.1	9:45p	SW
23	-2.6	2.7	12:15a	-11.7	9:45p	20.9	0.0	0.0	5.8	38.6	12:15a	SW
24	-1.9	6.0	1:45p	-8.2	9:45p	20.2	0.0	1.8	1.4	25.7	9:45a	SE
25	-1.0	6.4	12:45p	-6.8	12:30a	19.3	0.0	0.5	1.6	27.4	11:00a	SW
26	5.5	8.3	11:00p	-2.8	3:15a	12.8	0.0	2.3	4.5	29.0	1:15p	SW
27	4.6	8.7	12:00p	-2.0	12:00m	13.7	0.0	0.0	5.3	41.8	12:00p	SW
28	-7.4	-2.0	12:15a	-13.6	12:00m	25.7	0.0	0.0	2.1	24.1	12:30a	WNW
29	-16.6	-13.6	12:15a	-21.4	12:00m	34.9	0.0	0.0	1.4	12.9	3:00p	WNW
30	-25.2	-15.9	2:30p	-31.8	12:00m	43.5	0.0	0.0	0.2	6.4	3:30p	NNE
31	-25.9	-10.2	2:45p	-34.1	8:15a	44.3	0.0	0.0	0.2	6.4	1:30p	NNE
	-11.2	8.7	27	-34.1	31	914.1	0.0	5.1	2.4	45.1	22	SW

Max >= 32.0: 0
 Max <= 0.0: 19
 Min <= 0.0: 31
 Min <= -18.0: 16
 Max Rain: 2.29 ON 01/26/11
 Days of Rain: 5 (> .2 mm) 1 (> 2 mm) 0 (> 20 mm)
 Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for FEB. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	-16.3	0.3	3:00p	-30.5	4:30a	34.6	0.0	3.3	0.0	4.8	2:30p	NNE
2	-3.4	7.9	1:45p	-11.2	5:30a	21.7	0.0	6.3	0.6	16.1	1:15p	SW
3	2.4	6.9	12:45p	-4.7	12:15a	15.8	0.0	1.5	2.1	24.1	12:45p	SW
4	3.8	7.2	12:45p	-0.1	3:15a	14.5	0.0	0.0	7.9	45.1	12:45p	SW
5	-5.8	0.4	12:15a	-14.9	10:45p	24.1	0.0	0.0	6.1	29.0	3:30p	WNW
6	-12.8	-9.7	3:00p	-15.4	8:30a	31.1	0.0	0.0	2.7	19.3	3:00p	SSE
7	-15.4	-13.6	2:00p	-16.3	12:00m	33.7	0.0	0.0	1.0	11.3	3:30p	SSE
8	-18.4	-7.4	2:30p	-25.6	8:45a	36.7	0.0	2.3	0.2	8.0	12:15p	WSW
9	-8.6	0.9	2:15p	-22.6	12:15a	26.8	0.0	0.5	2.9	32.2	2:00p	SW
10	0.4	4.0	12:00p	-5.3	11:15p	17.9	0.0	1.0	5.8	35.4	1:15p	SW
11	1.9	5.2	1:45p	-5.7	12:45a	16.4	0.0	0.5	2.9	27.4	2:00p	SW
12	1.5	5.8	11:45a	-4.6	8:45a	16.8	0.0	0.3	2.7	27.4	6:30a	SSE
13	-1.4	3.2	3:45p	-6.6	10:00p	19.8	0.0	0.5	4.5	41.8	2:00a	SW
14	-4.1	5.2	3:15p	-11.1	7:15a	22.4	0.0	0.0	0.8	11.3	12:15p	SE
15	-9.4	0.6	3:45a	-19.9	12:00m	27.7	0.0	0.0	2.4	30.6	3:45a	WNW
16	-20.7	-18.9	4:45p	-22.0	6:15a	39.0	0.0	0.0	1.1	11.3	12:15p	WNW
17	-21.3	-18.7	2:45p	-23.7	12:00m	39.6	0.0	0.0	1.1	14.5	1:30p	WNW
18	-25.6	-19.2	3:15p	-31.3	8:15a	43.9	0.0	0.0	0.6	8.0	12:45a	WSW
19	-19.9	-3.5	2:45p	-32.3	4:45a	38.3	0.0	0.5	0.5	9.7	1:45p	N
20	-18.2	-2.6	3:15p	-30.5	7:00a	36.5	0.0	0.0	0.3	8.0	12:30p	W
21	-8.8	-1.3	12:30p	-18.4	12:45a	27.1	0.0	0.0	3.7	33.8	2:00p	S
22	-15.9	-9.7	12:15a	-23.2	11:30p	34.2	0.0	0.0	4.0	19.3	10:15a	WNW
23	-22.6	-20.3	1:00p	-27.1	12:00m	40.8	0.0	0.0	3.1	19.3	12:00p	WNW
24	-28.7	-20.8	4:00p	-34.3	7:15a	47.0	0.0	0.0	0.5	9.7	12:00p	WSW
25	-16.8	-8.4	4:45p	-34.0	12:15a	35.1	0.0	0.0	2.7	27.4	2:30p	SW
26	-6.9	-3.6	3:00a	-15.9	12:00m	25.3	0.0	0.0	4.3	32.2	8:30a	SW
27	-17.0	-12.1	11:00a	-24.3	12:00m	35.3	0.0	0.0	2.1	19.3	12:30p	WNW
28	-26.9	-23.8	3:15p	-35.3	11:45p	45.2	0.0	0.0	1.1	11.3	7:00a	WNW

	-12.0	7.9	2	-35.3	28	847.2	0.0	16.8	2.4	45.1	4	SW

Max >= 32.0: 0

Max <= 0.0: 16

Min <= 0.0: 28

Min <= -18.0: 16

Max Rain: 6.35 ON 02/02/11

Days of Rain: 10 (> .2 mm) 3 (> 2 mm) 0 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for MAR. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	-27.5	-19.9	3:30p	-36.2	3:00a	45.8	0.0	0.0	0.8	11.3	10:45a	NNE
2	-23.9	-19.7	3:00p	-26.3	11:00p	42.3	0.0	0.0	1.3	14.5	2:00p	NNE
3	-20.6	-13.7	3:45p	-29.3	7:30a	38.9	0.0	0.0	0.8	11.3	1:30p	WNW
4	-17.4	-12.3	1:45p	-23.2	7:15a	35.8	0.0	0.0	1.1	11.3	12:30p	NNE
5	-17.9	-14.5	3:30p	-20.6	7:30a	36.2	0.0	0.0	1.4	11.3	1:00p	WNW
6	-16.3	-9.8	3:45p	-21.6	12:00m	34.6	0.0	1.8	1.1	11.3	2:00p	NNE
7	-16.2	-5.0	4:00p	-26.0	7:00a	34.5	0.0	0.0	0.6	14.5	2:15p	WNW
8	-13.1	-1.6	3:15p	-25.8	6:45a	31.4	0.0	0.3	0.6	11.3	1:00p	NE
9	-8.1	1.7	4:30p	-17.3	6:15a	26.4	0.0	0.0	0.5	14.5	2:30p	ENE
10	-11.6	-7.1	12:30a	-16.9	11:15p	29.9	0.0	0.0	2.4	14.5	6:45p	WNW
11	-13.4	-3.1	3:45p	-22.3	7:30a	31.8	0.0	0.0	0.6	9.7	10:00a	NNE
12	-3.6	6.6	3:00p	-15.5	12:15a	21.8	0.0	0.8	2.6	35.4	4:00p	SE
13	-2.3	5.8	3:30p	-10.4	1:45a	19.8	0.0	0.0	0.6	11.3	3:45a	SW
14	1.4	6.0	1:30p	-4.5	5:30a	16.9	0.0	0.0	4.8	41.8	1:15p	S
15	-0.8	6.5	1:30p	-8.2	3:45a	19.1	0.0	0.0	1.0	17.7	6:00p	SW
16	-2.7	-0.4	6:00p	-5.3	7:00a	21.0	0.0	2.3	1.3	14.5	4:30p	WSW
17	-2.3	1.8	12:00p	-11.8	12:00m	20.6	0.0	7.4	0.5	20.9	3:45p	SW
18	-7.7	3.2	4:30p	-18.5	7:45a	26.0	0.0	0.8	0.6	12.9	3:45p	NNE
19	-8.1	-0.3	4:45p	-17.9	5:30a	26.4	0.0	0.0	1.3	12.9	9:45p	WNW
20	-5.6	-3.9	4:15p	-6.6	12:00p	23.8	0.0	2.0	1.6	12.9	2:15p	WNW
21	-6.2	-3.9	5:45p	-8.1	6:45a	24.4	0.0	0.0	3.2	19.3	7:45p	SSE
22	-3.3	1.5	5:00p	-6.5	7:30a	21.6	0.0	5.3	1.6	12.9	12:15a	NNE
23	-3.6	-1.3	2:45p	-5.3	12:00m	21.9	0.0	1.0	1.1	14.5	8:00p	SSE
24	-4.8	-2.8	1:00p	-5.9	6:15a	23.1	0.0	0.0	1.1	12.9	6:45p	SSE
25	-5.7	-3.9	3:15p	-7.2	7:00a	24.0	0.0	0.0	1.1	11.3	12:30a	SSE
26	-6.3	-4.4	3:00p	-8.1	8:15a	24.6	0.0	0.0	1.1	11.3	6:00p	SSE
27	-4.6	-1.5	12:45p	-7.2	5:00a	22.8	0.0	1.3	1.1	11.3	12:30p	SSE
28	-1.1	5.4	4:15p	-6.4	8:30a	19.4	0.0	0.3	0.8	11.3	5:45p	SSE
29	-2.2	6.3	3:15p	-12.0	6:15a	20.5	0.0	0.0	1.8	24.1	11:00a	SSW
30	-0.3	7.3	1:00p	-7.8	2:00a	18.6	0.0	0.0	4.2	43.5	2:45p	SW
31	0.8	6.0	4:00p	-3.6	7:30a	17.5	0.0	0.0	3.1	37.0	2:15p	SW
	-8.2	7.3	30	-36.2	1	821.3	0.0	23.1	1.5	43.5	30	SSE

