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January 29, 2013

Ms. Jennie Gjertsen
Environmental Manager
Minto Mine
Minto Explorations Ltd.
Suite 900 - 999 West Hastings Street
Vancouver, BC
V6C 2W2

Dear Ms. Gjertsen,

Re: Results of Selenium Monitoring in Minto Creek - 2012

Selenium was identified in the Yukon Government's intervention to the Minto Mine's Amendment 7 Water Use Licence (WUL) Application QZ09-094 as a parameter of concern and was subsequently included in the WUL (QZ96-006 Amendment 7, April 2011) with a water quality standard of 0.001 mg/L at Station W2 (in lower Minto Creek). This represents the adoption of the Canadian Water Quality Guideline (CWQG; CCME 1999) as a water quality standard for lower Minto Creek. The selenium standard for Station W2 was also used to back-calculate an effluent quality standard for the Minto Mine (0.003 mg/L) based on effluent dilution within Minto Creek. Critical differences in the development and application of standards versus guidelines aside, there is substantial recent evidence to indicate that water-based guidelines for selenium are poor predictors of potential adverse effects to aquatic life (e.g., Stewart et al. 2010; Hodson et al. 2010; Ohlendorf et al. 2011; DeForest et al. 2012) and that better tools for the assessment of effects to sensitive organisms are available, the best of which are effect thresholds for ripe egg and/or ovary tissue in fish (e.g., Janz et al. 2010; DeForest et al. 2012).

In response to the uncertainty over application of a water-based guideline or standard, the Minto Mine requested an integrated assessment of selenium in Minto Creek. Accordingly, Access Consulting Group (ACG) and Minnow Environmental Inc. (Minnow) undertook monitoring of selenium in additional aquatic environmental compartments in 2012, including water, sediment, periphyton, benthic invertebrates and fish tissue. ACG monitored selenium in fish tissue in the spring and summer of 2012, and Minnow monitored selenium in water, sediment, periphyton and benthic invertebrates in September, 2012 (Figure 1). This brief letter report provides the results of the monitoring, a brief interpretation of results and recommendations for selenium monitoring and assessment in 2013.

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Water Quality

Water quality data collected routinely by the Minto Mine in 2012 indicate that the Minto WUL receiving water standard (CWQG; 0.001 mg/L) was not exceeded despite the discharge of 175,000 m^3 of water from the Water Storage Pond in 2012 (Figure 2; Appendix Table 1). Concentrations of dissolved selenium were consistently below 0.0002 mg/L (2012 mean and standard deviation of 0.00014 ± 0.00005 mg/L); whereas concentrations of total selenium were more variable, with a maximum of 0.00094 observed on June 13^{th} (in association with high total suspended solids) and a 2012 mean and standard deviation of 0.00027 ± 0.00019 mg/L. Water quality data collected during the sediment, periphyton and benthic invertebrate sample collections in September 2012 documented highest concentration of total selenium (0.00044 mg/L) in Upper Minto Creek (Figure 3; Appendix Table 2). Although there is compelling evidence to indicate that ripe egg/ovary tissue represents the best means of evaluating potential for effects, it is nonetheless notable that selenium concentrations were below the CWQG at all stations from which water samples were collected in September 2012.

Sediment Quality

Sediment quality data collected in September 2012 indicated that concentrations of selenium in the sediments of Minto Creek were lower than in the sediments of both reference creeks (Wolverine Creek and Big Creek; Figure 4; Appendix Table 2). Furthermore, all sediment selenium concentrations were well below the British Columbia guideline for aquatic sediment (BCSQG; 2.0 mg/kg dw [dry weight]; BCMOE 2012a,b).

Tissue Quality

Periphyton Tissue

Periphyton has been identified as having an important role in the incorporation of selenium into the aquatic food chain (e.g., Stewart et al. 2010; Presser and Luoma 2010; Ohlendorf et al. 2011). In both Minto and Big creeks, periphyton was very sparsely distributed and therefore only one sample was obtained from each of these two areas. Periphyton coverage was substantially greater in Wolverine Creek and five samples were obtained. Selenium concentration in periphyton collected from lower Minto Creek was similar to that of Big Creek and lower than that of lower Wolverine Creek indicating no apparent mine-related influence (Figure 5; Appendix Table 2).

Benthic Macroinvertebrate Tissue

Benthic invertebrates are important diet items for selenium-sensitive fish (Janz et al. 2010). Low benthic macroinvertebrate biomass in local creeks made it impossible to collect replicate samples within an economically reasonable time frame, so only one composite sample was obtained per area. Selenium concentration in benthic macroinvertebrates collected from lower Minto Creek were similar to those collected in the reference areas (lower Wolverine Creek and lower Big Creek; Figure 6; Appendix Table 2). Furthermore, all benthic macroinvertebrate (fish diet) selenium concentrations were well below the new draft British Columbia guideline for invertebrate tissue (4.0 mg/kg dw; BCMOE 2012b).

