IDAHO MINING ASSOCIATION
SELENIUM SUBCOMMITTEE

Final
1998 Regional Investigation Report

Southeast Idaho
Phosphate Resource Area
Selenium Project

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Prepared by:

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LIST OF ACRONYMS

ADI	average daily intake
BIA	United States Department of Interior, Bureau of Indian Affairs
BLM	United States Department of Interior, Bureau of Land Management
BMP	best management practice
BW	body weight
CC	chronic criterion
CCC	criterion continuous concentration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
COPC	chemical of potential ecological concern
CSM	conceptual site model
CWBS	cold water biota standard
D	dose
EF	exposure frequency
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
EQH	environmental hazard quotient
FDA	Food and Drug Administration
FCV	Final Chronic Value
FSP	Field Sampling Plan
ft^2	square feet
g	gram
GIS	geographic information system
GPS	global positioning system
HI	Hazard Index
HQ	hazard quotient
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDEQ	Idaho Division of Environmental Quality
IMA	Idaho Mining Association
kg	kilogram
LOAEL	lowest-observable-adverse-effect-level
MCL	maximum contaminant level
mgd	million gallons per day
mg/d	milligrams per day
mg/kg	milligrams per kilogram: parts per million
mg/ kg·d	milligrams per kilogram·day
mg/l	milligrams per liter: parts per million
mi^2	square mile
MIS	Management Indicator Species
ml	milliliter
MSL	mean sea level
MW	Montgomery Watson
NAWQC	National Ambient Water Quality Criteria
NCHS	National Center for Health Statistics

LIST OF ACRONYMS
(continued)

NOAEL	no-observable-adverse-effect-level
QAPP	Quality Assurance Project Plan
RDA	recommended daily allowance
RfD	reference dose
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SUF	skin utilization factor
T	toxicity
TL	trophic level
TRV	toxicity reference value
UCL	upper confidence limit
USDA	United States Department of Agriculture
USFS	United States Department of Agriculture, Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTB	upper tolerance bound
μS/cm	micro-Siemens per centimeter
UCL	Upper Confidence Limit

EXECUTIVE SUMMARY

The Idaho Mining Association (IMA) is investigating the occurrence and potential release of metals associated with phosphate mining activities in the Southeast Idaho Phosphate Resource Area (Resource Area). The *1998 Regional Investigation Report* (1998 Report) presents results of sampling and analysis conducted during 1998 by the IMA Selenium Subcommittee. The following media were sampled in 1998:

- Surface water
- Sediment
- Groundwater
- Soil
- Vegetation
- Trout flesh

Samples were analyzed for the following six target elements:

- Selenium
- Cadmium
- Manganese
- Nickel
- Vanadium
- Zinc

Results of these analyses were compared with regulatory criteria (surface water and groundwater) and background conditions to determine if any of the sampled media contained concentrations of target elements that may have an adverse impact on the Resource Area. These data were also used to develop preliminary human health and ecological risk assessments.

The Selenium Subcommittee, a voluntary ad hoc committee of the IMA, was formed in early spring, 1997. The Selenium Subcommittee was tasked to identify the origin and environmental characteristics of selenium and other metals found in phosphate-mining waste rock in the Resource Area. In addition to identifying the environmental characteristics, the Selenium Subcommittee is developing mitigation measures to address selenium and other target element releases and minimize the potential threat to the environment. The IMA Selenium Subcommittee consists of the following five companies currently mining or who have recently mined phosphate ore in the Resource Area.

- FMC Corporation
- J.R. Simplot Company
- Nu-West Industries, Inc. and Nu-West Mining, Inc. (Nu-West)
- Rhodia, Inc.
- P4 Production LLC (a joint venture between Monsanto Inc. and Solutia Inc., the operating partner)

These companies, or their predecessors owned, leased, or operated four active and ten inactive mines included in the Southeast Idaho Phosphate Resource Area Selenium Project (Selenium Project). The fourteen mines are identified in the following table. The Selenium Subcommittee is addressing selenium and other target element releases at these fourteen mines and their associated lands and waters through implementation of a comprehensive sampling and analyses program and development of best management practices (BMPs).

