



# **Reference Creek Benthic Macroinvertebrate Metals Data Used to Develop Background Trophic Transfer Factors**



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***L Reference Creek Benthic Macroinvertebrate Metals Data Used to Develop Background Trophic Transfer Factors***

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## **Appendix L**

### **Reference Creek Benthic Macroinvertebrate Metals Data Used to Develop Background Trophic Transfer Factors**

This appendix includes a summary of metals data for composite benthic-macroinvertebrate samples collected from six reference creeks in the middle Kuskokwim River region by the United States Department of Interior Bureau of Land Management (BLM) in 2010 (see Tables L-1 and L-2). The exposure point concentrations developed from these data (see Table L-3) were used in the Baseline Ecological Risk Assessment (BERA) Supplement to develop background benthos-to-sculpin trophic transfer factors (see Appendix N). Appendix F includes a figure showing the locations of the reference creeks relative to the Red Devil Mine site.



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***L Reference Creek Benthic Macroinvertebrate Metals Data Used to Develop Background Trophic Transfer Factors***

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**Table L-1. Benthic Macroinvertebrate Metals Data for Reference Creeks (June and October 2010 Samples), Red Devil Mine Site BERA Supplement.**

Sample Date (Month-Year)	Lab ID	Client Sample ID	Arsenic		Antimony		Mercury		Methylmercury		Barium		Beryllium	
			(ug/ wet g)	QA Qual.	(ug/wet g)	QA Qual.	(ug/wet g)	QA Qual.	(ng/wet g)	QA Qual.	(ug/ wet g)	QA Qual.	(ug/wet g)	QA Qual.
June-10	197	NONAME CK #2/Macro	0.621		0.077		0.02		57.5		8.379		0.025	U
June-10	215	DOWNEY 1/Macro	1.102		0.036	J	0.03		14.6		6.349		0.025	U
June-10	216	DOWNEY 2/Macro	0.878		0.03	J	0.02		18.8		5.884		0.025	U
June-10	217	DOWNEY 3/Macro	0.815		0.028	J	0.03		17.5		4.926		0.025	U
October-10	1151	2-DOW - MACRO-1	2.102	J	0.227		0.045	J-			142.988	J+	0.032	J-
October-10	1152	2-DOW - MACRO-2	1.053		0.1		0.027	J-			78.43	J+	0.025	UJ
October-10	1153	2-DOW - MACRO-3	1.271		0.167		0.036	J-			103.212	J+	0.025	UJ
June-10	244	ICE CK 1/Macro	1.065		0.095		0.05		23		23.408		0.025	U
June-10	245	ICE CK 2/Macro	0.749		0.054		0.02		12.3		10.07		0.025	U
June-10	246	ICE CK3/Macro	1.35		0.204		0.01		9.8		12.306		0.025	U
June-10	300	FULLER CK 1/Macro	1.373		0.097		0.03		10.8		31.151		0.032	
June-10	301	FULLER CK 2/Macro	1.63		0.098		0.03		8.1		44.997		0.042	
October-10	1096	2-Fuller-MACRO-1	1.924		0.087		0.020				199.942		0.028	J-
October-10	1097	2-Fuller-MACRO-2	2.003		0.092		0.033				227.495		0.025	J-
October-10	1098	2-Fuller-MACRO-3	1.906		0.09		0.021				221.051		0.028	J-
June-10	319	VR A/Macro	0.626		0.425		0.08		41.8		9.742		0.025	U
June-10	320	VR B/Macro	0.903		0.113		0.04		9.4		16.054		0.025	U
June-10	321	VR C/Macro	0.614		0.06		0.03		11.6		12.275		0.025	U
June-10	322	VR D/Macro	0.661		0.058		0.02		8.7		10.815		0.025	U
October-10	1150	2-VR -MACRO-1	0.995	J	0.049		0.027	J-			12.894	J+	0.025	UJ
October-10	1149	2-VR -MACRO-2	0.966	J	0.025	U	0.024	J-			8.57	J+	0.025	UJ
June-10	366	California CK 1/Macro	0.482		0.125		0.01		6.3		11.263		0.025	U
October-10	1123	2-CC-MACRO-1	1.2		0.119		0.02353	J			7.379	J+	0.025	UJ
October-10	1124	2-CC-MACRO-2	0.858		0.132		0.01863	J			6.549	J+	0.025	UJ

