Selenium Project
Southeast Idaho Phosphate Mining Resource Area

Water Quality Sampling for Metals -
Blackfoot River and Tributaries (HUC 17040207) and
Selected Bear River Tributaries (HUC 16010201)

9 – 13 May 2005

Idaho Department of Environmental Quality

Pocatello Regional Office
444 Hospital Way, #300
Pocatello, ID 83201
208-236-6160

31 December 2005

SUMMARY

During May 2005, Idaho Department of Environmental Quality (IDEQ) and U.S. Forest Service personnel conducted surface water sampling of streams in the phosphate district of southeast Idaho. Fourteen (14) sites located on 9 streams were sampled. Discharge was measured at 11 sites. Samples were shipped under chain of custody to ACZ Laboratories (Steamboat Springs, Colorado) for analyses. Nine (9) of 11 metals analyzed for were present in one or more samples at concentrations greater than the minimum detection limit. Three sites sampled (East Mill Creek-middle, Spring Creek at its mouth, and Angus Creek) contained selenium at concentrations exceeding acute aquatic life criteria (CMC). Selenium concentrations at 8 sites were $\geq$ chronic aquatic life criteria (CCC).

INTRODUCTION

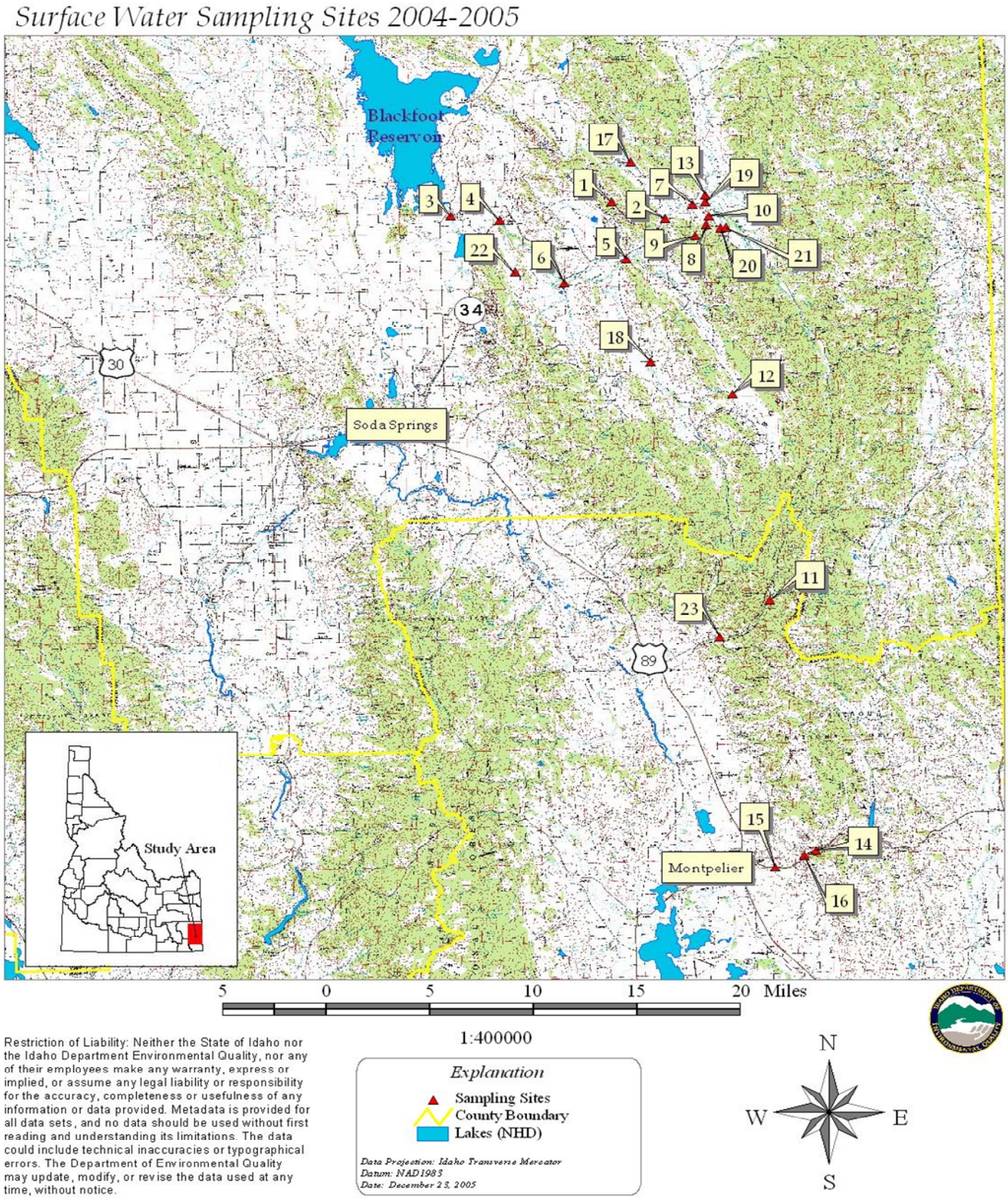
As part of the area-wide Total Maximum Daily Load (TMDL) selenium monitoring project, sampling of total selenium and ten dissolved metals in stream surface waters was conducted. This information will be used to continue assessment of water quality impacts from phosphate mining operations and aid in prioritizing and implementing remedial activities in affected waterbodies.

METHODS

Study Sites

Fourteen (14) sites in the Blackfoot and Bear River drainages were sampled 9-13 May 2005 (Figure 1), using 3 teams of personnel. Sampling personnel consisted of IDEQ and U.S. Forest Service employees. Field teams followed USGS and Federal Interagency Sedimentation Project sampling protocols described by TtEMI (2001, 2002, and 2003). Water samples were collected using a depth-integrated sampler (Model US DH-95). A bridge-board winch platform was used at several sites where wading was not possible. Samples were placed in polyethylene or glass containers, preserved with sulfuric or nitric acid as necessary, and stored at 4 °C on ice in a cooler or a refrigerator prior to analysis. Samples were collected in accordance with IDEQ 4-day averaging protocol at 12 sites and 2 sites were sampled on a discrete date. Blackfoot at China Hat samples were discretely analyzed, while other samples collected per site over a 4-day period were composited at IDEQ and shipped under chain of custody and within holding times, overnight to ACZ Laboratory, Steamboat Springs, Colorado. A YSI multiparameter monitoring system (model 6920 sonde, model 650 MDS display, Yellow Springs Instruments, Ohio) was used to acquire in-situ readings of dissolved oxygen, temperature, turbidity, conductivity, and pH concurrent with water sampling. Readings on Blackfoot River and Spring Creek were taken at 3 locations perpendicular to the stream flow (middle, left third, right third) except at the Blackfoot River Monsanto Bridge site and at the Blackfoot River above Narrows site during one sampling event . Readings at all other sites were taken in the thalweg. Discharge was measured using a portable electromagnetic flow meter (Marsh-McBirney model 2000) in conjunction with a top setting wading rod or a bridge board, winch, and torpedo weight. For purposes of determining loads, mean discharge of 2 measurements taken over the 3-d sampling period was calculated. Flow was measured at Lanes Creek, Blackfoot at Trail Creek Road, Blackfoot at Slug Creek Road, Blackfoot at Upper Bridge, and Rasmussen Creek at one time only.