SOUTHEAST IDAHO PHOSPHATE RESOURCE AREA PHOSPHATE MINES		
Company	**Mines**	
	Active	**Inactive**
FMC Corporation	Dry Valley Mine	Gay Mine[1]
J. R. Simplot Company	Smoky Canyon Mine	Lanes Creek Mine Conda Mine Gay Mine[1]
Nu-West Mining, Inc.	Rasmussen Ridge Mine[2]	Mountain Fuel Mine Champ Mine North Maybe Mine Georgetown Canyon Mine
P4 Production LLC[3]	Enoch Valley Mine	Henry Mine Ballard Mine
Rhodia Inc.[4]		Wooley Valley Mine

Notes:
1. Responsibility for Gay Mine is shared between the FMC Corporation and J. R. Simplot Company.
2. Rasmussen Ridge Mine is currently leased by Nu-West Industries, Inc., an affiliated company of Nu-West Mining, Inc.
3. P4 Production LLC is a joint venture between Monsanto Company and Solutia Inc. Solutia Inc. is the operating partner.
4. Rhodia does not have an active mine.

The Selenium Project, which was initiated in the spring of 1997 and is currently funded by the Selenium Subcommittee, is being conducted with the assistance and participation of the Interagency/Phosphate Industry Selenium Working Group (Selenium Working Group). The Selenium Working Group is comprised of the Selenium Subcommittee member companies and the following cooperating federal, state, local, and tribal agencies:

- United States Forest Service (USFS)
- United States Bureau of Land Management (BLM)
- Idaho Division of Environmental Quality (IDEQ)
- Idaho Department of Lands (IDL)
- Idaho Department of Fish and Game (IDFG)
- United States Bureau of Indian Affairs (BIA)
- United States Fish and Wildlife Service (USFWS)
- United States Environmental Protection Agency (EPA)
- United States Geological Survey (USGS)
- Idaho Division of Health
- Southeastern District Health Department
- Shoshone-Bannock Tribes

The Selenium Subcommittee has implemented a phased approach for characterizing potential impacts from phosphate-mining activities. Preliminary investigations of surface water and reclaimed waste rock dump vegetation and soils were conducted during 1997. The primary objective was to assess surface water quality at select locations to evaluate the extent and magnitude of selenium concentrations in area surface waters. Results of the sampling event were reported in the *Fall 1997 Interim Surface Water Survey Report* (Montgomery Watson [MW], 1998a).

Results from the evaluation of the 1997 data were used to design the 1998 Regional Investigation. Three general objectives for the 1998 Regional Investigation were developed.

1. To characterize the extent and magnitude of selenium and other target element releases from phosphate mine waste rock in a broad range of environmental media including surface water, sediments, groundwater, soil and vegetation.

2. To characterize the threat of releases from waste rock chemical constituents, including selenium and the other target elements, to human health, livestock and aquatic and mammalian wildlife.

3. To initiate a Management Study to develop and identify BMPs for mitigating potential releases of selenium or other target elements associated with historic, current, and future phosphate mine facilities.

The 1998 Report presents results of the first two regional investigation objectives. Results from the Management Study will be presented in a separate series of reports.

The 1998 investigation examined the characteristics of the extent and magnitude of the six target elements in surface water, sediments, groundwater, soil, vegetation, and trout flesh. Inventories of potential stream monitoring locations and mine facilities were compiled and used to develop a high-quality and cost-effective sampling program. Seventy-eight surface water and 20 groundwater monitoring stations were sampled in May and September. Surface water sampling was conducted at streams, waste rock dump seeps, french drains, tailing ponds and stock ponds. Samples were analyzed for major cations, anions and target elements. Field water quality measurements were also collected at each site. Sediment samples were collected in September at the stream, waste rock dump seep and stock pond monitoring stations. Three stream locations were also sampled in September for trout.

Laboratory analyses indicate that selenium was generally the only COPC that exceeded aquatic cold-water criteria in surface water samples. Selenium concentrations in mine facility samples were typically greater than the criterion. Twelve stream samples collected in May had selenium concentrations that were elevated above the criterion. Ten samples were collected in the upper Blackfoot River watershed; one was collected from Georgetown Creek and one from North Fork Sage Creek. The only stream sample in September with a selenium concentration greater than the criterion was collected from East Mill Creek. Groundwater sample results indicate that constituent concentrations in the groundwater were generally less than the drinking water numeric criteria.

Target element concentrations in sediment samples collected from streams were generally not elevated above background conditions. The sediment samples that had elevated concentrations were typically located immediately downstream of a mine facility. Mine facilities generally did have COPC concentrations greater than background values.