Max >= 32.0: 0

Max <= 0.0: 19

Min <= 0.0: 31

Min <= -18.0: 10

Max Rain: 7.37 ON 03/17/11

Days of Rain: 11 (> .2 mm) 4 (> 2 mm) 0 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for APR. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	-1.2	3.9	12:45p	-7.8	7:00a	19.4	0.0	0.0	2.3	27.4	2:30p	SW
2	-2.6	0.8	4:00p	-5.3	12:00m	20.9	0.0	2.5	1.3	12.9	12:15p	WSW
3	-2.4	4.5	4:45p	-12.7	8:00a	20.7	0.0	0.5	1.9	25.7	4:45p	S
4	0.1	5.1	2:15p	-5.4	12:00m	18.2	0.0	0.0	3.7	35.4	1:15p	SW
5	-1.2	2.6	10:15a	-8.1	1:45a	19.5	0.0	0.0	3.1	35.4	5:45p	SW
6	-3.3	1.5	1:30p	-9.1	7:00a	21.6	0.0	0.0	1.6	19.3	3:15p	SE
7	-3.4	1.7	3:45p	-8.5	6:45a	21.7	0.0	0.0	1.4	19.3	12:45p	WSW
8	-1.8	5.6	5:00p	-12.7	7:30a	20.1	0.0	0.0	2.4	27.4	11:00a	SSE
9	3.7	9.3	2:45p	-1.7	7:15a	14.6	0.0	0.0	2.4	29.0	5:15p	SW
10	3.2	8.1	4:45p	-3.2	7:00a	15.1	0.0	0.0	2.6	33.8	5:00p	SSE
11	1.9	5.6	1:30p	-4.3	12:00m	16.4	0.0	0.0	5.6	46.7	1:45p	SW
12	-1.8	4.2	2:45p	-9.8	6:30a	20.2	0.0	0.0	1.9	20.9	8:15p	SSE
13	-0.7	5.9	3:30p	-8.8	7:00a	19.0	0.0	0.0	3.1	25.7	10:30p	SSE
14	-1.8	-0.1	12:15a	-3.8	12:00m	20.1	0.0	2.5	3.5	22.5	1:30a	SSE
15	-5.0	-0.4	1:30p	-10.5	5:30a	23.3	0.0	0.3	2.3	20.9	3:00p	WNW
16	-5.1	-3.0	1:45p	-7.6	1:45a	23.3	0.0	3.8	2.7	19.3	2:45p	N
17	-6.4	-2.1	5:15p	-13.3	12:00m	24.7	0.0	2.0	1.8	17.7	1:15p	NNE
18	-7.7	1.7	3:15p	-19.6	6:45a	26.0	0.0	1.5	1.3	17.7	2:45p	SSE
19	-4.4	2.2	3:30p	-14.2	6:30a	22.7	0.0	0.0	2.6	32.2	3:45p	SW
20	-1.8	3.1	5:00p	-6.3	6:15a	20.1	0.0	0.0	2.3	24.1	5:30p	SW
21	-3.1	3.3	2:45p	-11.4	6:30a	21.4	0.0	0.0	1.4	19.3	2:30p	WSW
22	-1.2	5.8	4:00p	-11.1	6:15a	19.5	0.0	0.0	2.9	24.1	2:30p	SW
23	1.1	8.8	5:00p	-8.3	7:00a	17.2	0.0	0.0	2.9	27.4	5:30p	SW
24	4.1	11.3	4:30p	-5.9	6:45a	14.2	0.0	0.0	2.3	24.1	9:15a	SW
25	3.7	11.4	1:15p	-4.2	6:15a	14.7	0.0	0.0	1.6	29.0	2:15p	SSE
26	3.6	7.9	3:00p	-0.6	3:00a	14.8	0.0	0.0	3.9	32.2	9:15a	SW
27	3.1	9.1	3:45p	-3.3	6:30a	15.2	0.0	0.0	2.3	29.0	2:45p	WSW
28	1.1	7.3	2:15p	-5.3	6:30a	17.2	0.0	0.3	5.6	32.2	7:00p	WNW
29	1.7	6.8	5:45p	-1.1	6:30a	16.6	0.0	10.4	2.1	14.5	1:15a	WNW
30	2.2	6.7	5:45p	-2.1	3:30a	16.2	0.0	2.0	3.2	29.0	12:45p	WSW

	-0.9	11.4	25	-19.6	18	574.5	0.0	25.9	2.6	46.7	11	SW

Max >= 32.0: 0

Max <= 0.0: 4

Min <= 0.0: 30

Min <= -18.0: 1

Max Rain: 10.41 ON 04/29/11

Days of Rain: 10 (> .2 mm) 6 (> 2 mm) 0 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for MAY. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	4.1	11.1	5:30p	-4.7	6:30a	14.2	0.0	0.3	2.9	24.1	11:45a	SW
2	7.1	15.1	2:30p	-2.0	2:45a	11.2	0.0	0.0	1.4	19.3	12:15p	SSE
3	4.9	8.3	3:15p	1.4	6:30a	13.4	0.0	0.0	5.5	37.0	2:00p	SW
4	5.1	10.3	1:45p	-1.9	5:15a	13.2	0.0	0.0	4.0	29.0	12:15p	SW
5	3.9	10.9	4:30p	-1.5	3:00a	14.4	0.0	1.3	2.9	29.0	4:45p	S
6	3.2	8.4	2:15p	-0.7	6:00a	15.1	0.0	8.1	1.4	20.9	12:45p	SSE
7	3.4	10.1	2:45p	-1.7	6:15a	14.8	0.0	2.8	1.3	25.7	2:45p	SE
8	2.9	5.8	6:45p	-1.0	12:00m	15.4	0.0	5.6	1.1	12.9	1:45p	SSE
9	5.0	13.3	4:15p	-3.4	6:00a	13.3	0.0	0.3	1.3	16.1	4:15p	N
10	8.6	17.1	3:45p	-1.6	3:45a	9.7	0.0	0.0	1.9	33.8	4:00p	SSE
11	11.2	20.7	3:45p	0.2	3:30a	7.3	0.2	0.0	1.6	24.1	3:45p	SSE
12	8.5	13.9	2:45p	3.7	5:30a	9.8	0.0	0.8	3.1	24.1	5:00p	WNW
13	6.6	12.6	4:30p	-2.2	6:30a	11.7	0.0	0.5	2.7	24.1	4:45p	S
14	11.4	18.4	2:15p	4.3	5:45a	6.9	0.0	0.0	7.6	40.2	3:45p	SSE
15	9.9	15.2	3:45p	3.6	6:00a	8.3	0.0	0.0	7.6	37.0	3:15p	S
16	11.2	18.9	4:00p	-0.9	5:15a	7.1	0.0	0.0	2.6	24.1	2:45p	SSE
17	8.1	12.8	4:30p	0.8	12:00m	10.2	0.0	0.0	1.9	29.0	6:30p	SW
18	7.4	15.3	4:30p	-3.6	5:45a	10.9	0.0	0.0	1.8	20.9	4:30p	WNW
19	6.4	8.8	3:00p	4.2	8:00a	11.9	0.0	14.5	1.4	19.3	1:00p	SSE
20	10.4	17.7	4:45p	2.6	6:15a	7.9	0.0	0.3	1.1	37.0	1:00p	SSE
21	11.9	19.6	5:00p	2.7	5:30a	6.4	0.0	0.3	1.4	16.1	5:00p	WNW
22	10.6	17.8	12:30p	3.6	6:00a	7.7	0.0	18.8	1.9	22.5	2:00p	WNW
23	4.9	8.6	12:15a	1.7	11:45p	13.4	0.0	24.9	1.8	11.3	4:30a	WNW
24	2.9	4.7	2:30p	1.0	3:45a	15.4	0.0	2.8	0.8	12.9	3:30p	N
25	3.8	5.1	6:00p	2.1	7:15a	14.5	0.0	5.6	2.1	19.3	11:30a	SSE
26	5.3	6.8	11:00a	4.2	5:45a	13.0	0.0	9.4	1.9	24.1	3:15p	NNE
27	6.4	10.7	1:00p	3.4	4:30a	11.9	0.0	4.1	1.0	17.7	2:00p	SSE
28	7.9	13.3	4:30p	1.6	12:00m	10.4	0.0	2.0	3.5	27.4	12:30p	WNW
29	7.4	14.4	6:45p	-2.4	4:45a	10.9	0.0	0.0	2.3	24.1	11:15a	WNW
30	6.1	13.6	2:00p	0.1	5:45a	12.2	0.0	5.3	1.8	19.3	10:00a	SW
31	5.9	12.7	12:30p	0.0	4:15a	12.4	0.0	1.3	1.3	27.4	3:00p	SSE
	6.9	20.7	11	-4.7	1	355.0	0.2	108.7	2.4	40.2	14	SSE