Source: Matz et al (2017)

**Key:**

BERA = Baseline ecological risk assessment

BLM = Bureau of Land Management

QA Qual = Quality Assurance Qualifier

**Table L-1. Benthic Macroinvertebrate Metals Data for Reference Creeks (June and October 2010 Samples), Red Devil Mine Site BERA Supplement.**

Sample Date (Month-Year)	Lab ID	Client Sample ID	Cadmium		Chromium		Cobalt		Copper		Lead		Manganese	
			(ug/wet g)	QA Qual.	(ug/wet g)	QA Qual.	(ug/ wet g)	QA Qual.	(ug/wet g)	QA Qual.	(ug/wet g)	QA Qual.	(ug/wet g)	QA Qual.
June-10	197	NONAME CK #2/Macro	0.276		0.906		--		9.097		0.322		39.223	
June-10	215	DOWNEY 1/Macro	0.453		0.487		--		9.594		0.143		42.145	
June-10	216	DOWNEY 2/Macro	0.407		0.46		--		8.569		0.134		31.229	
June-10	217	DOWNEY 3/Macro	0.436		0.416		--		8.327		0.159		29.322	
October-10	1151	2-DOW - MACRO-1	0.126		2.884		--		5.186		0.951		303.215	
October-10	1152	2-DOW - MACRO-2	0.103		0.993		--		3.83		0.361		203.583	
October-10	1153	2-DOW - MACRO-3	0.124		2.217		--		4.097		0.670		233.353	
June-10	244	ICE CK 1/Macro	0.963		1.696		--		14.115		0.528		31.522	
June-10	245	ICE CK 2/Macro	0.608		0.733		--		11.851		0.178		40.893	
June-10	246	ICE CK3/Macro	0.562		0.797		--		11.34		0.235		63.177	
June-10	300	FULLER CK 1/Macro	0.666		1.596		--		9.563		0.501		84.883	
June-10	301	FULLER CK 2/Macro	0.874		2.188		--		11.949		0.691		150.562	
October-10	1096	2-Fuller-MACRO-1	0.125		1.82		--		4.5		0.655 J		177.396	
October-10	1097	2-Fuller-MACRO-2	0.164		1.534		--		4.686		0.588 J		218.135	
October-10	1098	2-Fuller-MACRO-3	0.114		1.658		--		4.745		0.623 J		194.448	
June-10	319	VR A/Macro	0.038		0.337		--		10.837		0.094		11.933	
June-10	320	VR B/Macro	0.029		1.468		--		6.163		0.326		42.829	
June-10	321	VR C/Macro	0.026		1.07		--		7.269		0.222		31.141	
June-10	322	VR D/Macro	0.025 U		0.92		--		5.793		0.239		42.915	
October-10	1150	2-VR -MACRO-1	0.053		0.364		--		4.738		0.102		20.109	
October-10	1149	2-VR -MACRO-2	0.043		0.365		--		4.501		0.098		20.742	
June-10	366	California CK 1/Macro	0.204		0.944		--		20.014		0.274		61.998	
October-10	1123	2-CC-MACRO-1	0.055		0.53		--		6.779		0.155 J		47.936	
October-10	1124	2-CC-MACRO-2	0.052		0.53		--		5.319		0.15 J		35.188	

Source: Matz et al (2017)

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**Table L-1. Benthic Macroinvertebrate Metals Data for Reference Creeks (June and October 2010 Samples), Red Devil Mine Site BERA Supplement.**