Soils and vegetation were sampled from 65 stations in July. Forty-five samples of both media were collected from waste rock dumps and five samples were collected adjacent to dump seeps. Fifteen soil and vegetation samples were collected at three background locations.

There are no promulgated standards for soil or vegetation. Consequently, target element concentrations were compared against background values. In general, target element concentrations in waste rock dump and seep soils were elevated above background values. The mean selenium concentration in soils was approximately 14 times greater than the mean background concentration. The mean cadmium, manganese, vanadium and zinc concentrations ranged from two to four times greater than their corresponding background mean values. Nickel was the only COPC with a soil mean concentration less than the background value. Target element concentrations in vegetation were also generally elevated against background values. Forty-one of 50 waste rock dump and seep vegetation samples had selenium concentrations greater than the background concentration. The mean selenium concentration in waste rock vegetation was approximately two orders of magnitude greater than the mean background selenium concentration. Nickel and zinc vegetation concentrations were also typically higher than the background values. The mean concentrations were six and two times greater, respectively, then the corresponding background vegetation concentrations. Cadmium and manganese concentrations were typically less than the background concentrations.

A preliminary, risk-based screening process was used to identify the contaminants of potential concern (COPC). The screening process was focused on ecological risk because the Selenium Working Group originally assumed, during the planning process for the 1998 investigation, that there was only an ecological risk associated with potential impacts from the phosphate mining activities. However, concerns were later raised that there was also potential human health risk attributable to phosphate mining. The human health Copes were screened by comparing observed concentrations of the six target elements in surface water and soil against EPA Region 9 preliminary remediation goal (PRG) levels. There were no observed waste rock dump soil concentrations of any of the six COPCs greater than their respective soil PRG. All concentrations were significantly less than their respective benchmark. Selenium and cadmium were the only COPCs with concentrations that exceeded their respective tap water PRGs.

The data collected during the 1998 investigation were used to develop preliminary human health and ecological risk assessments. The concern of potential human health risks resulted in a risk assessment that included a fish ingestion and beef ingestion scenario. The two scenarios were combined to allow for an overall evaluation. The preliminary human health conceptual model is:

- Substance of interest: selenium
- Receptor of interest: a randomly selected adult resident of the region who is a recreational fisherman who fishes downstream of phosphate mines and consumes his catch; is someone who consumes beef grazed on waste rock dumps; and, is sensitive to selenium
- Exposure pathway of interest: background dietary ingestion, multi-vitamin or mineral supplements ingestion, seleniferous fish ingestion and seleniferous beef ingestion.

Both a deterministic and probabilistic risk assessments were conducted. A hazard quotient (HQ) greater than 1.0 indicates that there is a potential for risk and that there is a basis for requiring site remediation. The deterministic estimate of risk is 1.71. However, the probabilistic assessment demonstrates that this value is an overly conservation estimate based on the 99.98th percentile of the risk estimate distribution. The 95th percentile of the estimate is 0.53.

The preliminary ecological risk assessment indicates receptor species could potentially be adversely affected by phosphate mining activities. For trout, the preliminary assessment indicates that the greatest potential for impacts are associated with selenium concentrations similar to those measured in East Mill Creek. The common snipe is the aquatic/riparian indicator species that displays the highest potential for adverse affects. Muskrat and red-winged blackbirds may be susceptible to adverse affects, especially when exposed to selenium concentrations similar to what was measured in area stock ponds and East Mill Creek. Mallard duck and moose do not appear to be adversely impacted by phosphate mining activities. However, there may be a potential for adverse impacts to sheep, horses and cattle exposed to waste rock dump soil and vegetation.

The preliminary assessments are subject to refinement based upon new data generated by the interim 1999 and 1999-2000 regional investigation activities and upon comments received from Selenium Working Group participants. Therefore, one should be cautious about drawing conclusions based upon the results of the preliminary effort. However, the data do indicate that there is no substantial and immediate risk to either human or ecological health.