Figure 1. Sampling locations for 18-21 May 2004 surface water sampling event.



Restriction of Liability: Neither the State of Idaho nor the Idaho Department Environmental Quality, nor any of their employees make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information or data provided. Metadata is provided for all data sets, and no data should be used without first reading and understanding its limitations. The data could include technical inaccuracies or typographical errors. The Department of Environmental Quality may update, modify, or revise the data used at any time, without notice.

Figure 1 (key). Sampling locations for 2004, 2005 surface water sampling events.

SiteNo	Sampling Location	Latitude	Longitude	Year(s) Sampled
1	Angus Creek - upper	42.827583	-111.400389	2004, 2005
2	Blackfoot above Narrows	42.813696	-111.350299	2004, 2005
3	Blackfoot @ China Hat	42.820019	-111.553545	2004, 2005
4	Blackfoot @ Monsanto haul Rd	42.815541	-111.507253	2004, 2005
5	Blackfoot @ Slug Cr Rd	42.784243	-111.387956	2004, 2005
6	Blackfoot @ Trail Cr Rd	42.767308	-111.447211	2004, 2005
7	Blackfoot @ upper bridge	42.824076	-111.323242	2004, 2005
8	E. Mill (middle)	42.807934	-111.310923	2004, 2005
9	E. Mill (upper)	42.800539	-111.321803	2004
10	E. Mill (lower)	42.814804	-111.308069	2004
11	Georgetown Cr below mill site	42.522972	-111.263333	2004, 2005
12	Goodheart Cr bel Champ Mine	42.679389	-111.291889	2004
13	Lanes Creek above Diamond confl	42.830729	-111.311123	2004, 2005
14	Montpelier Cr above mining	42.333000	-111.228139	2004
15	Montpelier Cr below Waterloo Mine at KOA	42.320772	-111.266746	2004
16	Montpelier Cr below Home Canyon	42.328972	-111.238861	2004
17	Rasmussen Creek	42.857332	-111.381155	2004, 2005
18	Slug Cr @ S Trail and Slug Cr Rd	42.706277	-111.368497	2004
19	Spring Cr @ Blackfoot R	42.825307	-111.311674	2004, 2005
20	Spring Cr (north spring)	42.805130	-111.297228	2004
21	Spring Cr (south spring)	42.805799	-111.292431	2004
22	State Land Creek	42.776570	-111.493881	2004
23	Georgetown Cr above Rt Hand Fork	42.496222	-111.312167	2005

RESULTS

Discharge Measurements

Discharge at individual sites (see Table 1 for mean discharge) ranged from 0.8 – 692.9 cubic feet per second (cfs). Discharge at most sites increased slightly over the sampling period. Measurements on East Mill – middle and Montpelier (at KOA) creeks indicated slight decreases in flow over the study period.

Table 1. Discharge measurements for water quality sampling locations, 9-13 May 2005.

Location	Date	Flow (cfs)	Mean Flow (cfs)	Field personnel	Notes
Angus Cr - upper	9-May	0.8		MT/LVE	
Angus Cr - upper	12-May	1.1	1.0	MT/MB	
Blackfoot above Narrows	9-May				
Blackfoot above Narrows	11-May				
Blackfoot above Narrows	12-May		NA		
Blackfoot @ Monsanto Bridge/China Hat	9-May	518			from USGS gage 13063000
Blackfoot @ Monsanto Bridge/China Hat	11-May	503			from USGS gage 13063000
Blackfoot @ Monsanto Bridge/China Hat	12-May	571	531		from USGS gage 13063001
Blackfoot @ Slug Cr Rd	9-May				
Blackfoot @ Slug Cr Rd	11-May	569.3		GM/DV	measured from bridge - overestimate
Blackfoot @ Slug Cr Rd	12-May				
Blackfoot @ Trail Cr Rd	9-May				
Blackfoot @ Trail Cr Rd	11-May	692.9		GM/DV	measured from bridge - overestimate
Blackfoot @ Trail Cr Rd	12-May				
Blackfoot @ upper bridge	9-May				
Blackfoot @ upper bridge	11-May	424.7		GM/DV	measured from bridge - overestimate
Blackfoot @ upper bridge	12-May				
E. Mill (middle)	10-May	3.8		GM/DV	
E. Mill (middle)	13-May	3.6	3.7	GM/WF	
Georgetown Cr below mine	9-May	13.2		MT/LVE	
Georgetown Cr below mine	12-May	14.6	13.9	MT/MB	
Georgetown Cr above Right Hand Fork	9-May	16.5		MT/LVE	
Georgetown Cr above Right Hand Fork	12-May	18.3	17.4	MT/MB	
Goodheart Cr bel Champ Mine	9-May				
Goodheart Cr bel Champ Mine	12-May				
Lanes Creek above Diamond confluence	10-May	265.1		GM/DV	
Lanes Creek above Diamond confluence					
Montpelier Cr below Waterloo Mine at KOA	9-May	55.9		MT/LVE	
Montpelier Cr below Waterloo Mine at KOA	12-May	50.6	53.2	MT/MB	
Montpelier Cr bel Waterloo Mine					
Montpelier Cr bel Waterloo Mine					
Montpelier Cr above mining					
Rasmussen Cr	9-May	4.9		MT/LVE	
Rasmussen Cr					
Slug Cr @ S Trail and Slug Cr Rd	NS				
Slug Cr @ S Trail and Slug Cr Rd	NS				
Spring Cr @ Blackfoot R	10-May	32.0		GM/DV	
Spring Cr @ Blackfoot R	13-May	32.3	32.2	GM/WF	

Physicochemical Measurements

Water temperature ranged from 4.15 -11.63° C. Specific conductivity @ 25° C ranged from 283 to 697 µs/cm^2. All dissolved oxygen measurements were > 8 mg/L. pH ranged from 7.62 to 8.32. Turbidity ranged from 0.0 to 30.6 NTU. Mean values for physicochemical parameters at all sites are presented in Table 2.

Table 2. Mean physical water parameters for selenium water sampling 9-13 May 2005.

SITE	T(°C)	SPC	DO %	DO mg/L	pH	Turbidity	Flow[1]
Angus Creek - Upper	8.54	681	74.8	8.71	7.69	1.5	1.0
Blackfoot @ Monsanto haul Rd	7.88	320	77.5	9.19	8.09	17.0	531
Blackfoot @ Slug Cr Rd	7.39	308	83.5	10.03	8.14	24.0	569.3
Blackfoot @ Trail Cr Rd	7.92	315	79.2	9.40	8.11	26.1	692.9
Blackfoot @ upper bridge	8.44	311	93.9	11.00	8.19	23.0	424.7
Blackfoot above Narrows	7.58	304	87.2	10.35	8.09	22.8	NS
Blackfoot River @ ChinaHat	7.62	331	87.5	10.44	8.00	18.7	531
E. Mill (lower)	NS						
E. Mill (middle)	6.73	469	89.6	10.95	8.23	25.7	3.7
E. Mill (upper)	NS						
Georgetown Cr above Right Hand Fork	8.80	404	80.1	9.29	8.00	0.5	17.4
Georgetown Cr below mine	4.65	365	78.8	10.13	7.82	2.3	13.9
Lanes Creek above Diamond confluence	5.72	303	79.7	9.98	8.08	20.6	265.1
Montpelier Cr above mining	NS						
Montpelier Cr bel Home Canyon	NS						
Montpelier Cr below Waterloo Mine at KOA	5.83	431	79.3	9.90	7.87	24.6	53.2
Rasmussen Cr	11.63	283	86.4	9.38	8.12	9.1	4.9
Slug Cr @ S Trail and Slug Cr Rd	NS						
Spring Cr (north spring)	NS						
Spring Cr (south spring)	NS						
Spring Cr @ Blackfoot R	6.95	359	98.8	11.98	8.24	8.6	32.2
State Land Cr	NS						