Fish Tissue

As previously indicated, there is reasonable scientific consensus that ripe fish egg and/or ovary tissue in fish provide the best (most certain) means of evaluating potential adverse effects associated with selenium (Stewart et al. 2010; Hodson et al. 2010; Ohlendorf et al. 2011; DeForest et al. 2012). Recent findings of effect thresholds (i.e., concentrations above which effects may start to occur in sensitive species) support a lowest effect threshold of approximately 20 mg/kg dw in these tissues (e.g., Janz et al. 2010; DeForest et al. 2012). Unfortunately, fishing was initiated too late in the spring of 2012 to obtain these critical tissues. Nonetheless, slimy sculpin were captured in lower Minto Creek and in lower Big Creek in 2012. Slimy sculpin of lower Minto Creek had moderately, but significantly, higher selenium concentrations (headless body) than those of lower Big Creek (Figure 7; Appendix Table 2). Furthermore, the mean concentration of selenium in sculpin collected in lower Minto Creek (5.3 ± 1.1 mg/kg dw) was slightly greater than the British Columbia guideline for fish tissue (4.0 mg/kg dw; BCMOE 2012a,b; subject to the same cautions as above), whereas the mean concentration of selenium in those collected in lower Big Creek (3.4 ± 0.7 mg/kg dw) was slightly lower than the British Columbia guideline for fish tissue. These results indicate a need to assess selenium in slimy sculpin ovaries (to allow comparison to a more meaningful effect threshold) and to consider selenium concentrations at additional reference locations (to characterize concentrations in Minto Creek slimy sculpin relative to a range of reference areas).

<u>Recommendations</u>

It is recommended that selenium monitoring in water, sediment, periphyton, benthic macroinvertebrates and fish is repeated in 2013. The importance of fish ovary tissue (slimy sculpin ovary tissue) to the utility of this monitoring cannot be over-stated. Fish eggs/ovaries are the most useful monitor to determine the potential for adverse effects (or to put such concerns to rest). Conversely, guidelines for other aquatic monitors (water, sediment, fish food and fish muscle/whole body), although they exist (CCME 1999; BCMOE 2012a,b) and are therefore tempting to apply, are of lesser utility in evaluating the potential for effects. It is therefore recommended that slimy sculpin are

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collected as soon as possible after water begins flowing in lower Minto Creek in the spring of 2013. It is also recommended that a second reference area for slimy sculpin collection is added in 2013, perhaps even in the Yukon River itself.

I trust that this brief letter effectively communicates the results of the 2012 selenium monitoring program and the recommendations for selenium monitoring in 2013. If you have any comments or questions on the content of this letter, I would be pleased to discuss them with you.

Sincerely,
Minnow Environmental Inc.

Pierre Stecko, M.Sc., EP, RPBio
Senior Aquatic Scientist / Principal

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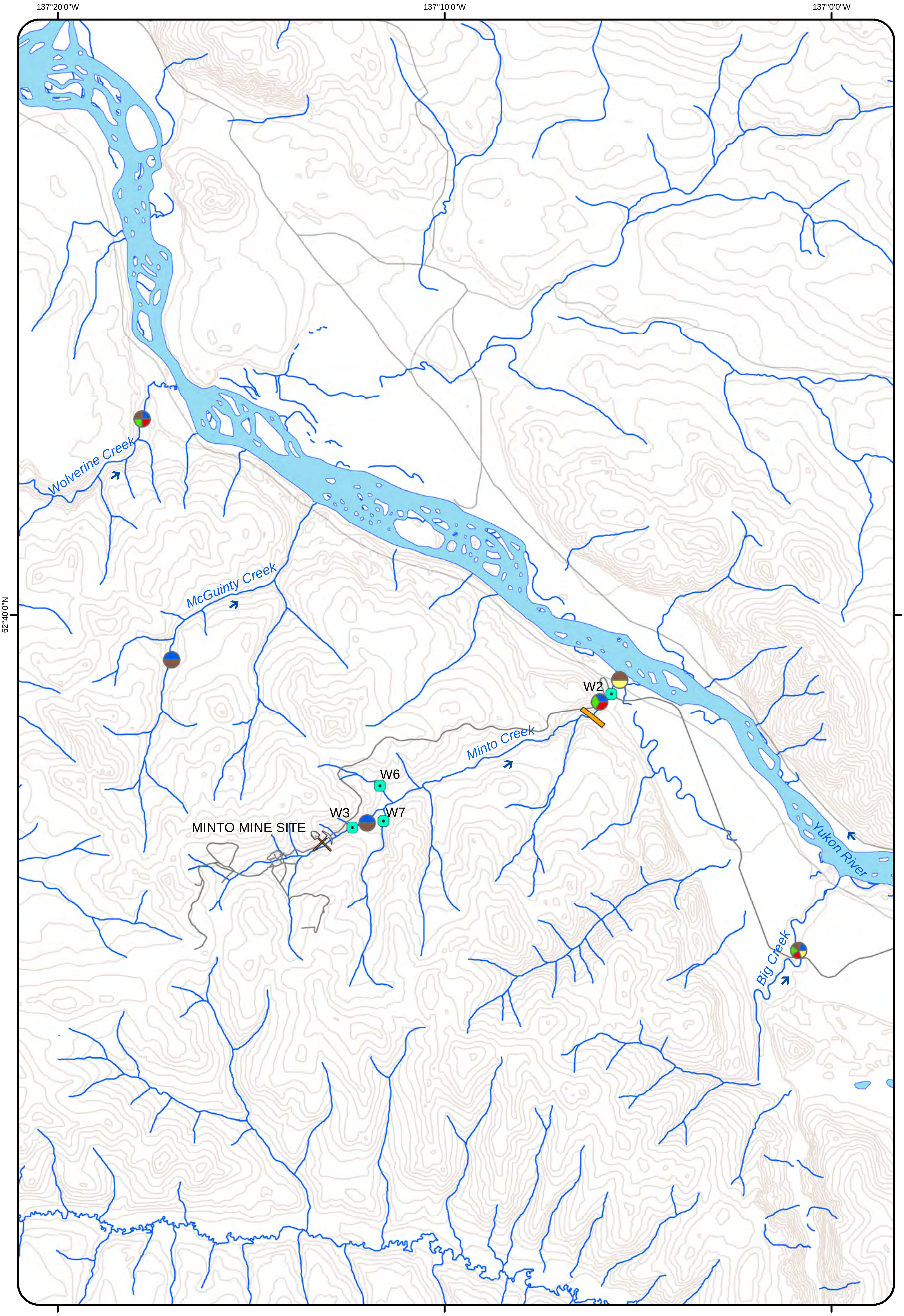