Max >= 32.0: 0

Max <= 0.0: 0

Min <= 0.0: 14

Min <= -18.0: 0

Max Rain: 24.89 ON 05/23/11

Days of Rain: 20 (> .2 mm) 12 (> 2 mm) 1 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for JUN. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	6.9	13.1	11:45a	-1.4	5:30a	11.4	0.0	1.0	1.3	16.1	11:45a	N
2	9.2	15.8	2:00p	0.2	5:15a	9.1	0.0	0.0	4.3	27.4	7:00p	WSW
3	5.3	9.5	12:15a	-0.7	11:30p	13.0	0.0	4.6	4.3	20.9	2:45a	WNW
4	5.9	13.8	5:15p	-0.7	12:15a	12.3	0.0	3.0	1.8	17.7	2:15p	SSE
5	9.6	14.8	4:00p	5.4	6:00a	8.7	0.0	1.8	2.3	20.9	1:15p	WNW
6	9.6	14.8	2:00p	3.5	5:15a	8.7	0.0	1.0	1.6	20.9	3:15p	N
7	6.1	9.8	10:45a	2.1	4:30a	12.2	0.0	32.5	0.8	16.1	10:15a	S
8	6.9	11.0	5:15p	4.4	3:45a	11.4	0.0	4.8	0.8	9.7	9:15a	WNW
9	11.7	19.7	4:15p	0.2	5:15a	6.7	0.1	0.3	1.1	14.5	10:15a	WNW
10	11.1	18.9	2:15p	3.2	5:30a	7.2	0.0	10.4	2.4	22.5	12:15p	WNW
11	9.4	13.8	6:15p	6.0	5:30a	8.8	0.0	1.8	1.1	19.3	1:45p	SW
12	9.9	15.3	4:30p	3.3	5:30a	8.4	0.0	2.8	1.4	24.1	12:45p	S
13	9.4	14.7	11:45a	4.8	4:45a	8.9	0.0	5.8	1.8	24.1	9:15p	SE
14	9.7	14.9	1:45p	3.1	3:45a	8.6	0.0	0.8	2.6	25.7	6:45p	WNW
15	8.1	13.6	1:00p	4.0	5:15a	10.2	0.0	14.7	6.4	35.4	9:45p	SW
16	7.0	8.2	10:00p	4.5	2:00a	11.3	0.0	65.8	8.5	35.4	1:00a	SW
17	8.2	12.2	3:15p	4.9	6:30a	10.1	0.0	27.7	1.9	17.7	11:15a	WNW
18	7.9	12.3	1:45p	1.2	5:45a	10.4	0.0	16.8	5.0	29.0	9:30p	SW
19	10.0	14.1	3:00p	7.7	4:00a	8.3	0.0	20.8	3.7	24.1	12:15a	SW
20	11.1	15.7	6:45p	7.8	6:00a	7.3	0.0	5.1	3.4	30.6	12:30p	SW
21	12.5	19.3	8:00p	4.4	5:30a	5.9	0.1	0.0	1.8	25.7	11:15a	SW
22	14.6	22.3	4:30p	2.9	5:30a	4.7	1.0	0.0	1.0	14.5	10:15a	NW
23	11.8	19.6	2:15p	6.1	4:00a	6.6	0.1	3.0	1.9	30.6	3:45p	SSW
24	9.3	14.3	5:15p	5.1	5:45a	9.0	0.0	0.5	3.1	30.6	3:15p	SW
25	7.6	13.3	10:30a	-0.6	6:15a	10.8	0.0	9.4	4.5	30.6	5:45p	SW
26	10.2	15.7	3:00p	5.9	12:15a	8.1	0.0	8.1	3.1	24.1	3:15a	SW
27	12.3	19.4	4:15p	2.1	5:30a	6.0	0.1	0.0	0.8	17.7	4:15p	W
28	13.1	19.7	4:45p	4.0	5:30a	5.3	0.1	0.0	0.8	20.9	8:15p	S
29	13.1	18.2	11:45a	6.6	10:45p	5.3	0.0	6.9	1.9	30.6	10:00p	WNW
30	9.1	12.9	4:30p	3.9	5:15a	9.2	0.0	0.0	3.1	29.0	12:15p	SW
	9.6	22.3	22	-1.4	1	263.8	1.5	249.4	2.6	35.4	15	SW

Max >= 32.0: 0

Max <= 0.0: 0

Min <= 0.0: 4

Min <= -18.0: 0

Max Rain: 65.79 ON 06/16/11

Days of Rain: 24 (> .2 mm) 17 (> 2 mm) 4 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for JUL. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	9.4	14.2	7:00p	1.1	5:30a	8.8	0.0	0.0	3.9	29.0	3:15p	SW
2	11.9	20.3	3:30p	1.9	3:15a	6.7	0.3	0.0	1.9	27.4	3:15p	SSE
3	12.1	17.2	9:30a	6.8	2:45a	6.2	0.0	0.3	3.5	33.8	5:15p	WNW
4	12.0	19.8	5:15p	2.3	5:45a	6.4	0.1	0.0	1.9	27.4	5:30p	SW
5	14.1	21.7	1:45p	2.3	5:45a	4.9	0.7	0.0	1.0	16.1	10:30a	S
6	15.7	24.2	6:00p	4.9	5:30a	4.2	1.6	0.0	2.1	25.7	12:45p	SSE
7	13.5	19.1	5:45p	9.6	4:00a	4.8	0.0	23.4	2.4	30.6	8:15p	WNW
8	7.9	10.0	12:15a	6.5	3:15p	10.4	0.0	20.6	5.8	38.6	3:00p	SW
9	8.8	11.6	5:15p	6.3	4:15a	9.5	0.0	14.7	5.1	32.2	5:15a	SW
10	11.1	15.1	6:00p	8.0	1:00a	7.2	0.0	9.1	3.9	22.5	9:45a	SW
11	12.1	16.9	2:00p	9.8	4:15a	6.3	0.0	8.1	1.4	19.3	8:00p	SSE
12	12.5	15.0	7:00p	10.4	12:00m	5.8	0.0	2.0	1.9	17.7	7:00p	SSE
13	11.6	13.6	7:00p	9.3	5:30a	6.8	0.0	3.3	0.5	11.3	3:15p	W
14	13.5	18.9	3:30p	8.2	6:30a	4.8	0.0	0.3	2.3	24.1	6:15p	SW
15	12.6	17.8	5:15p	7.8	3:30a	5.7	0.0	1.0	3.9	32.2	2:00p	SW
16	14.7	20.9	5:15p	5.2	6:00a	4.0	0.4	0.0	1.8	19.3	1:45p	WNW
17	15.7	22.6	4:45p	9.2	2:45a	3.4	0.8	0.0	1.0	16.1	1:30p	WNW
18	16.2	21.4	6:15p	10.2	6:00a	2.5	0.5	0.0	1.8	19.3	7:45p	WNW
19	13.0	18.3	3:15p	8.2	11:45p	5.3	0.0	2.0	2.4	30.6	8:45p	WNW
20	12.2	17.4	3:30p	5.6	6:00a	6.1	0.0	0.0	3.7	38.6	1:45p	SW
21	8.8	14.1	2:30p	5.6	6:15a	9.4	0.0	9.1	1.1	24.1	3:45p	ESE
22	7.8	11.9	4:00p	5.1	4:45a	10.5	0.0	8.6	1.0	20.9	4:45p	S
23	10.1	14.6	6:00p	5.1	6:15a	8.2	0.0	0.8	2.3	25.7	9:45a	SW
24	14.4	21.1	5:30p	4.3	6:00a	4.4	0.5	0.0	2.4	32.2	1:30p	SW
25	15.3	22.6	3:30p	3.9	6:15a	4.4	1.4	2.3	1.8	17.7	9:30p	SSE
26	12.4	16.8	1:00p	9.4	6:30a	5.9	0.0	5.3	2.3	27.4	2:15p	SW
27	11.4	16.4	5:45p	5.5	5:00a	6.9	0.0	0.5	1.9	20.9	1:00p	SW
28	12.0	19.6	3:45p	3.9	6:00a	6.3	0.0	3.8	1.6	27.4	10:15p	SSE
29	11.2	16.6	4:00p	3.9	6:15a	7.1	0.0	1.0	3.5	33.8	7:00p	SW
30	14.7	24.6	3:30p	2.9	2:30a	5.4	1.8	0.0	1.6	27.4	5:15p	SSE
31	11.7	15.9	1:15p	8.2	11:15p	6.6	0.0	7.4	2.4	19.3	11:30p	SW
	12.3	24.6	30	1.1	1	195.0	8.4	123.7	2.4	38.6	8	SW