NS = not sampled in 2005

[1]Flows for Blackfoot River at Slug Cr., Trail Cr., and upper bridge are overestimates (see discussion)

Chemical Constituents

Calcium ranged from 41.2 – 107 (mean = 62.6) mg/L. Magnesium ranged from 7.6 – 25.5 (mean = 12.7) mg/L. Bicarbonate ranged from 72 – 208 (mean = 160) mg/L. Total organic carbon averaged 5 (range = 2 – 7) mg/L. Mean water hardness was 209 (range = 134 – 372) mg/L $CaCO_3$. Nutrient concentrations ranged from a nitrate + nitrite mean of 0.14 (range = <0.03 – 1.00) mg/L and a phosphorus mean of 0.17 (range = <0.08 – 0.64) mg/L. Total alkalinity ranged from 73 – 212 (mean = 164) mg/L.

Metals concentrations varied among sites (Table 3). Zinc and silver were not present above the laboratory detection limits (0.01 and 0.00005 mg/L, respectively) in any samples. Cadmium was detected in one sample taken at Blackfoot River at China Hat at a concentration of 0.0002 mg/L. Chromium ranged from 0.0002 – 0.002 (mean = 0.0004) mg/L. Copper ranged from <0.0005 – 0.0017 (mean = 0.0008) mg/L, lead ranged from <0.0001 – 0.0004 (mean = 0.0002) mg/L. Nickel ranged from <0.0006 – 0.0021 (mean = 0.0015) mg/L. Selenium ranged from <0.001 – 0.62 (mean = 0.053) mg/L. Vanadium ranged from <0.0002 – 0.0019 (mean = 0.0006) mg/L (see Appendix A for the complete ACZ analytical report).

Table 3. Results of surface water quality sampling from 9-13 May 2005 in the southeastern Idaho phosphate mining district. (All results in mg/L)

	Cadmium, dissolved	Calcium, dissolved	Chromium, dissolved	Copper, dissolved	Lead, dissolved	Magnesium, dissolved	Nickel, dissolved	Selenium, total	Silver, dissolved	Vanadium, dissolved	Zinc, dissolved	Bicarbonate as CaCO3	Carbon, total organic (TOC)	Carbonate as CaCO3	Hardness as CaCO3	Hydroxide as CaCO3	Nitrate/Nitrite as N, dissolve	Phosphorus, total	Residue, Non-Filterable (TSS)	Sulfate	Total Alkalinity
minimum detection limit (MDL)	0.0001	0.2	0.0001	0.0005	0.0001	0.2	0.0006	0.001	0.00005	0.0002	0.01	2	1	2	1	2	0.02	0.01	5	10	2
Angus Cr - upper	ND	107	0.0002	ND	0.0001	25.5	0.0018	0.039	ND	0.0004	ND	207	4	5	372	ND	0.11	0.11	14	170	212
Angus Cr - upper (DUP)	ND	107	0.0002	ND	ND	25.5	0.0018	0.039	ND	0.0004	ND	208	4	ND	372	ND	0.08	0.13	6	170	208
Blackfoot @ Monsanto haul Rd	ND	52.7	0.0004	0.0006	0.0001	9	0.0016	0.005	ND	0.0004	ND	151	7	3	169	ND	0.05	0.11	28	20	153
Blackfoot @ Slug Cr Rd	ND	52	0.0004	0.0009	0.0002	8.9	0.0021	0.006	ND	0.0004	ND	145	7	3	167	ND	0.05	0.14	46	20	149
Blackfoot @ Trail Cr Rd	ND	52.3	0.0003	0.0007	0.0001	9.1	0.002	0.006	ND	0.0004	ND	146	7	3	168	ND	0.04	0.12	46	20	149
Blackfoot @ China Hat	6.6667E-05	55.0	0.0003	0.0011	0.0003	9.9	0.0017	0.005	ND	0.0004	ND	154	7	2	178	ND	0.17	0.13	33	13	155
Blackfoot above Narrows	ND	51	0.0004	0.0006	0.0001	8.8	0.0011	0.006	ND	0.0003	ND	142	7	4	164	ND	0.05	0.1	36	10	145
Blackfoot above Narrows (DUP)	ND	51.5	0.0003	ND	ND	8.8	0.001	0.011	ND	0.0003	ND	144	7	4	165	ND	0.05	0.14	44	10	148
Blackfoot @ upper bridge	ND	53.4	0.0003	0.0009	0.0001	9	0.0012	0.006	ND	0.0003	ND	155	7	6	170	ND	0.06	0.19	50	10	161
E. Mill (lower)	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
E. Mill (middle)	ND	75.9	0.002	0.0017		16.3	0.0007	0.62	ND	0.0019	ND	177	3	6	257	ND	1	0.64	10	70	183
E. Mill (upper)	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Georgetown Cr above Right Hand Fork	ND	62.7	0.0006		0.0002	17.1	ND	0.003	ND	0.0008	ND	180	2	10	227	ND	0.23	0.09	8	40	190
Georgetown Cr below mine	ND	61.2	0.0004		0.0002	12.5	ND	0.011	ND	0.0012	ND	182	2	8	204	ND	0.04	0.36	10	20	190
Goodheart Cr bel Champ Mine	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Lanes Creek above Diamond confl	ND	52	0.0003	0.0006	0.0001	8.1	0.001	0.001	ND	0.0002	ND	151	7	2	163	ND	0.05	0.15	40		153
Montpelier Cr above mining	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Montpelier Cr bel Home Canyon	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Montpelier Cr below Waterloo Mine at KOA	ND	65	0.0002	0.0006	0.0004	15.9	ND	ND	ND	ND	ND	171	3	3	228	ND	0.17	0.16	38	50	173
Rasmussen Cr	ND	41.2	0.0005	0.0009		7.6	0.0021	0.005	ND	0.0007	ND	72	7		134	ND	0.03	0.09	12	40	73
Slug Cr @ S Trail and Slug Cr Rd	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Spring Cr (north spring)	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Spring Cr (south spring)	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Spring Cr @ Blackfoot R	ND	61.3	0.0003	0.0005	0.0002	11.8		0.038	ND	ND	ND	176	5	7	202	ND	0.03	0.08	22		183
State Land Cr	NS	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Equipment blank	ND	ND	0.0002	0.0026	0.0002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	6	10	ND
low	6.6667E-05	41.2	0.0002	0.0005	0.0001	7.6	0.0007	0.001	0	0.0002	0	72	2	2	134	0	0.03	0.08	6	10	73
high	6.6667E-05	107	0.002	0.0017	0.0004	25.5	0.0021	0.62	0	0.0019	0	208	7	10	372	0	1	0.64	50	170	212
mean	0.0001	62.5729	0.0004	0.0008	0.0002	12.7375	0.0015	0.0534		0.0006		160.0833	5.3542	4.7143	208.7500		0.1381	0.1715	27.7083	47.3810	164.0833
DUP 1 % tolerance	0	0	0	0	0	0	0	0	0	0	0	0.004807692	0	-1.5	0	0	-0.375	0.153846154	-1.333333	0	-0.019231
DUP 2 % tolerance	0	0.0097087	-0.33333333	-0.2	0	0	-0.1	0.4545455	0	0	0	0.013888889	0	0	0.006060606	0	0	0.285714286	0.1818182	0	0.0202703
CCC (mg/L)	0.0014		0.0105	0.0146	0.0034		0.2014	0.005			0.133										
exceedence (Yes or No)	NO		NO	NO	NO		NO	YES	NO		NO										