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MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: January 2013

Features

Mine Site

SAMPLES COLLECTED

Water
Sediment
Periphyton
Benthos
Fish

Water Quality Station
Fish Barrier
Water Flow
Contours (30m interval)
Roads

Figure 1: Sampling Locations for the Minto Mine Selenium Monitoring Program, 2012

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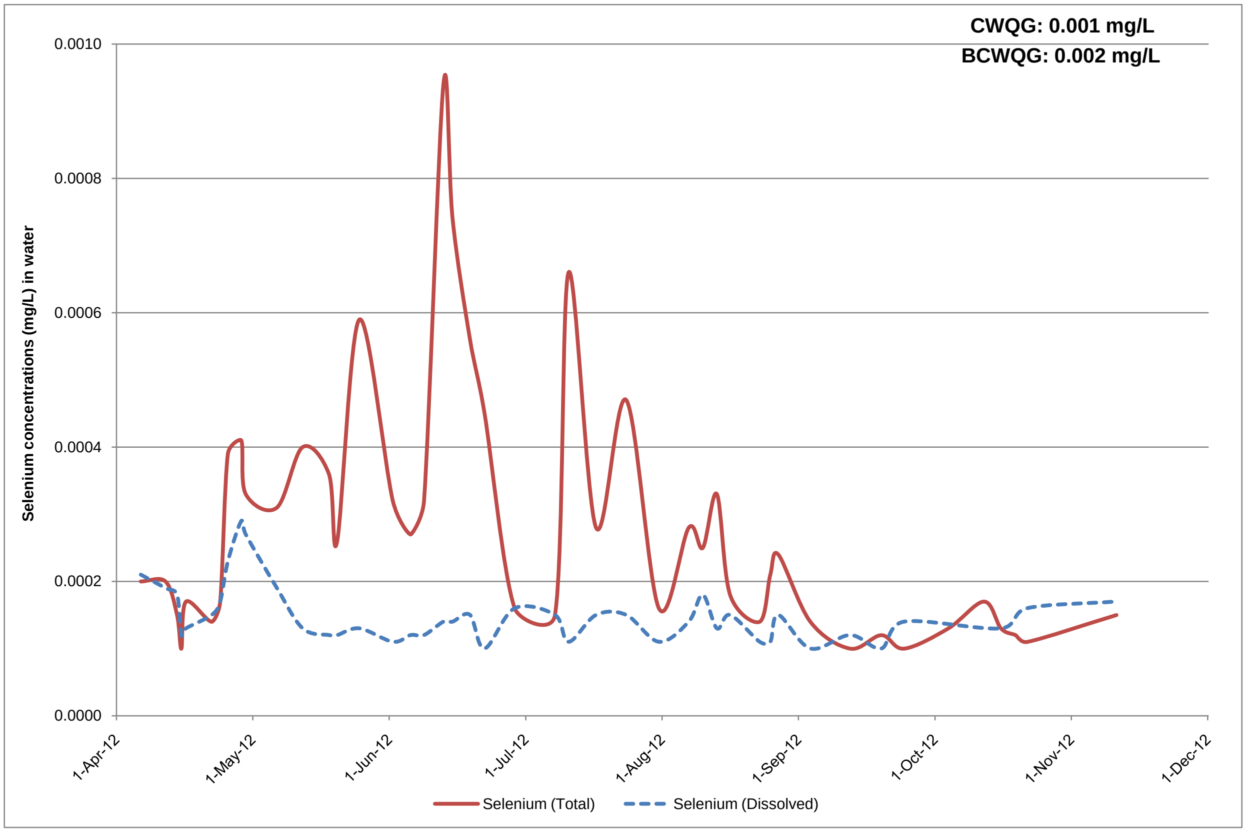