Max >= 32.0: 0
 Max <= 0.0: 0
 Min <= 0.0: 0
 Min <= -18.0: 0

Max Rain: 23.37 ON 07/07/11

Days of Rain: 20 (> .2 mm) 14 (> 2 mm) 2 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for AUG. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	12.4	18.4	5:45p	3.7	6:30a	5.9	0.0	0.0	2.9	29.0	4:30p	SSE
2	12.1	20.7	3:45p	0.3	5:45a	6.5	0.3	0.0	1.1	19.3	8:30p	SSE
3	11.7	18.2	4:30p	6.3	6:00a	6.6	0.0	0.8	1.6	20.9	4:00p	SW
4	13.4	20.4	4:15p	4.6	3:15a	5.3	0.4	0.3	1.0	16.1	1:45p	NNW
5	14.2	22.8	3:00p	4.7	6:30a	4.9	0.8	1.8	1.3	33.8	4:00p	SSE
6	9.6	14.3	1:15p	4.9	12:00m	8.7	0.0	23.9	2.7	30.6	3:30a	WNW
7	9.6	15.2	7:30p	3.7	1:30a	8.7	0.0	6.1	3.7	27.4	4:15p	SW
8	13.1	20.2	5:15p	3.3	6:15a	5.6	0.4	0.0	0.8	12.9	11:45a	NNE
9	13.6	21.1	2:00p	5.7	5:30a	5.1	0.4	6.9	1.3	22.5	8:45p	SSE
10	12.2	19.7	2:00p	6.0	6:30a	6.2	0.1	0.3	1.0	20.9	3:15p	SE
11	12.3	19.4	5:30p	3.9	6:30a	6.0	0.1	4.6	1.3	19.3	8:30p	SSE
12	14.2	22.6	3:00p	4.3	6:30a	5.1	1.1	0.3	0.8	17.7	5:45p	SSE
13	14.8	23.7	3:45p	7.4	3:30a	4.4	1.0	0.0	1.3	19.3	2:30p	ESE
14	11.1	16.3	4:00p	6.7	2:30a	7.3	0.0	1.0	2.6	22.5	6:00p	WNW
15	9.4	14.8	5:15p	5.2	4:00a	8.9	0.0	1.3	1.9	25.7	3:45p	SW
16	9.6	18.4	2:30p	-0.6	5:30a	8.7	0.0	0.0	2.4	32.2	4:15p	S
17	7.3	12.8	10:30a	4.0	1:45a	11.0	0.0	6.1	1.3	24.1	11:00p	SSW
18	7.7	14.3	4:30p	2.1	6:30a	10.6	0.0	2.8	1.8	24.1	5:00p	SW
19	9.6	17.4	5:00p	0.6	6:45a	8.7	0.0	0.0	1.9	20.9	6:15p	SW
20	15.7	23.7	6:00p	8.8	7:15a	4.0	1.4	0.0	1.8	19.3	10:15a	SW
21	16.7	25.8	1:00p	6.9	6:00a	3.6	2.0	0.0	2.3	37.0	3:00p	SSE
22	18.2	21.9	2:45p	11.6	12:00m	0.7	0.7	0.0	2.7	27.4	1:45p	SSE
23	13.4	19.1	6:15p	8.1	7:30a	4.9	0.0	2.8	3.4	32.2	12:45p	SW
24	13.5	22.1	1:00p	3.8	6:45a	5.6	0.8	0.0	1.6	20.9	1:45p	WNW
25	12.5	18.4	3:45p	4.9	7:15a	5.8	0.0	0.0	1.6	19.3	1:00p	N
26	12.7	18.9	2:30p	3.3	7:15a	5.7	0.0	0.0	0.6	14.5	2:30p	ESE
27	13.8	23.0	12:15p	3.4	5:45a	5.7	1.1	0.0	1.0	17.7	12:30p	SE
28	13.7	22.4	4:30p	2.2	6:45a	5.7	1.1	0.0	1.1	17.7	4:15p	SE
29	10.7	16.6	4:45p	4.8	6:45a	7.6	0.0	5.3	1.9	29.0	10:30a	WNW
30	9.2	13.4	6:00p	5.4	7:45a	9.1	0.0	11.9	1.3	22.5	9:45p	WNW
31	5.5	8.1	6:00p	1.2	12:00m	12.8	0.0	5.1	1.1	14.5	2:45p	WNW
	12.1	25.8	21	-0.6	16	205.5	11.8	81.0	1.7	37.0	21	SSE

Max >= 32.0: 0
 Max <= 0.0: 0
 Min <= 0.0: 1
 Min <= -18.0: 0

Max Rain: 23.88 ON 08/06/11

Days of Rain: 17 (> .2 mm) 10 (> 2 mm) 1 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for SEP. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	7.1	15.7	2:00p	-1.7	7:15a	11.2	0.0	1.0	1.1	24.1	1:00p	SSE
2	5.8	8.8	5:45p	2.4	5:30a	12.5	0.0	4.1	2.9	27.4	1:45p	SW
3	8.3	17.1	5:30p	-1.1	7:00a	10.0	0.0	0.3	0.8	12.9	11:00a	W
4	11.9	22.0	4:00p	0.3	7:00a	7.4	1.0	0.0	1.0	19.3	6:45p	NE
5	12.8	22.3	2:00p	2.7	5:00a	6.5	1.0	0.0	1.0	19.3	11:30a	SW
6	13.2	24.4	4:15p	1.3	7:15a	6.8	1.6	0.0	0.6	14.5	12:00p	SW
7	14.9	25.5	3:45p	3.4	7:30a	5.8	2.4	0.0	0.8	14.5	3:30p	SSE
8	14.8	25.0	3:30p	4.4	7:00a	5.7	2.3	0.0	1.3	19.3	3:45p	WNW
9	14.9	26.2	2:15p	3.9	7:30a	5.9	2.5	0.0	1.0	16.1	3:45p	WNW
10	14.0	21.7	3:30p	3.9	7:00a	5.3	0.9	0.0	1.0	16.1	1:30p	N
11	7.9	15.4	10:00a	2.3	12:00m	10.4	0.0	0.8	2.3	27.4	10:30a	WNW
12	6.4	11.8	4:15p	1.9	12:30a	11.9	0.0	0.0	1.1	20.9	4:15p	WNW
13	5.2	11.3	2:15p	-0.3	3:00a	13.1	0.0	0.3	2.1	19.3	5:30p	SSE
14	8.9	16.3	4:15p	3.0	7:30a	9.4	0.0	0.0	1.3	16.1	4:45p	SSE
15	9.8	21.9	12:30p	1.2	7:30a	8.8	0.2	5.8	1.0	32.2	5:15p	NE
16	9.2	14.2	3:30p	1.7	12:00m	9.1	0.0	0.8	3.7	37.0	11:30a	S
17	5.2	10.8	1:00p	-1.8	12:00m	13.1	0.0	0.8	1.6	29.0	5:15p	SW
18	5.1	15.2	2:00p	-4.7	7:15a	13.3	0.0	1.0	1.6	27.4	4:15p	SSW
19	6.7	12.8	3:00p	-0.3	12:00m	11.6	0.0	0.3	3.5	30.6	12:00p	SW
20	6.1	17.4	4:00p	-4.5	8:00a	12.2	0.0	0.0	0.6	17.7	1:45p	SW
21	12.3	24.7	3:15p	0.5	4:30a	7.1	1.1	0.0	1.1	29.0	1:30p	ESE
22	12.6	17.1	1:30a	8.3	6:45a	5.7	0.0	0.0	1.0	24.1	1:00a	SSE
23	16.7	24.9	2:45p	7.8	1:15a	3.9	2.3	0.0	4.3	41.8	1:00p	SSE
24	11.5	19.8	3:30p	2.8	7:15a	7.0	0.2	0.0	1.1	16.1	12:15a	NNE
25	11.8	21.7	3:15p	3.2	6:30a	6.9	0.4	0.0	2.3	30.6	9:30p	SSE
26	8.8	15.2	1:45p	1.8	8:15a	9.5	0.0	0.0	1.0	20.9	3:15p	SSE
27	8.6	12.6	3:00p	3.9	9:45p	9.7	0.0	0.5	4.8	51.5	12:45p	SSE
28	6.4	11.7	12:45p	-2.6	12:00m	11.9	0.0	0.0	2.7	41.8	12:45p	SW
29	3.7	12.6	1:45p	-5.8	4:00a	14.6	0.0	0.0	0.3	11.3	2:00p	SSE
30	10.3	21.6	1:15p	-0.4	3:30a	8.6	0.6	0.0	3.9	37.0	2:30p	SSE
	9.7	26.2	9	-5.8	29	274.9	16.5	15.5	1.8	51.5	27	SSE