The equipment blank collected during field sampling showed low concentrations for chromium (0.0002 mg/L, MDL=0.0001 mg/L), copper (0.0026 mg/L, MDL=0.0005 mg/L), lead (0.0002 mg/L, MDL=0.0001 mg/L), nitrate/nitrite (0.02 mg/L, MDL=0.02 mg/L), TSS (6.0 mg/L, MDL=5 mg/L), and sulfate (10 mg/L, MDL=10 mg/L). One set of duplicate samples (Angus Creek - upper) was within 20 percent for all constituents except nitrate/nitrite (38%) and carbonate (150%). The second set of duplicate samples (Blackfoot Above Narrows) was out of acceptable limits for total phosphorus (28%), selenium (45%), and chromium (33%). The second duplicate set was within 20% for all other constituents.

DISCUSSION

Sample Sites

State Land Creek was not sampled due to rainfall making the route to this site impassable during the sampling event. Sampling at Blackfoot River at Monsanto Bridge did not include a mid-channel location because extremely deep, swift flow made wading impossible. Due to haul truck traffic, bridge board sampling could not be safely conducted at this site either. The channel at this location is confined and narrower than the width of the Blackfoot River channel at other locations, and physicochemical data indicate flow was well-mixed at this site. Depth-integrated samples were taken (as at all other large stream/river sites) to account for any potential water column differences in suspended sediment and other constituents.

Discharge

Discharge at all sites was > discharge measured during previous sample events in 2003 – 2004 (IDEQ 2004; Figure 2; Table 4). Discharge at Blackfoot River (USGS gage 13063000; Figure 3) during this sampling event was approximately 4X the discharge during the 2004 sampling event. During this study, change in discharge ranged from -10% (Montpelier Creek at KOA) to +29% (Angus Creek). Blackfoot at China Hat samples were analyzed discretely, while all other samples were composited at IDEQ prior to being shipped to the laboratory for analyses. At that site, chromium, copper, lead, nickel, vanadium, and nitrate/nitrite concentrations were greatest on 12 May 2005 – when maximum flow over the 3 days of sampling occurred; however, selenium concentrations did not follow this pattern.

Figure 2. Discharge for sample sites during 2003, 2004 and 2005 sampling events.

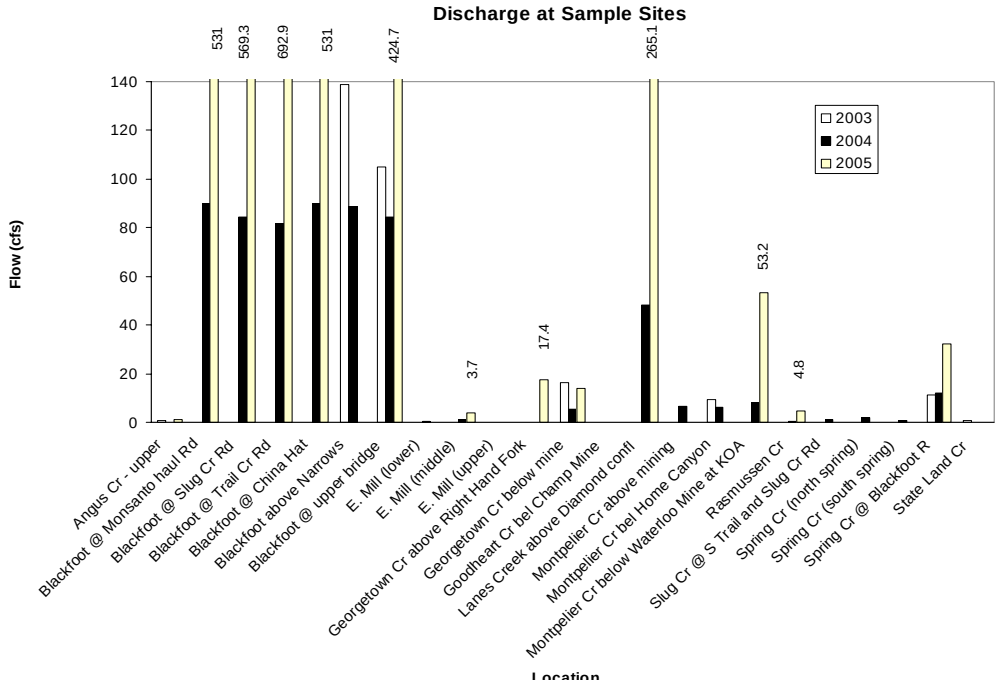
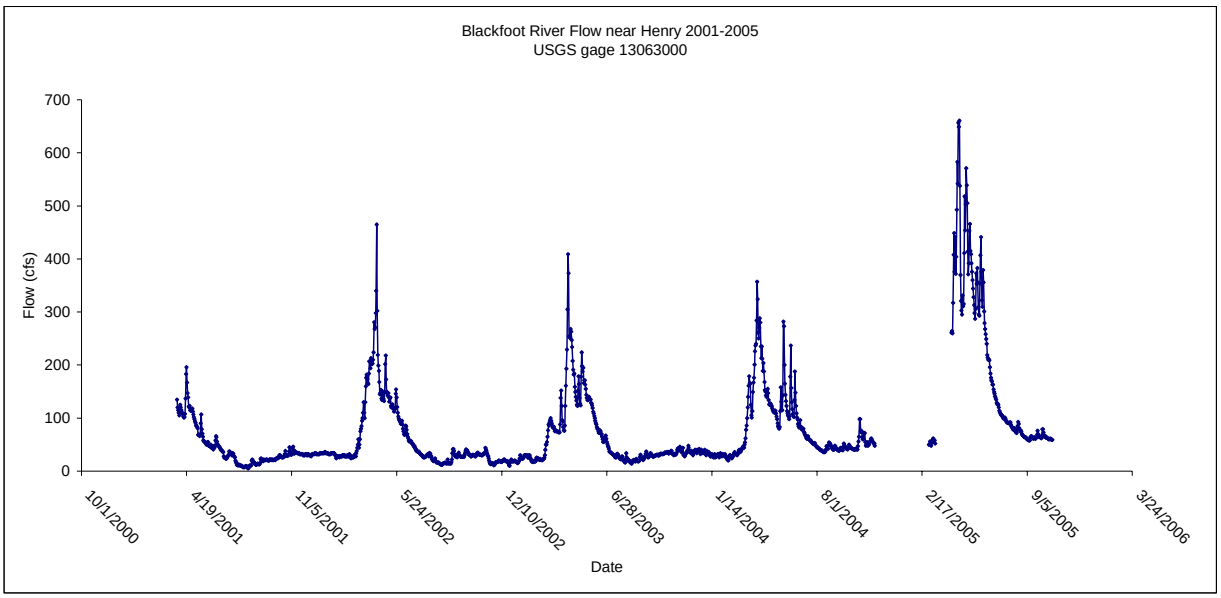


Table 4. Comparison of stream flows 2003-2005.