Figure 2: Selenium Concentrations in water at lower Minto Creek in 2012, Minto Mine Routine Monitoring

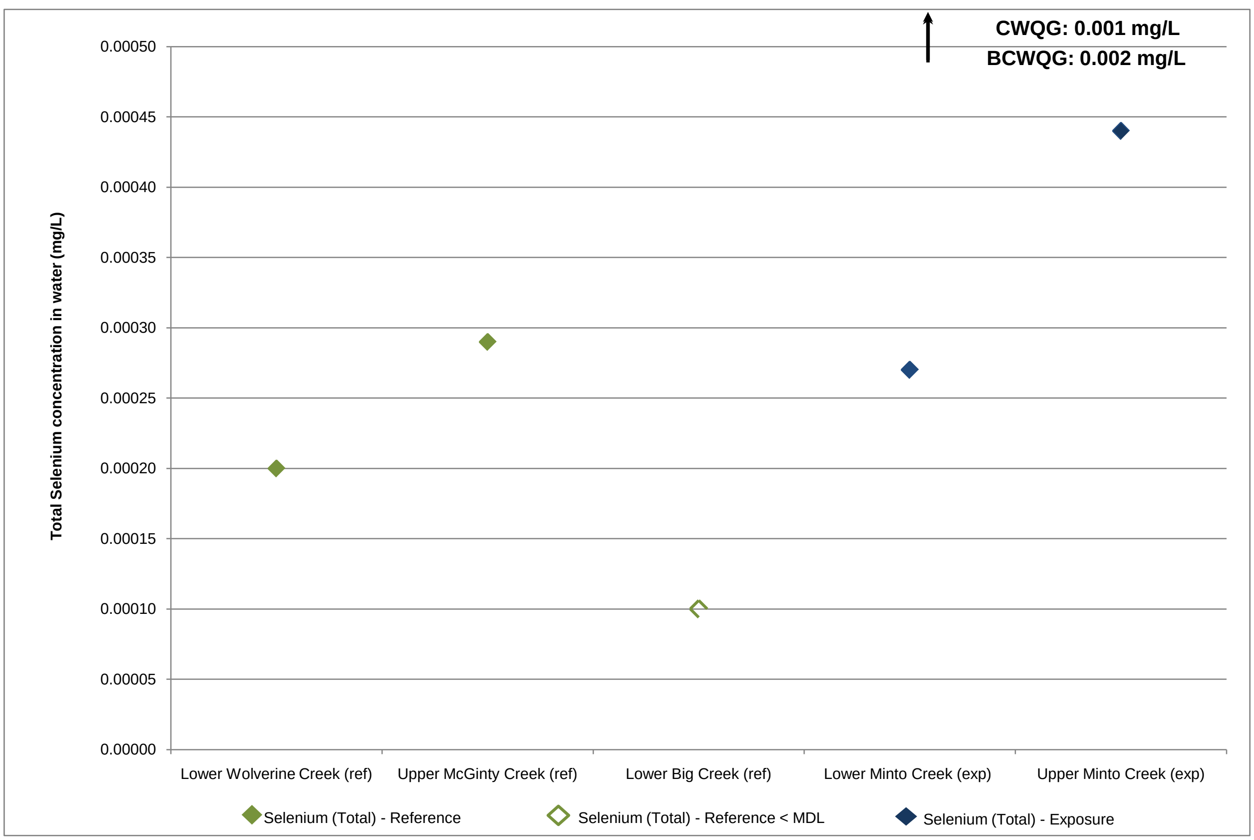

Figure 3: Total selenium concentrations (mg/L) in water, n = 1, September 2012.