Max >= 32.0: 0

Max <= 0.0: 0

Min <= 0.0: 10

Min <= -18.0: 0

Max Rain: 5.84 ON 09/15/11

Days of Rain: 11 (> .2 mm) 2 (> 2 mm) 0 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for OCT. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	2.6	5.1	12:15a	0.4	6:15a	15.8	0.0	7.1	0.8	16.1	12:45p	SSE
2	2.6	3.9	3:00p	1.4	6:45a	15.8	0.0	1.5	0.3	12.9	8:15p	NNE
3	4.8	9.2	2:45p	2.7	8:00a	13.4	0.0	0.3	1.0	16.1	2:30p	WNW
4	4.4	9.8	4:00p	-0.2	6:45a	13.9	0.0	8.1	1.0	14.5	11:15a	SE
5	3.3	9.8	3:00p	-2.3	8:00a	15.0	0.0	0.3	1.0	16.1	3:30p	N
6	4.7	7.8	3:45p	2.4	12:00m	13.6	0.0	0.3	0.3	8.0	11:30a	NW
7	2.6	6.7	4:00p	-1.9	12:00m	15.7	0.0	2.0	1.4	22.5	4:45p	SW
8	2.5	12.2	3:15p	-5.1	7:45a	15.8	0.0	0.3	0.5	12.9	12:15p	SSE
9	4.3	11.3	4:00p	-2.2	12:00m	14.0	0.0	0.0	1.1	22.5	4:30p	SE
10	1.2	8.5	4:00p	-5.3	7:15a	17.1	0.0	0.0	0.5	16.1	12:15p	SSE
11	4.2	10.5	2:45p	-1.0	6:15a	14.1	0.0	2.0	0.3	17.7	7:00p	N
12	3.5	9.7	1:45p	-0.4	5:00a	14.8	0.0	0.0	1.4	33.8	2:45p	SW
13	1.6	6.3	3:00p	-2.4	4:15a	16.7	0.0	0.3	2.6	32.2	3:00p	SW
14	-1.5	5.4	4:45p	-8.3	8:00a	19.8	0.0	0.0	1.1	20.9	3:00p	SW
15	-1.3	6.5	5:15p	-6.8	3:00a	19.6	0.0	0.0	0.6	12.9	3:00p	SW
16	-1.5	8.6	3:00p	-9.0	8:00a	19.8	0.0	0.0	0.5	14.5	3:30p	WNW
17	3.5	11.3	1:45p	-5.2	1:30a	14.8	0.0	0.0	2.1	24.1	10:00a	SW
18	5.1	18.9	4:00p	-3.7	5:30a	13.2	0.0	0.0	0.5	14.5	4:00p	SSW
19	6.3	13.3	2:30p	0.3	1:15a	12.0	0.0	0.0	0.5	24.1	11:45p	SSW
20	1.3	5.6	12:15a	-1.2	12:00m	17.0	0.0	5.1	0.8	17.7	1:00a	SSE
21	-0.8	3.9	2:15p	-5.6	8:00a	19.1	0.0	0.0	0.3	17.7	12:00m	SSE
22	2.1	8.4	4:00p	-2.4	7:00a	16.2	0.0	1.0	1.8	38.6	11:30p	SSE
23	0.2	6.3	3:15p	-5.3	12:00m	18.1	0.0	0.0	1.8	29.0	12:30p	SW
24	-2.2	5.0	1:15p	-7.2	5:15a	20.4	0.0	0.0	0.8	19.3	3:15p	SW
25	-0.9	4.4	3:00p	-7.2	12:00m	19.3	0.0	0.0	1.3	24.1	11:45a	SW
26	-2.4	5.9	4:30p	-9.2	6:15a	20.8	0.0	0.0	1.9	32.2	5:15p	SE
27	0.3	4.7	3:00p	-6.1	11:45p	18.0	0.0	0.0	4.5	35.4	3:00p	SW
28	1.6	9.6	2:45p	-6.9	3:15a	16.8	0.0	0.0	0.8	24.1	2:30p	SE
29	1.1	5.9	1:30p	-4.0	10:15p	17.2	0.0	0.0	3.1	35.4	12:00p	SW
30	2.8	10.8	12:45p	-3.0	1:45a	15.5	0.0	0.0	2.3	33.8	2:00p	SW
31	0.6	5.3	2:15p	-3.7	9:30p	17.7	0.0	0.0	2.9	41.8	2:45p	SW
	1.8	18.9	18	-9.2	26	510.9	0.0	28.2	1.3	41.8	31	SW

Max >= 32.0: 0

Max <= 0.0: 0

Min <= 0.0: 26

Min <= -18.0: 0

Max Rain: 8.13 ON 10/04/11

Days of Rain: 12 (> .2 mm) 5 (> 2 mm) 0 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for NOV. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	-0.7	4.5	3:00p	-8.3	8:45a	19.0	0.0	0.0	2.3	22.5	1:45p	SW
2	3.5	11.3	2:45p	-2.6	4:15a	14.8	0.0	0.0	1.9	38.6	2:15p	SSE
3	-3.3	4.4	12:15a	-8.9	12:00m	21.6	0.0	0.0	2.1	19.3	11:00a	WNW
4	-9.3	-0.9	2:00p	-16.3	12:00m	27.6	0.0	3.8	0.2	8.0	2:00p	SSE
5	-11.8	-0.9	3:45p	-19.6	4:45a	30.1	0.0	0.3	0.0	6.4	12:15p	NNE
6	-10.1	0.1	2:30p	-17.1	6:45a	28.4	0.0	0.5	0.5	12.9	11:15a	SW
7	-7.2	0.9	3:45p	-15.4	3:00a	25.5	0.0	0.0	0.5	16.1	1:45p	SE
8	-4.6	1.1	1:00p	-14.3	12:00m	22.9	0.0	0.0	1.8	25.7	2:30p	SW
9	-7.2	0.7	12:00p	-16.8	5:00a	25.5	0.0	0.0	0.2	8.0	11:00a	ESE
10	3.9	8.8	6:45a	-2.7	4:15a	14.4	0.0	0.5	2.9	35.4	1:45p	SW
11	-0.8	2.8	11:15a	-2.9	7:45a	19.1	0.0	0.0	1.8	20.9	9:45p	WNW
12	-3.2	-1.8	2:30p	-6.2	7:45a	21.5	0.0	0.0	1.4	19.3	12:45a	SW
13	-3.9	-0.4	12:15p	-9.1	7:30a	22.3	0.0	0.0	3.7	38.6	12:45p	SW
14	-8.1	-5.2	11:45a	-14.8	11:00p	26.4	0.0	0.0	4.0	35.4	12:00p	SW
15	-7.5	-4.6	2:15p	-10.8	6:45a	25.8	0.0	0.0	2.9	29.0	1:30p	SW
16	-7.1	-3.4	1:30p	-14.9	8:30a	25.4	0.0	0.0	2.3	25.7	12:15a	SSE
17	-11.7	-8.1	12:15a	-16.7	12:00m	30.0	0.0	0.0	0.8	16.1	2:15p	WNW
18	-18.6	-16.3	12:00p	-23.2	7:45a	36.9	0.0	0.0	0.6	14.5	4:00p	N
19	-23.7	-17.1	2:00p	-29.2	10:15p	42.0	0.0	0.0	0.0	6.4	12:45a	SSE
20	-17.7	-5.4	1:30p	-30.3	8:30a	36.0	0.0	1.0	0.0	12.9	2:30p	SE
21	-5.9	2.1	2:15p	-12.8	11:15p	24.2	0.0	1.5	1.6	40.2	3:00p	SSE
22	-1.2	3.8	11:30a	-9.4	4:15a	19.5	0.0	0.8	2.7	43.5	9:00a	SE
23	-4.1	-1.5	12:15a	-8.9	10:00p	22.4	0.0	0.0	0.2	17.7	6:30a	S
24	-8.3	-1.6	3:15p	-13.5	9:45p	26.6	0.0	0.0	0.0	9.7	6:45p	SE
25	-3.5	-0.1	5:45a	-9.6	12:15a	21.8	0.0	0.0	5.3	45.1	1:00p	SW
26	2.3	11.1	12:00m	-7.7	12:30a	16.0	0.0	5.3	2.7	40.2	9:00p	SE
27	3.2	12.1	2:30a	-3.9	12:00m	15.2	0.0	0.3	6.6	69.2	2:30a	SSE
28	-8.8	-3.0	2:45p	-14.6	6:15a	27.1	0.0	0.3	0.0	11.3	11:45p	SE
29	-2.8	0.0	6:45a	-7.6	4:30a	21.1	0.0	0.0	0.2	11.3	6:30a	SSE
30	-7.6	-2.2	12:15a	-15.9	10:45p	25.9	0.0	0.5	2.6	20.9	7:15a	WNW

	-6.2	12.1	27	-30.3	20	734.7	0.0	14.7	1.7	69.2	27	SW

Max >= 32.0: 0

Max <= 0.0: 17

Min <= 0.0: 30

Min <= -18.0: 4

Max Rain: 5.33 ON 11/26/11

Days of Rain: 11 (> .2 mm) 2 (> 2 mm) 0 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

MONTHLY CLIMATOLOGICAL SUMMARY for DEC. 2011

NAME: Office Station CITY: STATE:
 ELEV: 0 ft LAT: LONG:

TEMPERATURE (°C), RAIN (mm), WIND SPEED (km/hr)