	Flow (cfs)		
	2003	**2004**	**2005**
Angus Cr - upper	0.9	0.1	1.0
Blackfoot @ Monsanto haul Rd		90.0	531
Blackfoot @ Slug Cr Rd		84.3	569.3
Blackfoot @ Trail Cr Rd		81.5	692.9
Blackfoot @ China Hat		90.0	531
Blackfoot above Narrows	138.7	88.6	NM
Blackfoot @ upper bridge	105.1	84.5	424.7
E. Mill (lower)		0.6	NM
E. Mill (middle)		1.3	3.7
E. Mill (upper)		0.2	NM
Georgetown Cr above Right Hand Fork		NS	17.4
Georgetown Cr below mine	16.3	5.5	13.9
Goodheart Cr bel Champ Mine		0.0	NM
Lanes Creek above Diamond confl		48.1	265.1
Montpelier Cr above mining		6.7	NM
Montpelier Cr bel Home Canyon	9.5	6.4	NM
Montpelier Cr below Waterloo Mine at KOA		8.1	53.2
Rasmussen Cr		0.4	4.9
Slug Cr @ S Trail and Slug Cr Rd		1.1	NM
Spring Cr (north spring)		1.8	NM
Spring Cr (south spring)		0.9	NM
Spring Cr @ Blackfoot R	11.5	11.9	32.2
State Land Cr	0.7	0.1	NM

NM=not measured

Figure 3. Blackfoot River flow, 2001-2005.



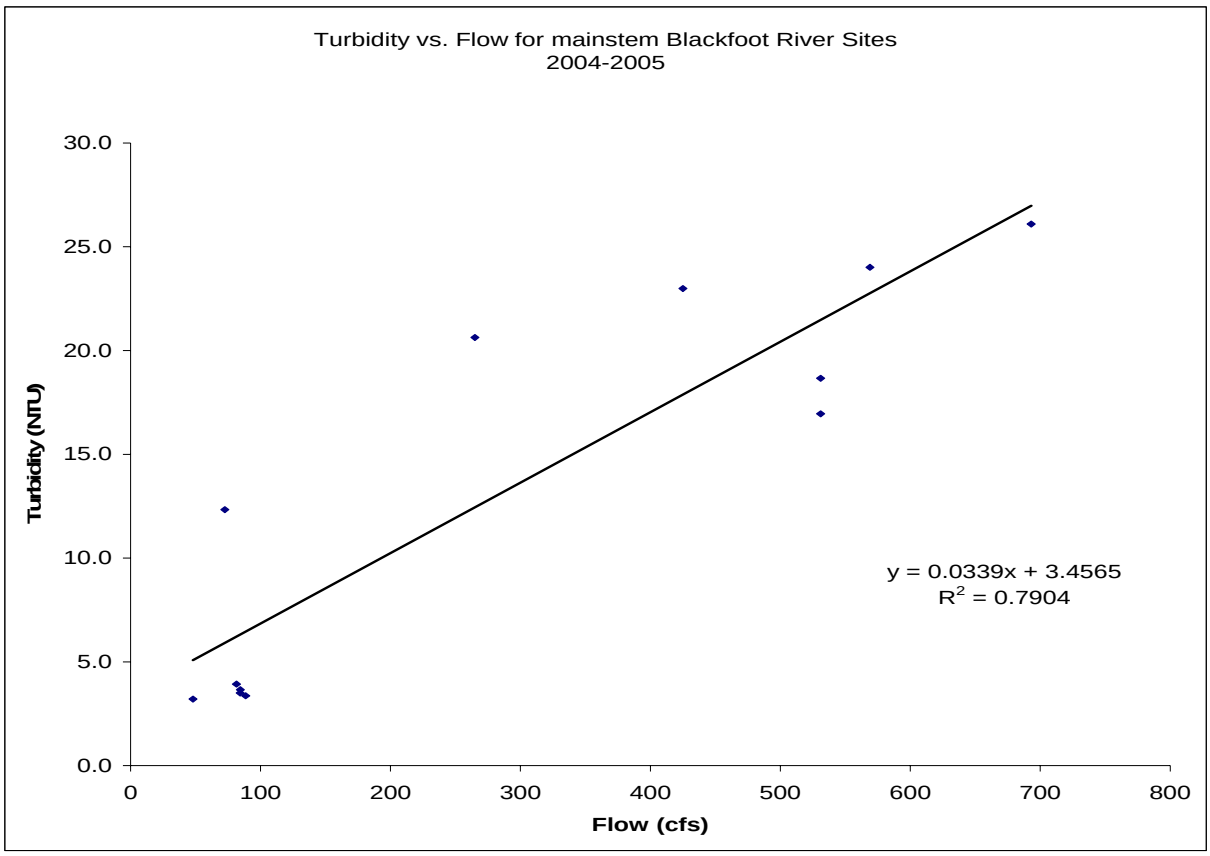
Discharge and sampling on Lanes Creek was conducted only the first day of sampling due to increased flow preventing wading access on subsequent days. Discharge was measured using a top-setting wading rod 10 May 2005; however, higher flows precluded accurate measurement and sampling at this site during subsequent days.

Discharge measurements for the Blackfoot River at Trail Creek Road, Blackfoot River at Slug Creek Road, and Blackfoot River at Upper Bridge sites overestimated flow. The torpedo weight used to measure velocity from the bridge deck was too light to resist deflection by high water velocities in the river. This downstream deflection caused depth readings to be greater than actual depth. Additionally, velocity sensor placement was not exactly at correct depths (0.2, 0.6, and or 0.8 X cross section depth) as a result of this deflection. A heavier torpedo weight will be used in future sampling events when high flows preclude measurement of flow by wading with a top-setting rod. More flows will be measured at the Blackfoot River sites in future sampling events in order to better establish relationships between those sites and USGS gage 13063000 (Blackfoot River near Henry) at higher flows.

Physicochemical Parameters

Measured turbidity was higher during this study than in 2004. Mean turbidity during this year's sampling was 16.0 NTU (range = 0.5-26.1 NTU), compared to 3.7 NTU (range = 0.0 -12.3 NTU) in 2004. Mean turbidity increased as a function of flow at Blackfoot River sites (Figure 4). One pH measurement (8.48 units at Blackfoot River at Monsanto Bridge) appears anomalous and was not used in determining mean pH at that site.