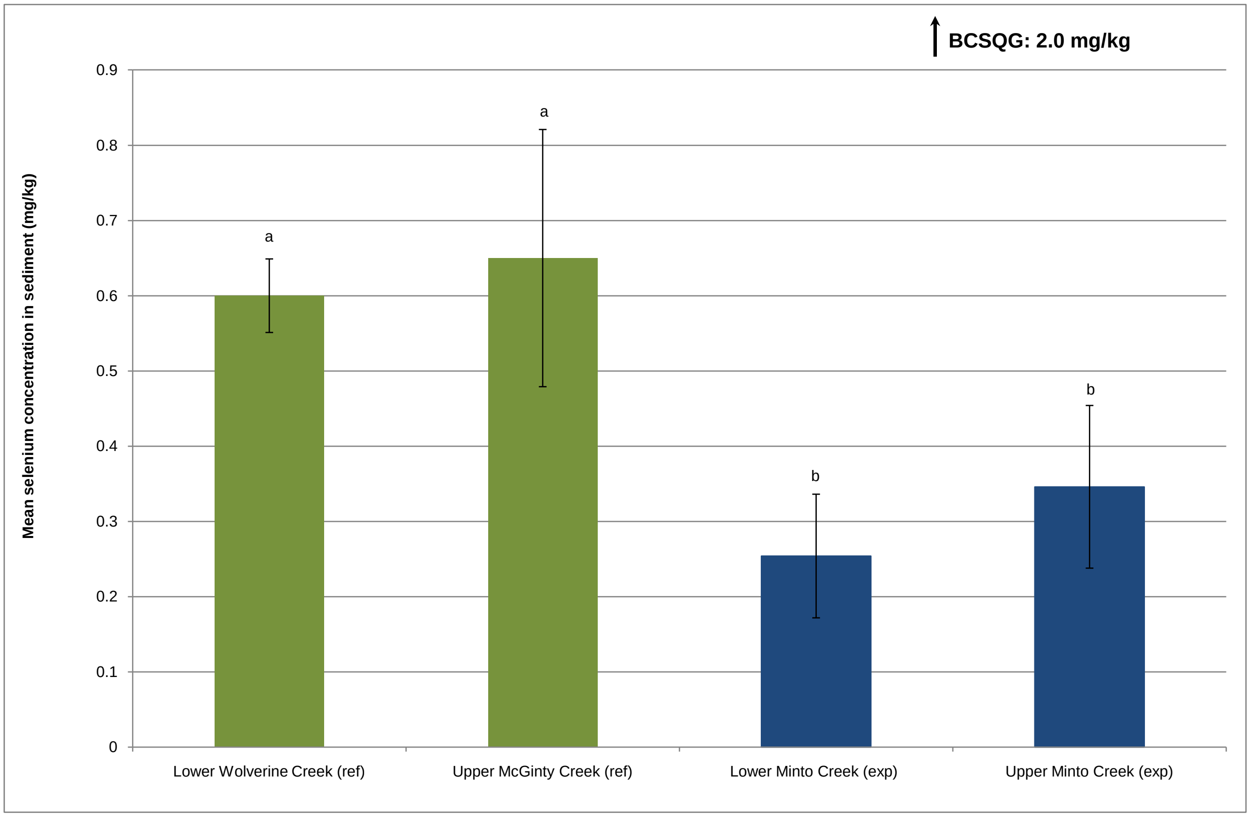

Figure 4: Selenium concentrations (mg/L) and 95% confidence limits in sediment, n = 5, September 2012. Green bars represent reference sites and blue bars represent exposure sites.