DAY	MEAN TEMP	HIGH	TIME	LOW	TIME	HEAT DEG DAYS	COOL DEG DAYS	RAIN	AVG WIND SPEED	HIGH	TIME	DOM DIR
1	0.9	5.7	2:00p	-13.3	12:30a	17.3	0.0	0.3	4.8	40.2	11:00p	SW
2	-5.5	-1.8	1:00a	-14.1	9:00p	23.8	0.0	0.0	7.2	45.1	7:45a	SW
3	-1.9	0.8	8:30a	-7.0	12:15a	20.2	0.0	0.0	8.7	38.6	7:00p	SW
4	-7.6	-3.1	1:15p	-12.9	10:00a	25.9	0.0	0.0	1.4	25.7	12:15a	WNW
5	-2.3	9.5	11:45p	-14.9	5:15a	20.6	0.0	5.8	1.3	40.2	11:30p	SW
6	-0.8	9.1	12:15a	-6.8	12:00m	19.1	0.0	1.0	4.3	45.1	1:45a	WNW
7	-13.7	-6.8	12:15a	-26.3	12:00m	32.0	0.0	0.0	3.4	25.7	4:45a	WNW
8	-11.8	-4.1	7:30a	-26.7	1:00a	30.1	0.0	0.0	0.6	17.7	9:00a	SW
9	1.4	8.9	12:30p	-12.1	4:30a	16.9	0.0	2.5	1.8	25.7	5:45a	SW
10	-1.5	3.9	7:00a	-6.2	2:30a	19.8	0.0	0.0	1.9	30.6	12:00p	SW
11	-9.1	-4.2	1:00a	-21.0	12:00m	27.3	0.0	0.0	0.5	11.3	11:00a	WSW
12	-14.8	-1.0	9:30p	-26.6	8:15a	33.1	0.0	0.0	0.0	8.0	8:15p	W
13	-1.9	2.3	3:15p	-6.9	12:00m	20.3	0.0	1.3	0.2	9.7	4:30p	SW
14	-9.6	-4.7	1:15a	-14.0	5:45p	27.9	0.0	0.3	0.5	16.1	1:15a	SW
15	-9.2	-5.4	2:45p	-13.5	2:15a	27.4	0.0	0.0	0.3	12.9	11:30a	SW
16	-2.2	2.9	5:00p	-10.7	1:15a	20.5	0.0	0.5	0.5	16.1	2:00p	SW
17	0.8	8.4	1:15p	-5.4	3:00a	17.4	0.0	1.3	1.3	30.6	4:00p	SW
18	-8.1	-1.1	1:00a	-18.9	11:00p	26.4	0.0	0.0	2.4	27.4	2:45a	SW
19	0.1	6.9	11:00p	-17.7	12:15a	18.2	0.0	4.8	4.0	41.8	12:00m	SW
20	-0.2	6.6	12:15a	-5.3	12:00m	18.5	0.0	0.0	7.4	46.7	2:00a	SW
21	-7.9	-2.9	1:00p	-12.2	9:30a	26.2	0.0	0.3	1.9	27.4	1:00a	SW
22	-0.9	4.5	2:00p	-8.4	12:15a	19.2	0.0	0.3	1.6	24.1	8:15a	SW
23	0.7	3.4	2:15p	-5.2	12:15a	17.7	0.0	0.0	6.6	49.9	10:45a	SW
24	1.5	5.3	3:45p	-4.9	11:00p	16.8	0.0	0.0	3.4	35.4	12:45a	SSE
25	5.1	8.6	3:15a	-2.1	12:00m	13.3	0.0	0.0	5.8	46.7	10:30a	S
26	-4.3	0.2	2:00p	-11.8	9:30a	22.6	0.0	0.0	1.3	29.0	12:45a	SE
27	-4.3	1.4	6:00a	-13.4	8:15p	22.6	0.0	0.0	1.9	27.4	2:00a	WNW
28	-3.6	6.1	1:00p	-13.9	8:45a	21.8	0.0	0.0	2.3	40.2	11:00a	S
29	-3.2	1.6	1:30p	-10.3	10:00p	21.5	0.0	0.5	2.3	38.6	1:30p	SW
30	-5.6	1.2	2:15p	-14.4	9:30a	23.9	0.0	0.0	1.9	29.0	12:15p	SW
31	-11.4	-4.6	12:15a	-24.8	12:00m	29.8	0.0	0.0	2.7	29.0	2:45p	SW
	-4.2	9.5	5	-26.7	8	698.3	0.0	18.8	2.7	49.9	23	SW

Max >= 32.0: 0

Max <= 0.0: 11

Min <= 0.0: 31

Min <= -18.0: 6

Max Rain: 5.84 ON 12/05/11

Days of Rain: 12 (> .2 mm) 3 (> 2 mm) 0 (> 20 mm)

Heat Base: 18.3 Cool Base: 18.3 Method: Integration

Appendix 86

Water Management and Aquatic Discussion Paper

Robb Trend Project – ESRD SIR Round #1

Appendix 86: Water Management and Aquatic Discussion Paper

1. Introduction and General Approach

The mine plan as presented in the application is focused towards maximizing coal recovery. This document provides a discussion of updated water management strategies and alternatives that have been developed in an effort to reduce potential risk to aquatic resources. It is expected that additional refinements to the mine and water management plans may occur to further reduce environmental impacts during detailed planning and design and during the licensing stage.

The main goal of the updated water management strategy discussed here is to show that natural channel flows can be maintained across active mine pits such that potential impacts to aquatic resources are minimized. To that end, CVRI has developed the following key water management operating strategies:

- Bypass stream flows, including flood events, around or through the active mining area with open channels or culverts and gravity flow;
- Maintain the water as clean water without entering any mine disturbed area using ‘constructed’ or lined channels;
- Use pumping as a ‘last option’ to route stream flows past mining areas; and
- ‘Trim’ high flows’ from the bypass flows to fill end pit lakes.

Several clean temporary water diversion ditches above and around mine pits or “bridged” across pits will be utilized, as typically illustrated in the application in Volume 1, [Section C, Figure C1-7](#) and in the schematic in [Figure 1](#) attached. Ditches will be sized based upon a minimum 5-year peak discharge with adequate freeboard to safely convey the 100-year flood. Ditches will be armoured, as required, for erosion control and lined over backfilled or permeable material to limit seepage loss. Lining materials in trapezoidal shaped ditch sections will depend upon detailed designs and timing, but may consist of either: HDPE corrugated liners (e.g. Megaditch), flexible woven fabrics, heavy duty geomembrane (e.g. Coletanche), or plastic. Habitat cover features could be incorporated in the diversions, if deemed appropriate, for long term or long distance diversions. Where diversion ditches are located across pits that will eventually become end pit lakes, they will be equipped or later modified with controlled overflows and gated pipes

or syphons to divert a controlled portion of the natural streamflow to fill the lake. When the end pit lake is filled these bridges may be lowered or partly removed to allow the flow into and out of the lake. These former bridge sections will then create littoral zones and could direct flows as / where most desired for enhancement purposes.

As described below, implementation of the proposed water management strategies is expected to reduce potential adverse impacts, in general, to aquatic resources. Reductions to potential adverse impacts include:

- The risk to fish and fish habitat as a result of pump failure will be reduced since open water channels or culverts will be the primary method of diverting flows and pumping will only be used in the short-term or as a 'last option';
- Open channel or culvert diversions may allow for a more natural flow regime to persist downstream of mining in comparison to a pumped diversion;
- Temporary loss of fish habitat during mining will be limited since the diversion channels will provide fish habitat; and
- Open channel diversions will allow for fish movements past active mine areas.

A discussion of proposed drainage schemes and options is presented in the following document. Detailed analysis and quantification of impacts to fish habitat associated with temporary and permanent diversions will be completed at the licensing stage once diversion plans have been finalized.

The tributary naming convention used in this document is described in [CR #2](#) and shown on the maps in [CR #2, Figures 5 to 12](#). The various mine stages and figures referred to in the discussion below are located in [Section C](#), Project Description.

2. Bryan Creek

2.1. Mining and Drainage ([Section C](#), [Figure C.3-9 to C.3-11](#))

The proposed mine plan for Robb West will require staged diversions of the lower portion of Bryan Creek above Highway 47 as shown in [Figure 86-1](#). Approximately 2.5 km of the creek will be involved.

The upstream Mynheer Pit will be mined first to the west of Bryan Creek to make room for backfill. Diversion 13 is expected to consist of two lined and partly rock cut ditch diversions to the north to permit mining of the east end of the Mynheer Pit. The upper diversion will be about 750 m long at a 1.3% grade and will be aligned in the south side of the cut for the Val d'Or /

Arbour Pit. The second diversion will be about 280 m long at about 1% grade at the most downstream east end. These ditches will convey natural flows and accommodate fish passage. The active diversion channel sections would be 1.2 m deep with 2 m base widths to accommodate much greater than a 5-year peak design flow of 5.6 m³/s.

During this time much of the Val d'Or /Arbour Pit can be developed to the west without any further impact on the creek. When mining in the Val d'Or /Arbour Pit proceeds to the east to intercept Bryan Creek, the creek flow will be directed through the mined out east end of Mynheer Pit. A lined channel could be provided within the pit to accommodate all flows and allow for fish passage or the pit could be developed and flooded for conveyance.

Upon conclusion of mining, the end pit lakes will be permitted to fill with controlled overflows from Bryan Creek (see [ESRD Figure 75a-1](#)). The creek flow through Mynheer Pit will be maintained until end pit lake 2 is overflowing. At that point the diversion can be discontinued.

Alternate Drainage Plans

An alternate to routing Bryan Creek through the eastern end pit lake would be to reclaim and develop a permanent channel through the Mynheer Pit. Another more extensive but single diversion alternative would be to shift Bryan Creek to the south of the Mynheer Pit all the way. This diversion would be approximately 2.5 km long plus meanders at a gradient of 1%. It would require significant modification or removal of the dump to the south of the east end of the Mynheer Pit. Flood overflows could still be utilized to fill the end pit lakes, if required.

The western dump south of the Mynheer Pit is currently shown extending over a portion of upper Bryan Creek (above BRT2.5). The dump could be modified here to not encroach upon the creek in this area. Alternatively, a 1.3 to 1.6 km long channel diversion could be provided to the south of this dump. With upper Bryan Creek drainage path maintained, the filling time for Upper Bryan Lake 1 would be extended significantly from that indicated in [Table 13, CR #6](#) (drainage area excluding the lake is reduced from 7.06 km² to 1.03 km²); however, pumped outflows from Lake 1 would not be proposed to maintain downstream flows as it would represent less than 5% of the basin area. In this case, allowed seepage in the permeable backfill between lakes 1 and 2 will allow for gradual filling of both lakes to the same level. The main inflow will be the controlled flood overflows from Bryan Creek. Mine plan scheduling modifications may also allow for greater filling of waste material between the end pits to reduce the two lake sizes.

2.2. Pumping

No pumping will be required for the bypass as flow is routed through open channels.

Filling of Lakes 1 and 2 will ‘skim’ high flows from the creek through overflow weirs.