Figure 4. Mean Turbidity vs. Flow at Blackfoot River sites (2004-2005 sampling event data)



Chemical Constituents

State of Idaho criteria for metals criteria consists of acute (CMC) and chronic (CCC) concentration limits. Criteria for several metals (cadmium, chromium, copper, lead, silver, and zinc) also are hardness-dependent. Acute and chronic criteria concentrations were calculated for each of these metals using hardness values in the analytical report (Table 3). Selenium concentrations in samples from East Mill Creek – middle, Spring Creek at Blackfoot River, and Angus Creek were ≥ the CMC for aquatic life (0.02 mg/L; Figure 5). Selenium concentrations at all other sites sampled except Georgetown Creek, Lanes Creek, and Montpelier Creek a KOA were ≥ to the CCC for aquatic life (0.005 mg/L; Figure 5). All sites sampled in both 2004 and 2005 showed increases in selenium concentrations (Table 5). Concentrations of all hardness-dependent metals analyzed for (cadmium, chromium, copper, lead, silver, nickel, and zinc) were less than detection limits, or were 1-2 orders of magnitude < the CCC at all sites (see Table 6 for hardness-dependent criteria). Vanadium concentrations ranged from <0.0002 – 0.0019 mg/L (mean = 0.0006 mg/L). No criteria except for human consumption of drinking water (0.26 mg/L) are available for vanadium.

Figure 5. Selenium concentrations for sites sampled May 2005.

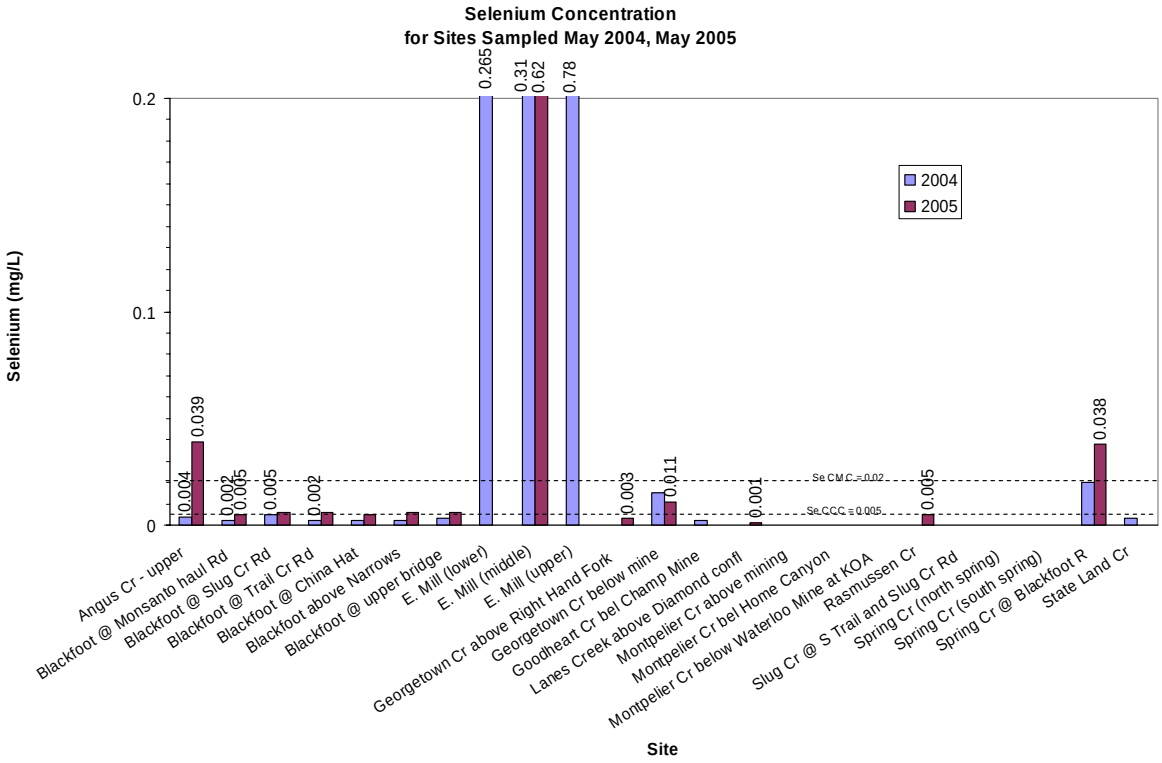


Table 5. Comparison of selenium concentrations 2004-2005.

	Selenium Concentration (mg/L)	
	2004	**2005**
Angus Cr - upper	0.004	0.039
Blackfoot @ Monsanto haul Rd	0.002	0.005
Blackfoot @ Slug Cr Rd	0.005	0.006
Blackfoot @ Trail Cr Rd	0.002	0.006
Blackfoot @ China Hat	0.002	0.005
Blackfoot above Narrows	0.002	0.006
Blackfoot @ upper bridge	0.003	0.006
E. Mill (lower)	0.265	
E. Mill (middle)	0.31	0.62
E. Mill (upper)	0.78	
Georgetown Cr above Right Hand Fork		0.003
Georgetown Cr below mine	0.015	0.011
Goodheart Cr bel Champ Mine	0.002	
Lanes Creek above Diamond confl	< 0.001	0.001
Montpelier Cr above mining	< 0.001	
Montpelier Cr bel Home Canyon	< 0.001	
Montpelier Cr below Waterloo Mine at KOA	0.001	<0.001
Rasmussen Cr	< 0.001	0.005
Slug Cr @ S Trail and Slug Cr Rd	< 0.001	
Spring Cr (north spring)	< 0.001	
Spring Cr (south spring)	< 0.001	
Spring Cr @ Blackfoot R	0.02	0.038
State Land Cr	0.003	
Equipment blank	ND	ND
Angus Cr - upper (DUP)		0.039
Blackfoot above Narrows (DUP)		0.011

NS=not sampled

ND = not detected at laboratory minimum detection limit (MDL)

Table 6. Calculated CMC and CCC values for hardness-dependent metals.

	Hardness	**CMC Conversion**	**CCC Conversion**	**CMC (ug/l)**	**CCC (ug/l)**	**CMC (mg/L)**	**CCC (mg/L)**
Arsenic (III)	134	1.000		360	190	0.3600	0.190000
Cadmium	178	0.920	0.800	6.91	1.43	0.0069	0.001427
Chromium III	134	0.316	0.860	697	226	0.6974	0.226220
Chromium VI	134	0.982	0.962	16	11	0.0157	0.010582
Copper	134	0.960	0.960	22.4	14.6	0.0224	0.014576
Lead	134	0.748	0.748	89	3.46	0.0887	0.003456
Mercury	134	0.850	1.000	2.0	0.012	0.0020	0.000012
Nickel	134	0.998	0.997	1813	201	1.8131	0.201355
Silver	134	0.850	1.000	5.71		0.0057	0.000000
Zinc	134	0.978	0.986	147	133	0.1467	0.133070