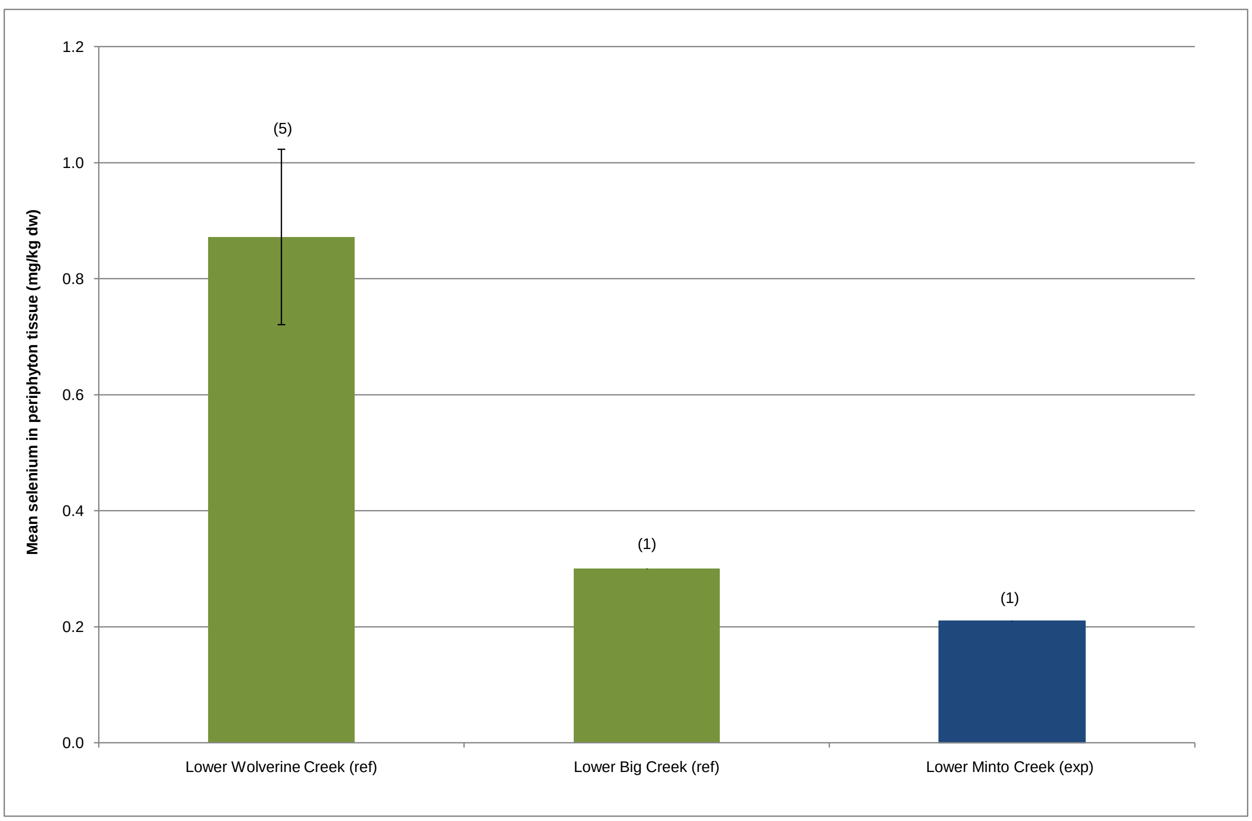

Figure 5: Selenium concentrations (mg/kg dw) and 95% confidence limits in periphyton tissue, September 2012. Green bars represent reference sites and blue bars represent exposure sites.

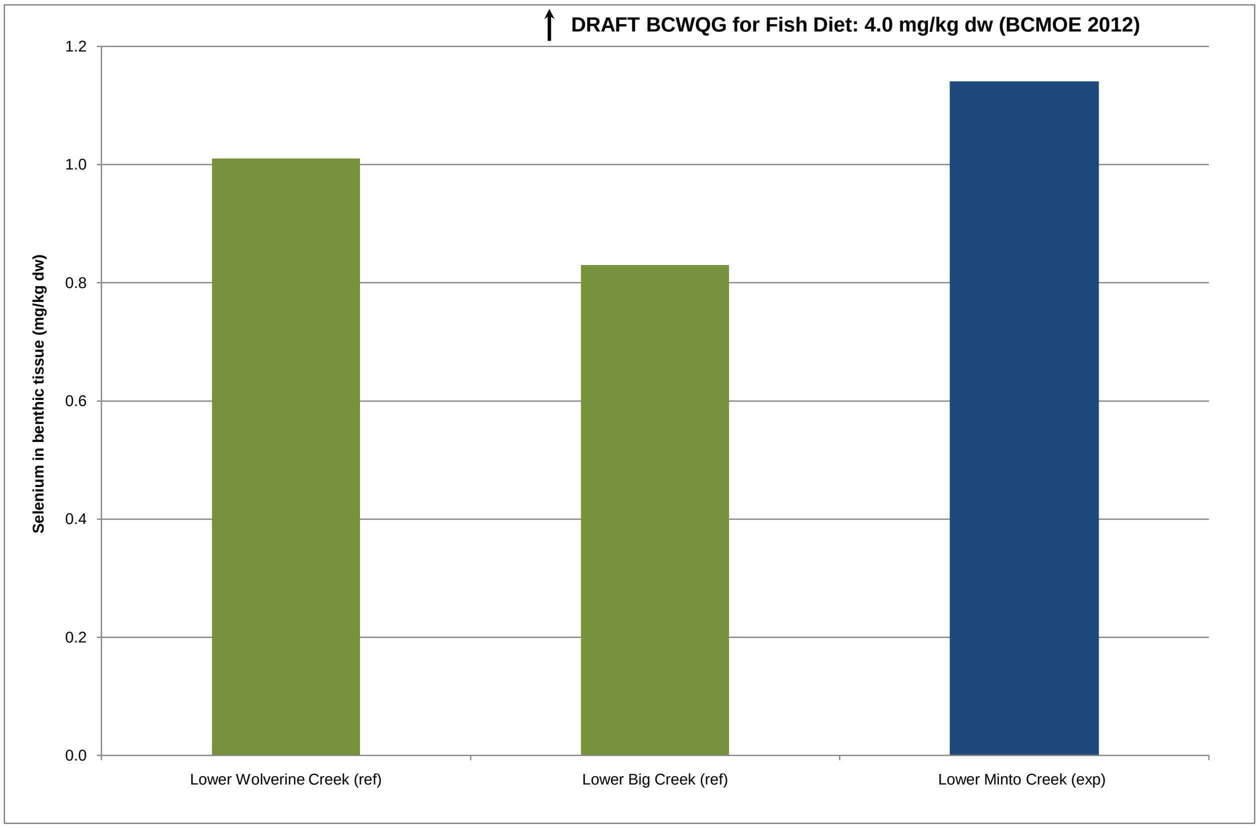

Figure 6: Selenium concentrations (mg/kg dw) in benthic tissue, n = 1, September 2012. Green bars represent reference sites and blue bars represent exposure sites