2.3 Fisheries

As described above there are three diversions that will be required to facilitate mining. These diversions would be adequately sized to convey natural flows and accommodate fish passage. CVRI’s proposed post-mining drainage scheme would involve an end pit lake system with surface connection to Bryan Creek. Impacted sections of Bryan Creek include areas that were considered to have high habitat potential as well as areas with lower habitat potential. Rainbow Trout are the only species that currently occupy Bryan Creek and it is suspected that the Highway 47 culvert crossing represents a barrier to fish movements that precludes species that are resident to the Embarras River (i.e. Brook Trout) from moving into the system. Efforts could be made to ensure that Bryan Creek remains inaccessible to other species so that Athabasca Rainbow Trout are only species occupying the end pit lake system. Lake inlet and outlet channels and possibly other accessible sections of natural channel could be enhanced to maximize Rainbow Trout habitat suitability. Under this scenario the end pit lakes would have a regulating effect on downstream flows in Bryan Creek such that the 2 year flushing flow return period would increase to approximately 6.5 years.

Alternate post-mining drainage schemes involve constructing a permanent diversion channel that would result in two isolated end pit lakes that could be filled by flood overflows. Under this scenario habitat enhancements would be constructed in the permanent diversion channel to maximize habitat suitability. The end pit lakes could be fishless or could be stocked by Alberta Environment and Sustainable Resource Development (ESRD).

The diversion schemes discussed above would involve the replacement of over 2.5 km of Bryan Creek channel (plus meanders) but maintain natural flows and fish passage at all time without the need for any bypass pumping.

3. Hay Creek

3.1 Mining and Drainage (Section C, Figure C.3-7 and C.3-8)

Mining in the Hay Creek area will involve mining in the upper drainage approximately 1.5 km above the Hay Creek crossing on the Robb Road.

Mining will first be done in the Mynheer Seam which cuts over the main channel and cuts across upper ephemeral draws in the headwaters (Figure 86-1). Because of this, there is little opportunity for collecting and bypassing any significant drainage around the pit. Short term

bypass pumping of headwater flows around pit sections will be provided depending upon timing and flows. Water collected at the pit will be handled through a series of ponds and discharged downstream to a main pond and then into Hay Creek as Diversion 10. Flows will be largely regulated by the ponds and pumps in place. A controlled overflow release is expected to be provided at the downstream pond for flow management.

Subsequent mining in Val d'Or /Arbour Pit will further intercept additional upper flows in the basin. Again, water collected in the pit will be handled through ponds and discharged downstream to Hay Creek. Downstream flow releases during mining may be expected to vary from 0.005 m³/s to 0.6 m³/s.

After mining a large end pit lake will be left to fill via inflows from the upper portion of the basin (ESRD Figure 75a-2).

Alternate Drainage Plans

Due to the length of time required to fill the lake, downstream flows to Hay Creek may be expected to be discontinued for an extended period, in the order of 10 years. An alternative to providing long term pump releases to maintain downstream flows may be to pump from the Embarras River during high flows. This may reduce the filling time to about 5 years.

3.2 Pumping

The upper reaches of Hay Creek will be intercepted by the pit and become part of 'mine water' to be handled as mine waste water.

Intercepted flows will drain into final end pit lake 3 to assist filling. Pumped outflows will be required to maintain downstream flows, as needed.

3.3 Fisheries

As presented in the application, the upper portion of Hay Creek up to site HA-4 will be mined out representing approximately 1.75 km of channel that has limited habitat potential. During mining, flows will be maintained via pumps since there will not be enough surface flow to warrant a bypass channel. Downstream flow in the lower 2.3 km long reach of Hay Creek to its mouth at the Embarras River will be altered by lake filling and may be discontinued for a period of time (up to 10 yrs) if long-term pumping is not feasible. Implementation of a pumping program that uses water from the Embarras River during high flows would reduce the time required to fill the lake to around 5 years and could negate the need to discontinue downstream flows. Currently there is limited information on the habitat of lower Hay Creek. Prior to mining CVRI will complete additional field investigations to document baseline conditions in this reach.

Once the lake has filled, downstream flows in Hay Creek will be regulated and peak flows will be reduced such that the frequency of the return of the 2 year flushing flow would increase to approximately 5 years (see response to [ESRD SIR #77](#)).

4. Erith River

4.1 Mining and Drainage ([Section C, Figure C.3-2 to C.3-4 and C.3-7](#))

Approximately 5 km of the main Erith River channel will be altered by mining. This is Diversion 1 in the application and shown in [CR #6, Figure 26](#) with the final drainage plan in [Figure 28](#) and repeated in [ESRD Figure 75a-3](#).

Initial mining will occur in a narrow McPherson Pit located on the north side of the Erith River. Short meander sections of the Erith River will have to be cut off and bermed to keep the river separated from this mine area ([Section C, Figure C.3-2](#)). It is expected that old meanders can be re-established to accommodate a revised flow route and maintain natural flows and fish passage during this period.

Upon completion of the McPherson Pit, this long parallel excavation will be prepared as a low gradient diversion route for the Erith River. This preparation will include stabilization of embankments, riprap placement, development of pools and placement of liner material as needed. The Erith River will then be redirected through this channel to continue to maintain natural flow and allow for fish use and passage for a period of about 4 years ([Section C, Figure C.3-3](#)).

The new channel in the McPherson Pit will remove the Erith River flow from the Mynheer Seam area so that mining can proceed ([Section C, Figure C.3-4](#)). Upon completion of Mynheer mining, the excavation will be reclaimed as Upper Erith Lake #4 to form the permanent route for the Erith River. Preparation will include sloping of pit walls and dumps, soil placement, channel and end pit lake development. A narrow, shallow end pit lake will result for the Erith River to flow through. The lake will be filled in a period of about 2 years using controlled overflows from the initial channel diversion into the McPherson Pit ([Section C, Figure C.3-5](#)). Once filled, the Erith River will be entirely switched to flow through this new alignment and the McPherson Pit channel will be filled with subsequent mine waste from the Val d'Or pit. Natural flows and fish passage will be maintained through the Mynheer Pit (Upper Erith Lake 4).

Additional mining is then proposed downstream in the Val d'Or/Arbour seam ([Section C, Figure C.3-6 and C.3-7](#)). In this area the Erith River crosses perpendicular to the mining zone. To accommodate mining a lined bypass channel will be excavated on a pit bench to convey the

natural river flow around the active pit area. This will be a 700 m long channel at approximately 0.4% grade. The typical active channel section would be over 1.2 m deep with a 10 m base width to accommodate in excess of a 5-year peak design flow of 21.8 m³/s. This will permit mining to be completed beneath the current channel. Once mining is completed a 'land bridge' (see schematics Volume 1, [Section C, Figure C.1-7](#); and [Figure 1](#)) will be constructed in the pit to accommodate placement of a second 'bypass channel' and to mine out under the initial bypass channel. This second channel will be placed on select compacted backfill material to form the land bridge. A similar sized lined channel will be constructed on the land bridge to accommodate in excess of the 5 year peak flow.

Once full mining of the Val d'Or/Arbour Seam is completed in this area ([Section C, Figure C.3-7](#)), end pit lake 5 (or Lower Erith Lake) reclamation will proceed. The end pit lake will be allowed to fill from a controlled overflow in the bypass channel on the land bridge. When the lake level reaches the outflow level after about 5 years, the Erith River land bridge diversion can be discontinued. The Erith River will then be permitted to flow into the lake, across the width of the lake and exit into the original downstream channel to maintain natural flows ([ESRD Figure 75a-3](#)). This will permit fish passage at all times except during short term diversion channel switchover periods.

Alternate Drainage Plans

Alternative plans for reclamation of the Mynheer Pit are feasible. One alternative to a long narrow end pit lake is development of a series of interconnected ponds with short reconstructed low gradient channels in between. A low overall gradient of 0.5% or less over the 5.5 km long reach would resemble a series of beaver dams or meanders to replicate similar conditions in portions of the existing Erith River channel in this area. Another alternative mine plan would be to eliminate the Mynheer Pit in the Erith River valley section altogether to leave most of the existing channel undisturbed.

4.2 Pumping

No pumping will be required for the bypass as flow is routed through open channels.

Lake 4 and 5 filling will 'skim' high flows from the Erith River through overflow weirs, gated pipes, syphon's or pumping.

4.3 Fisheries

During mining, flows will be diverted via open channel to facilitate fish movements. Temporary

channels that will be in place for longer periods could have habitat enhancements incorporated in the design to address requirements of target species and to increase overall habitat complexity. The Erith River provides habitat for a number of fish species and is considered to have high habitat potential. The proposed post-mining drainage scheme would result in the Erith River flowing through two end pit lakes (Lakes 4 and 5). The lakes would be constructed to maximize habitat suitability for target species and habitat enhancements could be created on inlet, outlet and connecting channels. Additional habitat enhancement of portions of natural channel located upstream of the lake system could also be considered in an effort to improve habitat suitability for target fish species. These lakes will have an attenuating effect on downstream flows; under this scenario the end pit lakes would have a regulating effect on downstream flows in the Erith River such that the 2 year flushing flow return period would increase to approximately 2.3 years (see response to [ESRD SIR #77](#)).

One alternate drainage strategy would involve reclamation of the Mynheer Pit into a series of interconnected ponds with connecting channels. This strategy would reduce the amount of lotic habitat that would be changed to lentic habitat and would likely provide habitat that is similar to sections of the Erith River where there is beaver activity currently.