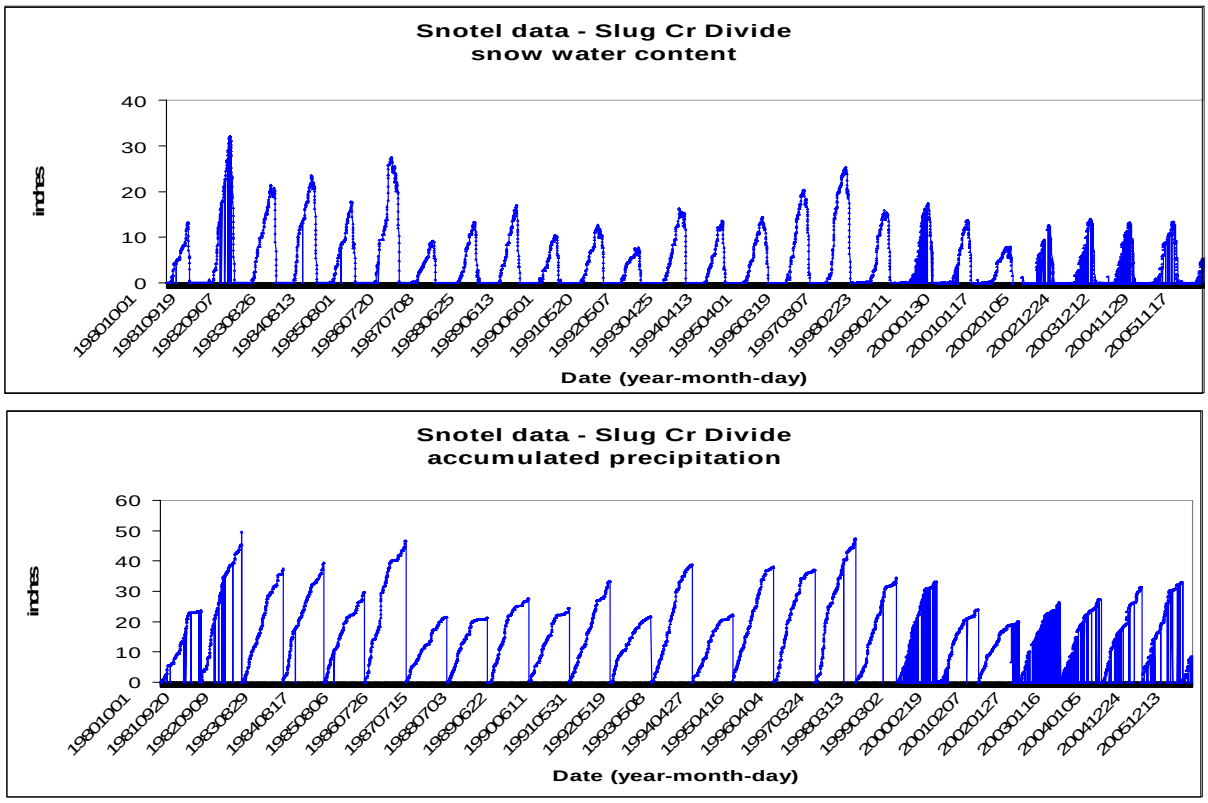
There are NO exceedences for metals other than Se at a CCC calculated at hardness 134 (Cd calculated at 178 for only site detected)

Laboratory Data Quality
Detections of chromium, copper, lead, nitrate/nitrite, TSS, and sulfate in equipment blanks were at or slightly above method detection limits; however all were < practical quantitation limits. Duplicate samples were generally similar and within acceptance criteria (25% for low level duplicates; APHA 1998); however, selenium concentrations in duplicate samples for Blackfoot River Above Narrows were considerably different (45% > its paired sample). Total phosphorus concentrations in these duplicate samples differed by 28%. ACZ Laboratory was contacted regarding these discrepancies; however, samples had been discarded, so re-analysis could not be conducted (see Appendix A). The Angus Creek duplicate sample differences exceeded acceptable limits (25%) for TSS and carbonate; however, concentrations were < the probable quantitation limit (PQL) in each case. All other constituents in the Angus Creek duplicates were within acceptable limits.

RECOMMENDATIONS

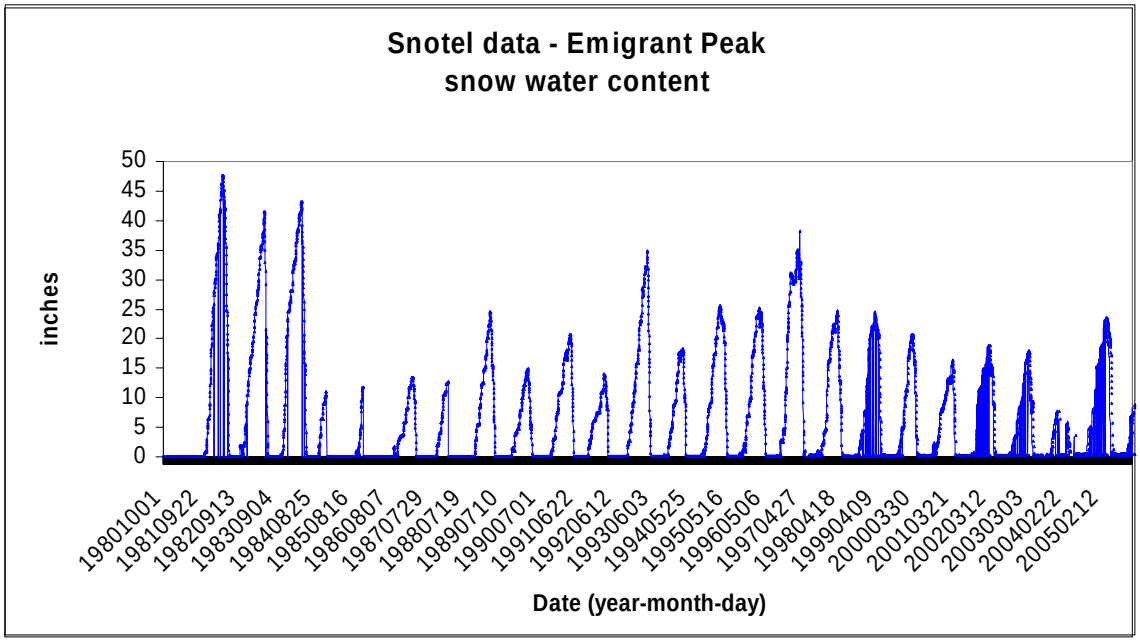
Blackfoot River at Slug Creek and Georgetown Creek below the mine exceeded the selenium CCC in both 2004 and 2005 samples, and therefore will be recommended for addition to the next 303d list. Sampling should continue at all sites investigated in this study. Ideally, sampling would be correlated with annual precipitation in order to monitor highest runoff in wet years. An earlier report indicated selenium concentrations correlate with annual snowfall (TtEMI 2004); however, Slug Creek Divide is the only snotel station in the Blackfoot drainage area. This makes predicting spring runoff intensity from snow accumulation difficult. For example, snow water content and accumulated precipitation data from the Slug Creek Divide snotel site (Figure 6) did not predict this year's increased spring runoff or increased selenium concentrations detected in samples.

Figure 6. Snotel station data for Slug Creek Divide.



Emigrant Peak and Giveout snotel sites represent precipitation accumulation in parts of the Bear River drainage. Accumulated precipitation and snow water content (with the possible exception of snow water content at Emigrant Peak) for 2004-2005 at these sites also did not predict increased runoff from that watershed (Figures 7 and 8).

Figure 7. Snotel station data for Emigrant Peak.