Sample Date (Month-Year)	Lab ID	Client Sample ID	Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
			(ug/ wet g)	QA Qual.	(ug/wet g)	QA Qual.	(ug/wet g)	QA Qual.	(ug/wet g)	QA Qual.	ug/ wet g)	QA Qual.	(ug/wet g)	QA Qual.
June-10	197	NONAME CK #2/Macro	1.012		3.27		--		--		1.222		29.04	
June-10	215	DOWNEY 1/Macro	1.455		2.238		--		--		0.732		46.659	
June-10	216	DOWNEY 2/Macro	1.206		1.921		--		--		0.695		41.496	
June-10	217	DOWNEY 3/Macro	1.089		2.112		--		--		0.495		43.858	
October-10	1151	2-DOW - MACRO-1	4.327	J	1.195	J+	--		--		4.353	J	68.46	
October-10	1152	2-DOW - MACRO-2	2.046	J-	1.021	J+	--		--		1.435		66.974	
October-10	1153	2-DOW - MACRO-3	3.132	J-	1.018	J+	--		--		3.401		75.119	
June-10	244	ICE CK 1/Macro	1.488		3.442		--		--		3.326		44.361	
June-10	245	ICE CK 2/Macro	0.713		3.675		--		--		1.453		41.232	
June-10	246	ICE CK3/Macro	0.699		3.255		--		--		1.648		36.556	
June-10	300	FULLER CK 1/Macro	1.57		1.448		--		--		3.103		44.483	
June-10	301	FULLER CK 2/Macro	2.004		1.822		--		--		4.305		53.395	
October-10	1096	2-Fuller-MACRO-1	2.619	J-	0.739	J+	--		--		3.163		74.012	
October-10	1097	2-Fuller-MACRO-2	2.464	J-	0.759	J+	--		--		2.818		82.209	
October-10	1098	2-Fuller-MACRO-3	2.563	J-	0.738	J+	--		--		2.881		79.198	
June-10	319	VR A/Macro	0.37		1.425		--		--		0.549		64.188	
June-10	320	VR B/Macro	1.591		0.493		--		--		2.383		10.637	
June-10	321	VR C/Macro	1.134		0.415		--		--		1.772		10.386	
June-10	322	VR D/Macro	1.195		0.458		--		--		1.396		9.09	
October-10	1150	2-VR -MACRO-1	0.65	J	0.705	J+	--		--		0.654	J	22.908	
October-10	1149	2-VR -MACRO-2	0.67	J	0.759	J+	--		--		0.62	J	22.22	
June-10	366	California CK 1/Macro	0.606		1.013		--		--		1.048		21.886	
October-10	1123	2-CC-MACRO-1	0.88	J	1.618	J+	--		--		0.829	J	27.511	
October-10	1124	2-CC-MACRO-2	0.699	J	1.147	J+	--		--		0.753	J	24.578	

Source: Matz et al (2017)

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**Table L-2. Benthic Macroinvertebrate Methylmercury Data for Reference Creeks (June and October 2010 Samples), Red Devil Mine Site BERA Supplement.**