The third option would result in fewer direct impacts to aquatic resources since most of the Erith River would remain intact under this scenario.

5 ERT1 (Erith River Tributary)

5.1 Mining and Drainage ([Section C](#), [Figure C.3-3](#), [C.3-5](#) and [C.3-7](#))

The planned Mynheer Pit overlaps a section of ERT1 (Erith River Tributary 1) approximately 1.5 km upstream of its confluence with the Erith River. During mining, the flow of ERT1 will be 'cut' off by the pit development. Flows can be handled (Diversion 2) by channeling the creek over the pit via a land bridge and parallel to the pit on the high wall to accommodate natural flows in this creek and accommodate fish passage. This channelized section would be about 300 m long at a grade of 4% and have a cross-section 2 m wide by 0.8 m deep in order to accommodate in excess of a 5-year peak flow of 4.4 m³/s. When the Mynheer Pit is reclaimed and Lake 4 fills after about 3 years, the land bridge would be lowered to allow ERT1 to flow into Lake 4 ([ESRD Figure 75a-3](#)).

Alternate Drainage Plans

An alternate plan, because of the high habitat value of this channel reach, would be to eliminate approximately 500 m of the Mynheer Pit to leave the ERT1 channel intact and undisturbed in this area. However, the lower 400 m channel reach up from its confluence

with the Erith River would be mined out by the Val d'Or Pit. In this case, a new connecting channel, between Lakes 4 and 5 or directly down to Lake 5, would be required for ERT1 to join to the Erith River.

5.2 Pumping

No pumping will be required for the bypass as flow is routed through open channels.

Lake 4 filling will 'skim' high flows from ERT1 through over flow weirs or pumping.

5.3 Fisheries

As described above, open channels will be constructed to convey flows and accommodate fish movements during mining. ERT1 was identified as high-value habitat that provides spawning and rearing habitat for Rainbow Trout. The current mine plan would result in the loss of most of this habitat. Post reclamation ERT1 would flow into Lake 4, which would outlet to the Erith River.

The alternate strategy would limit direct habitat impacts such that some of the spawning habitat in ERT1 would be maintained.

6. Bacon Creek

6.1 Mining and Drainage (Section C, Figure C.3.3 and C.3-7)

Mining in the Bacon Creek area will initially be in the Mynheer Seam. Mining in this pit can be achieved by channeling Bacon Creek over the pit via a land bridge (Diversion 3) to accommodate natural flows and fish passage. The channelized section would be about 200 m long at a grade of 1.5% and have a cross-section 2 m wide by 0.5 m deep in order to accommodate in excess of a 5-year peak flow of 1.6 m³/s. This channelized bypass section would later be removed to redirect the drainage into Lake 4 and allow mining downstream in the Val d'Or /Arbour Pit, as discussed below.

The major Val d'Or/Arbour Pit in this area will cut off the lower Bacon Creek channel and eliminate any further downstream flow. Options for a land bridge diversion are not feasible here due to the depth of the pit and final grading in the area. After mining, Bacon Creek could drain into the east end of Lake 4 or the channel bypass section could be used to direct the flow into the

east end of Lake 5 and then to the Erith River ([ESRD Figure 75a-3](#)).

Alternate Drainage Plans

Alternate reclamation plans are to have Bacon Creek flow through a reconstructed channel in the Mynheer Pit and join ERT1 flow. Lowering Bacon Creek at Lake 5 to have it drain out here and maintain its pre-mine drainage path is not considered feasible. This would require more than a 10 m deep cut in the existing channel which would require lowering half of the 2.6 km long lower reach of Bacon Creek to maintain drainage out this channel.

6.2 Pumping

No pumping will be required for the bypass as flow is routed through open channels and then Bacon Creek drains into Lake 4 or Lake 5.

6.3 Fisheries

As described above, downstream flows in Bacon Creek will be maintained via an open channel that will be constructed to convey natural flows and accommodate fish movements. The proposed post-mining drainage scheme will result in the lower part of Bacon Creek (below Lake 5 east) being permanently dry since flows will be diverted through Lake 4 or Lake 5 East, both of which will outlet to the Erith River. Habitat potential of Bacon Creek within the project area was high. Additional field investigations will be conducted to assess baseline conditions in the downstream portion of Bacon Creek that will become dry. The lakes will be designed and constructed to maximize habitat potential. Inlet and outlet channels of the lakes could be enhanced to maximize habitat suitability and opportunities for additional in-stream habitat enhancements in the natural habitat upstream of the disturbed area could be explored.

An alternate post-mining drainage scheme would involve construction of a permanent channel that directs Bacon Creek into ERT1. While this scenario would reduce the amount of lotic habitat that is changed to lentic habitat as a result of the project, it would result in additional flows (in excess of the baseline condition) in ERT1 which could affect Rainbow Trout spawning and rearing that is known to occur in the creek.

7. Halpenny Creek

7.1 Mining and Drainage ([Section C](#), [Figure C.3-4](#) and [C.3-5](#))

Halpenny Creek has its main west tributary (HLT1) running east and its main channel running north across the planned Mynheer Pit. These channels join just upstream of the planned Val

d'Or Pit. HLT1 and Halpenny Creek will be crossed separately by Mynheer Pit mining and then, will be crossed by Val d'Or Pit mining below their confluence (Figure 86-2). A smaller east tributary (HLT2) also joins the main channel in the Mynheer Pit area near the eastern limit of the pit. A break in Mynheer Pit in this area means most of HLT2, which would normally run right along the pit alignment, will not be disturbed by mining.

HLT1 and the Halpenny main channels will be handled by re-channeling across the pit areas to maintain natural flows and allow for fish passage (Diversions 4 and 5). HLT1 will consist of a 550 m long channel diversion (with 120 m of this extending perpendicular across the pit) at 0.7% grade. A 1.5 m base width channel section by 0.7 m deep would convey in excess of the 5-year peak discharge of 2 m³/s on this stream. Depending upon timing of mining and reclamation, short term seasonal pumping across the pit may also be used for one of the diversions over the pit section.

The Halpenny main diversion for the Mynheer Pit will consist of a 480 m long channel at 1.7% grade. A 2.5 m base width channel section, approximately 0.7 m deep would convey in excess of the 5-year peak discharge of 4.8 m³/s on the Halpenny Creek.

HLT2 could be diverted around the eastern limit of Mynheer Pit to Halpenny Creek with a single permanent channel diversion about 180 m long at 2.2% grade (Diversion 6). A typical channel section about 1 m wide by 0.3 m deep would replicate the natural channel in this reach.

At reclamation (ESRD Figure 75a-4), HLT1 will flow east in the reclaimed Mynheer Pit for 900 m at about 0.4% grade. It will join a wetland/pool in the reclaimed Mynheer Pit at Halpenny Creek's natural channel outlet. The reclaimed HLT1 drainage path may consist of a series of interconnected ponds and short channel sections. The inlet of upper Halpenny Creek into the reclaimed Mynheer Pit will meander to provide a 5% or lower graded channel section dropping into the wetland/pool at about elevation 1136 m.

End pit lake 6 will be created in the larger Val d'Or Pit with the natural Halpenny Creek channel entering and exiting the lake at elevation 1125 m. There is minimal channel drop over the 200 m section across this end pit lake.

Alternate Drainage Plans

An alternate plan for mining would involve eliminating a short length (200m) of the Mynheer Pit to allow HLT1 to remain intact to its mouth at Halpenny Creek just upstream of Lake 6 in the Val d'Or Pit area. Similarly, an alternate plan for mining would involve eliminating a short length (400m) of the Mynheer Pit to allow the Halpenny Creek main channel to remain undisturbed until the main Val d'Or Pit development area is complete. HLT2 realignment at its mouth could be eliminated with a 150 m shortening of the east end of Mynheer Pit.

7.2 Pumping

Other than possible short term seasonal pumping for HLT1, no pumping will be required for the bypass as flow is routed through open channels.

Lake 6 filling will 'skim' high flows from Halpenny Creek through over flow weirs or pumping.

7.3 Fisheries

As described above, multiple open channel diversions will be constructed during mining to convey natural flows and accommodate fish movements. The proposed post-mining drainage scheme would eliminate much of the Rainbow Trout spawning habitat identified in Halpenny Creek. Under this scenario efforts would be made to enhance the inlet channels to re-create some of this spawning habitat and habitat enhancements would be constructed in permanent diversion channels. A minor attenuating effect on flows would result in change in the frequency of the 2 year flushing flow return period to approximately 2.4 years (see response to [ESRD SIR #77](#)).

Alternate drainage strategies that limit coal extraction could eliminate direct habitat impacts to upper Halpenny Creek (above the Val d'Or Pit), HLT1 and HLT2. Under this scenario a substantial amount of the Rainbow Trout spawning habitat in Halpenny Creek would be undisturbed.

8. Lendrum Creek

8.1 Mining and Drainage ([Section C](#), [Figure C.3-6](#) and [C.3-7](#))

Lendrum Creek and two tributaries (LET1 and LET3) will be intersected by mining, first by work in the upstream Mynheer Pit and then with excavation of the Val d'Or Pit, as shown in [Figure 86-2](#).

LET1, the western tributary, is crossed first. Depending upon scheduling, LET1 flow may be pumped across initially for a few months to allow for mining and backfilling in the channel area. A short 200 m lined bridge diversion over the backfilled pit would then be constructed (Diversion 7). This will maintain natural flows and allow for fish passage until the Mynheer Pit is reclaimed. The diversion channel section, with a 1% grade, 2 m base width and active depth