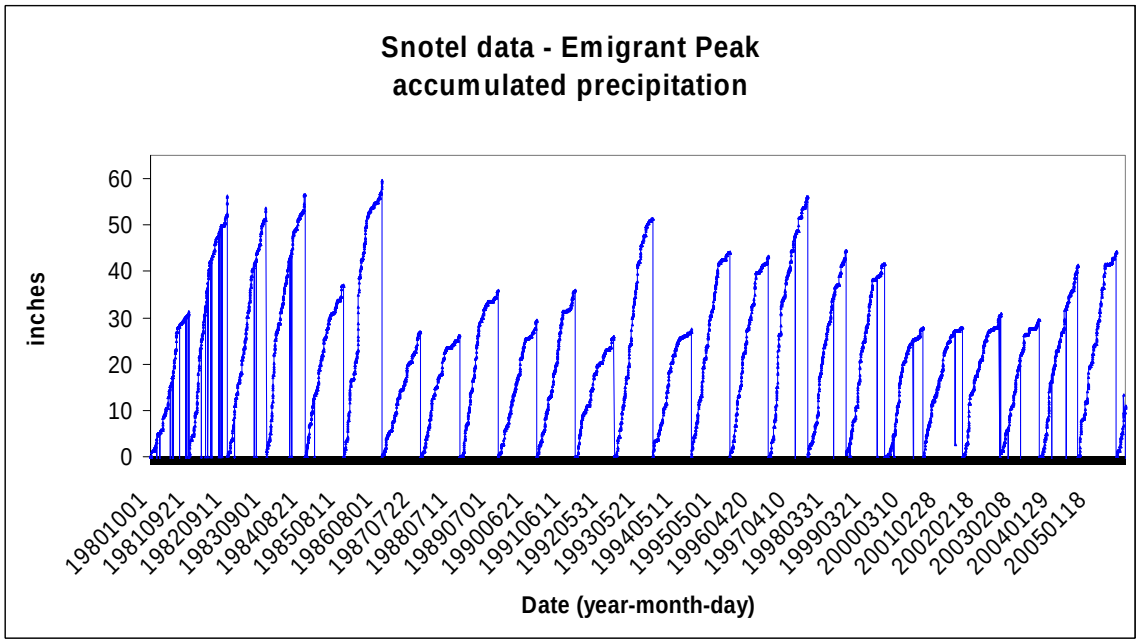
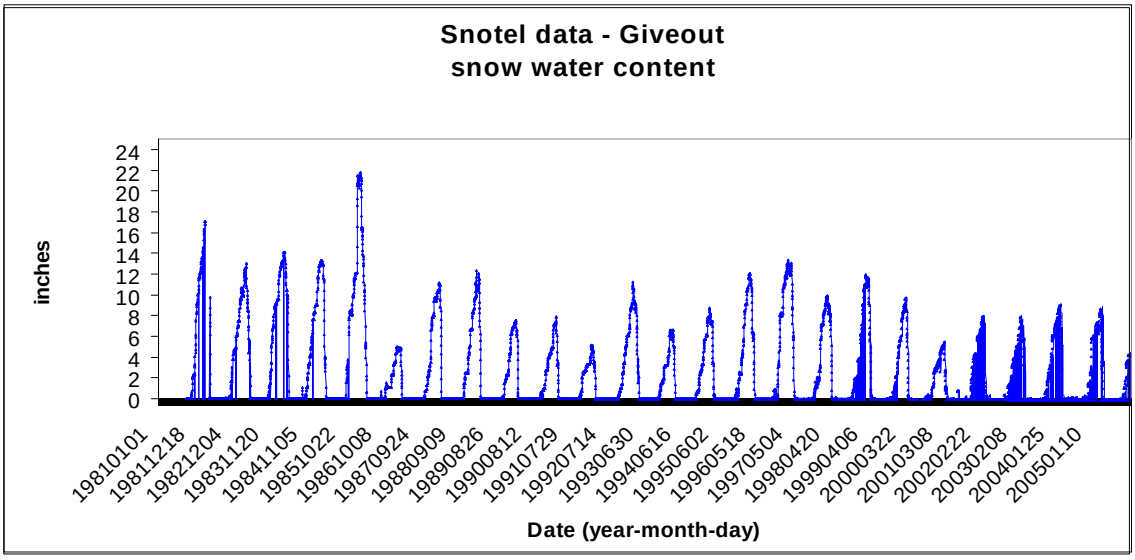
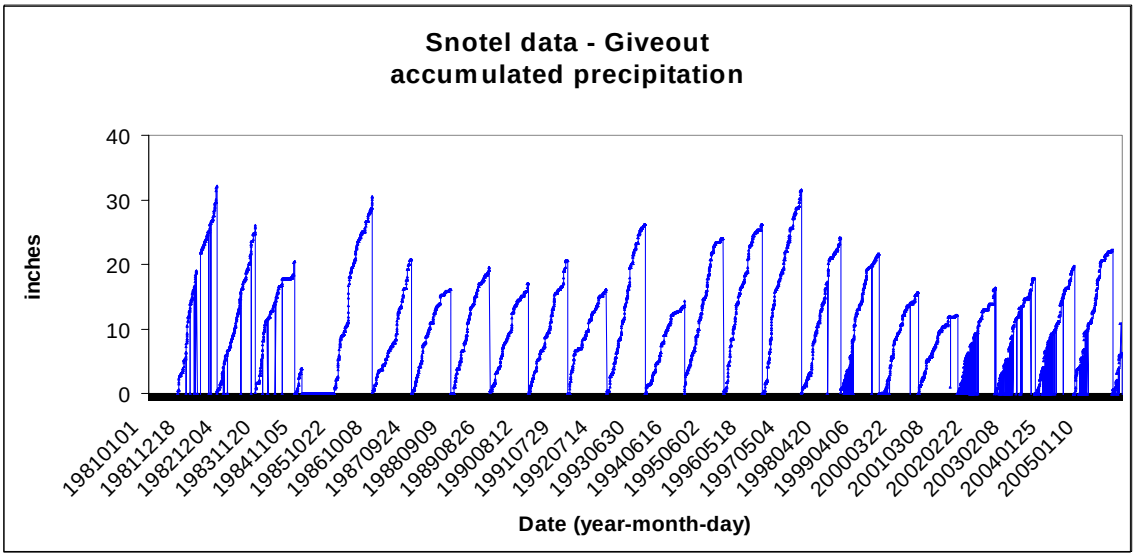


Figure 8. Snotel station data for Giveout.





Results obtained through this year's sampling effort indicate higher concentrations of metals, likely resulting from increased runoff and sampling occurring close to the runoff peak. However, given that prediction of spring runoff flow magnitude based on snotel site data is presently unreliable, sampling to monitor selenium/metal concentrations under a variety of spring flow conditions should continue on an annual basis.

Study sites in 2006 will include those sampled in 2005. Additional sites recommended for sampling are Crow, Deer, and Sage creeks in the Salt River drainage. If funding permits, selenium sample analyses should be further differentiated into selenate and selenite components to determine their relative contributions to selenium concentrations at study sites.

LITERATURE CITED

APHA 1998. "Standard Methods for Examination of Water and Wastewater." 20th ed., American Public Health Association, Washington D.C. (1998).

IDEQ 2004. 2004 Area wide TMDL baseline sampling report. Prepared by IDEQ. March 2005.

Tetra Tech EM Inc. (TtEMI). 2001. Final Sampling and Analysis Plan—Baseline Water Quality Assessment Selenium Project. Prepared for the IDEQ. May 2001.

TtEMI. 2002. Final 2001 TMDL Baseline Monitoring Report. Prepared for the IDEQ. April 2002.

TtEMI. 2003. 2003 TMDL Baseline Monitoring Sampling and Analysis Plan Addendum. Prepared for the IDEQ. May 2003.

TtEMI. 2004. Supplement to 2001 Total Maximum Daily Load Baseline Monitoring Report Prepared for the IDEQ. January 2004.

APPENDIX A