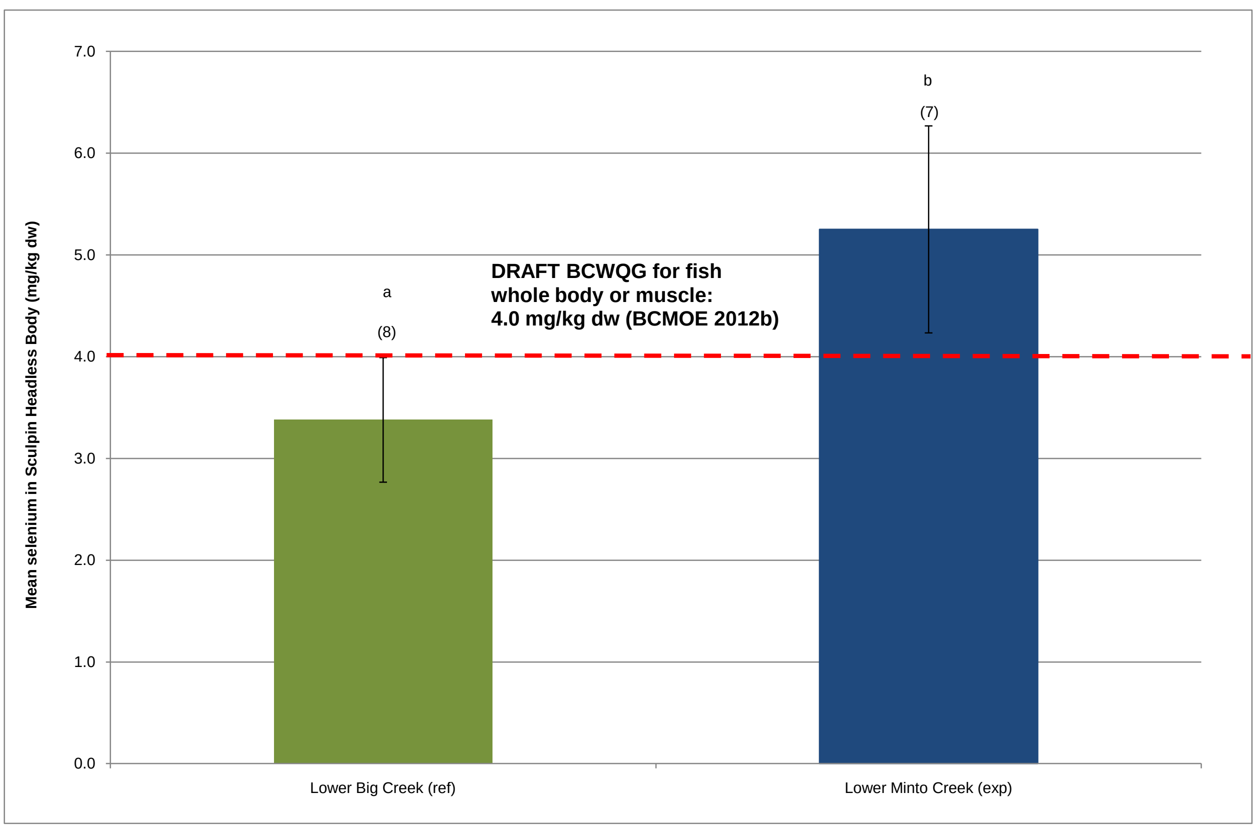

Figure 7: Selenium concentrations (mg/kg dw) and 95% confidence limits in fish whole body, September 2012. Green bars represent reference sites and blue bars represent exposure sites

Appendix A

Chemical Data

Appendix Table 1: Concentrations of selenium and suspended solids at Minto Creek routine water quality monitoring Station W2 (lower Minto Creek), 2012