Sample Date (Month-Year)	Lab ID	Sample ID	Reference Creek	MeHg (ng/wet g)	QA Qual.
July-10	366	California CK 1/Macro	California Creek	6.3	
July-10	215	DOWNEY 1/Macro	Downey Creek	14.6	
July-10	217	DOWNEY 3/Macro	Downey Creek	17.5	
July-10	216	DOWNEY 2/Macro	Downey Creek	18.8	
July-10	301	FULLER CK 2/Macro	Fuller Creek	8.1	
July-10	300	FULLER CK 1/Macro	Fuller Creek	10.8	
July-10	246	ICE CK3/Macro	Ice Creek	9.8	
July-10	245	ICE CK 2/Macro	Ice Creek	12.3	
August-10	1009071-17RE1	2-ICE-2 ICE CK-macro	Ice Creek	12.7	
August-10	1009071-18RE1	2-ICE-3 ICE CK-macro	Ice Creek	13.3	
August-10	1009071-16	2-ICE-1 ICE CK-macro	Ice Creek	18.8	
July-10	244	ICE CK 1/Macro	Ice Creek	23.0	
August-10	1009071-13RE1	2-NN-1 NONAME CK #2-macro	No Name Creek	13.1	
August-10	1009071-14	2-NN-2 NONAME CK #2-macro	No Name Creek	16.7	
August-10	1009071-15	2-NN-3 NONAME CK #2-macro	No Name Creek	16.8	
July-10	197	NONAME CK #2/Macro	No Name Creek	57.5	
July-10	322	VR D/Macro	Vreeland Creek	8.7	
July-10	320	VR B/Macro	Vreeland Creek	9.4	
July-10	321	VR C/Macro	Vreeland Creek	11.6	
July-10	319	VR A/Macro	Vreeland Creek	41.8	

Source: Matz et al. (2017)

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**Table L-3. Summary of ProUCL Output and Exposure Point Concentrations for Reference Creek Benthic Macroinvertebrate Samples, Red Devil Mine BERA Supplement.**

Analyte	Units	Number of Observations	Number of Detections	Mean of Detected	SD of Detected	Maximum Detected	Distribution (detects only)	UCL Statistic	95% UCL	EPC	EPC Source
Arsenic	mg/kg wet	24	24	1.131	0.477	2.102	Approx. Normal	95% Student's-t UCL	1.298	1.298	95% UCL
Antimony	mg/kg wet	24	23	0.111	0.0851	0.425	Gamma	95% KM Adjusted Gamma UCL	0.148	0.148	95% UCL
Mercury	mg/kg wet	24	24	0.0289	0.0145	0.08	Gamma	95% Adjusted Gamma UCL	0.0346	0.0346	95% UCL
Barium	mg/kg wet	24	24	50.67	72.61	227.5	Not Discernable	95% Chebyshev (Mean, Sd) UCL	115.3	115.3	95% UCL
Beryllium	mg/kg wet	24	6	0.0312	0.00595	0.042	Normal	95% KM (t) UCL	0.028	0.028	95% UCL
Cadmium	mg/kg wet	24	23	0.283	0.284	0.963	Gamma	Gamma Adjusted KM-UCL	0.418	0.418	95% UCL
Chromium	mg/kg wet	24	24	1.121	0.7	2.884	Approx. Normal	95% Student's-t UCL	1.366	1.366	95% UCL
Copper	mg/kg wet	24	24	8.036	3.916	20.01	Approx. Normal	95% Student's-t UCL	9.406	9.406	95% UCL
Lead	mg/kg wet	24	24	0.35	0.241	0.951	Gamma	95% Adjusted Gamma UCL	0.458	0.458	95% UCL
Manganese	mg/kg wet	24	24	89.91	84.79	303.2	Approx. Lognormal	95% H-UCL	143.3	143.3	95% UCL
Methylmercury	µg/kg wet	20	20	17.08	12.17	57.5	Lognormal	95% H-UCL	21.49	21.49	95% UCL
Nickel	mg/kg wet	24	24	1.508	0.956	4.327	Approx. Normal	95% Student's-t UCL	1.842	1.842	95% UCL
Selenium	mg/kg wet	24	24	1.529	1	3.675	Approx. Normal	95% Student's-t UCL	1.878	1.878	95% UCL
Vanadium	mg/kg wet	24	24	1.876	1.24	4.353	Approx. Normal	95% Student's-t UCL	2.31	2.31	95% UCL
Zinc	mg/kg wet	24	24	43.35	22.84	82.21	Normal	95% Student's-t UCL	51.34	51.34	95% UCL

**Key:**

BERA = Baseline ecological risk assessment

CLT = Central limit theorem

EPC = Exposure point concentration

KM = Kaplan-Meier

SD = Standard deviation

UCL = Upper confidence limit