Sampling Date	Selenium - Total	Selenium - Dissolved	Total Suspended Solids
	mg/L	mg/L	mg/L
4/6/2012	0.0002	0.00021	4.3
4/12/2012	0.0002	0.00019	2.0
4/14/2012	0.00015	0.00018	7.1
4/15/2012	0.0001	0.00012	31.2
4/16/2012	0.00017	0.00013	39.9
4/22/2012	0.00014	0.00015	29.6
4/24/2012	0.00017	0.00017	32.3
4/26/2012	0.00039	0.00023	202
4/29/2012	0.00041	0.00029	390
4/30/2012	0.00033	0.00027	597
5/7/2012	0.00031	0.00019	581
5/12/2012	0.0004	0.00013	619
5/18/2012	0.00036	0.00012	276
5/20/2012	0.00026	0.00012	207
5/25/2012	0.00059	0.00013	897
6/2/2012	0.00032	0.00011	301
6/6/2012	0.00027	0.00012	272
6/9/2012	0.00032	0.00012	540
6/13/2012	0.00094	0.00014	2,600
6/15/2012	0.00074	0.00014	1,410
6/19/2012	0.00056	0.00015	1,030
6/22/2012	0.00045	<0.00010	385
6/29/2012	0.00016	0.00016	157
7/8/2012	0.00015	0.00015	150
7/11/2012	0.00066	0.00011	1,010
7/17/2012	0.00028	0.00015	557
7/24/2012	0.00047	0.00015	1,150
7/31/2012	0.00016	0.00011	165
8/7/2012	0.00028	0.00014	2,100
8/10/2012	<0.00025	0.00018	228
8/13/2012	0.00033	0.00013	224
8/16/2012	0.00018	0.00015	124
8/23/2012	0.00014	0.00011	75.8
8/25/2012	0.00021	0.00011	443
8/27/2012	0.00024	0.00015	169
9/3/2012	0.00014	<0.00010	85.1
9/12/2012	<0.00010	0.00012	401
9/19/2012	0.00012	<0.00010	11.7
9/24/2012	<0.00010	0.00014	9.3
10/4/2012	0.00013		62.8
10/12/2012	0.00017		21
10/16/2012	0.00013	0.00013	30
10/19/2012	0.00012		32.4
10/22/2012	0.00011	0.00016	4.1
11/11/2012	0.00015	0.00017	<1.0

Count	45	42	45
Count <DL	3	3	1
Mean	0.00027	0.00014	393
Standard Deviation	0.00019	0.00005	551
Minimum	0.00005	0.00005	0.5
Maximum	0.00094	0.00029	2,600
1st Quartile	0.00014	0.00012	32
Median	0.00020	0.00014	202
3rd Quartile	0.00033	0.00016	540
95th Percentile	0.00066	0.00023	1,371

Appendix Table 2: Selenium concentrations by replicate sample, Minto Mine, 2012.

Site		Compartment				
		Water (mg/L)	Sediment (mg/kg)	Periphyton Tissue (mg/kg)	Invertebrate Tissue (mg/kg)	Fish Whole Body (mg/kg)
Lower Wolverine Creek	LWC-1	0.0002	0.64	0.97	0.139	-
	LWC-2	-	0.59	0.92	0.187	-
	LWC-3	-	0.63	0.67	0.161	-
	LWC-4	-	0.54	0.95	0.125	-
	LWC-5	-	0.60	0.85	0.149	-
Mean		**-**	**0.60**	**0.87**	**0.152**	**-**
Standard Deviation		-	**0.04**	**0.12**	**0.024**	-
Upper McGinty Creek	URC-1	0.0003	0.77	-	-	-
	URC-2	-	0.80	-	-	-
	URC-3	-	0.64	-	-	-
	URC-4	-	0.47	-	-	-
	URC-5	-	0.57	-	-	-
Mean		**-**	**0.65**	**-**	**-**	**-**
Standard Deviation		-	**0.14**	-	-	-
Lower Big Creek	LBC-1	< 0.0001	-	0.30	0.122	3.79
	LBC-2	-	-	-	-	4.18
	LBC-3	-	-	-	-	2.73
	LBC-4	-	-	-	-	4.52
	LBC-5	-	-	-	-	3.39
	LBC-6	-	-	-	-	3.19
	LBC-7	-	-	-	-	2.62
	LBC-8	-	-	-	-	2.60
Mean		-	-	-	-	3.38
Standard Deviation		-	-	-	-	0.73
Lower Minto Creek	LMC-1	0.0003	0.24	0.21	0.102	4.50
	LMC-2	-	< 0.20	-	-	5.31
	LMC-3	-	0.27	-	-	5.39
	LMC-4	-	0.36	-	-	5.35
	LMC-5	-	< 0.20	-	-	7.44
	LMC-6	-	-	-	-	4.81
	LMC-7	-	-	-	-	3.96
Mean		-	**0.25**	-	-	**5.25**
Standard Deviation		-	**0.07**	-	-	**1.10**
Upper Minto Creek	UMC-1	0.0004	0.36	-	-	-
	UMC-2	-	0.28	-	-	-
	UMC-3	-	0.28	-	-	-
	UMC-4	-	0.49	-	-	-
	UMC-5	-	0.32	-	-	-
Mean		-	**0.35**	-	-	-
Standard Deviation		-	**0.09**	-	-	-