Section 1

1.0 INTRODUCTION

Montgomery Watson (MW) is under contract to the Idaho Mining Association (IMA) to investigate the occurrence and potential release of metals associated with phosphate mining activities in the Southeast Idaho Phosphate Resource Area (Resource Area). Sampling and analysis activities have been ongoing since 1997. Results of sampling and analysis conducted in 1997 are presented in the report, *Fall 1997 Interim Surface Water Survey Report* (MW, 1998a). The *1998 Regional Investigation Report* (1998 Report) presents results of all sampling and analysis conducted on behalf of IMA during 1998. The following media were sampled in 1998:

- Surface water
- Sediment
- Groundwater
- Soil
- Vegetation
- Trout flesh

Samples were analyzed for the following six target elements:

- Selenium
- Cadmium
- Manganese
- Nickel
- Vanadium
- Zinc

Results of these analyses were compared with applicable regulatory criteria (surface water and groundwater) and background conditions to determine if any of the sampled media contained concentrations of target elements that may have an adverse impact on the Resource Area. These data were also used to develop preliminary risk assessment measures for human and environmental receptors. Data presented in this report were generated using protocols presented in the *Southeast Idaho Phosphate Resource Area Selenium Project 1998 Regional Investigation Sampling and Analysis Plan* (1998 SAP, [MW, 1998b]).

The 1998 Report is organized into the following seven sections:

- **Section 1 - Introduction.**
  This section presents the report organization, provides project background, identifies the members of the Idaho Mining Association Selenium Subcommittee and Interagency/Phosphate Industry Selenium Working Group and outlines objectives of the 1998 Report.

- **Section 2 - Project Area Physical Characterization.**
  This section characterizes the Resource Area physical environment.

- **Section 3 - Methodology.**
  This section identifies sample locations, presents the collection methods, data validation procedures, describes the screening criteria used to identify the contaminants of potential concern (COPC) and the methodology used for evaluating sampling results.

- **Section 4 - 1998 Sampling Results.**
  This section presents data from surface water, sediment, groundwater, soil, vegetation and trout sampling. These data are compared against applicable numeric standards and background conditions to assess if concentrations are elevated. In addition, seasonal and spatial trends in the data are evaluated.

- **Section 5 - Preliminary Risk Assessment.**
  This section summarizes results of the preliminary human health and ecological risk assessments.

- **Section 6 - Considerations for Future Data-Collection Activities.**
  This section describes future investigations that could be conducted to refine target element characterization and potential threats to human health and the environment.

- **Section 7 - References.**
  This section lists references utilized in the 1998 Report.

1.1 PROJECT BACKGROUND

In late 1996, six horses pastured downstream of a historic phosphate mine were diagnosed with chronic selenosis. Selenosis is an adverse health condition caused by ingesting excess levels of selenium. In the summer of 1997, additional horses pastured on a second phosphate-mine property were also diagnosed with selenosis. These events prompted concern about potential selenium releases to the environment from phosphate-mining activities and a corresponding threat to human health and the environment.

The Selenium Subcommittee, a voluntary ad hoc committee of the IMA, was formed in early spring, 1997. The Selenium Subcommittee was tasked to identify the origin and environmental characteristics of selenium and other metals found in phosphate-mining waste rock in the Resource Area. In addition to identifying the environmental characteristics, the Selenium Subcommittee is developing mitigation measures to address selenium and other target element releases and minimize the potential threat to the environment. The IMA Selenium Subcommittee consists of the following five companies currently mining or who have recently mined phosphate ore in the Resource Area.

- FMC Corporation
- J.R. Simplot Company
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- Rhodia, Inc.
- P4 Production LLC (a joint venture between Monsanto Inc. and Solutia Inc., the operating partner)

These companies and their respective active and inactive mines are identified in Table 1-1, *Phosphate Mines in the Southeast Idaho Phosphate Resource Area*. These companies, or their predecessors owned, leased, or operated four active and ten inactive mines included in the Southeast Idaho Phosphate Resource Area Selenium Project (Selenium Project). The locations of these mines are shown on Figure 1-1, *Southeast Idaho Selenium Project Study Area*. The Selenium Subcommittee is addressing the selenium concern at these fourteen mines and their associated lands and waters through implementation of a comprehensive sampling and analyses program and development of best management practices (BMPs) to control, reduce or manage the release of elevated concentrations of target elements.

TABLE 1-1 PHOSPHATE MINES IN THE SOUTHEAST IDAHO PHOSPHATE RESOURCE AREA SELENIUM PROJECT		
Company	**Mines**	
	Active	**Inactive**
FMC Corporation	Dry Valley Mine	Gay Mine[1]
J. R. Simplot Company	Smoky Canyon Mine	Lanes Creek Mine Conda Mine Gay Mine[1]
Nu-West Mining, Inc.	Rasmussen Ridge Mine[2]	Mountain Fuel Mine Champ Mine North Maybe Mine Georgetown Canyon Mine
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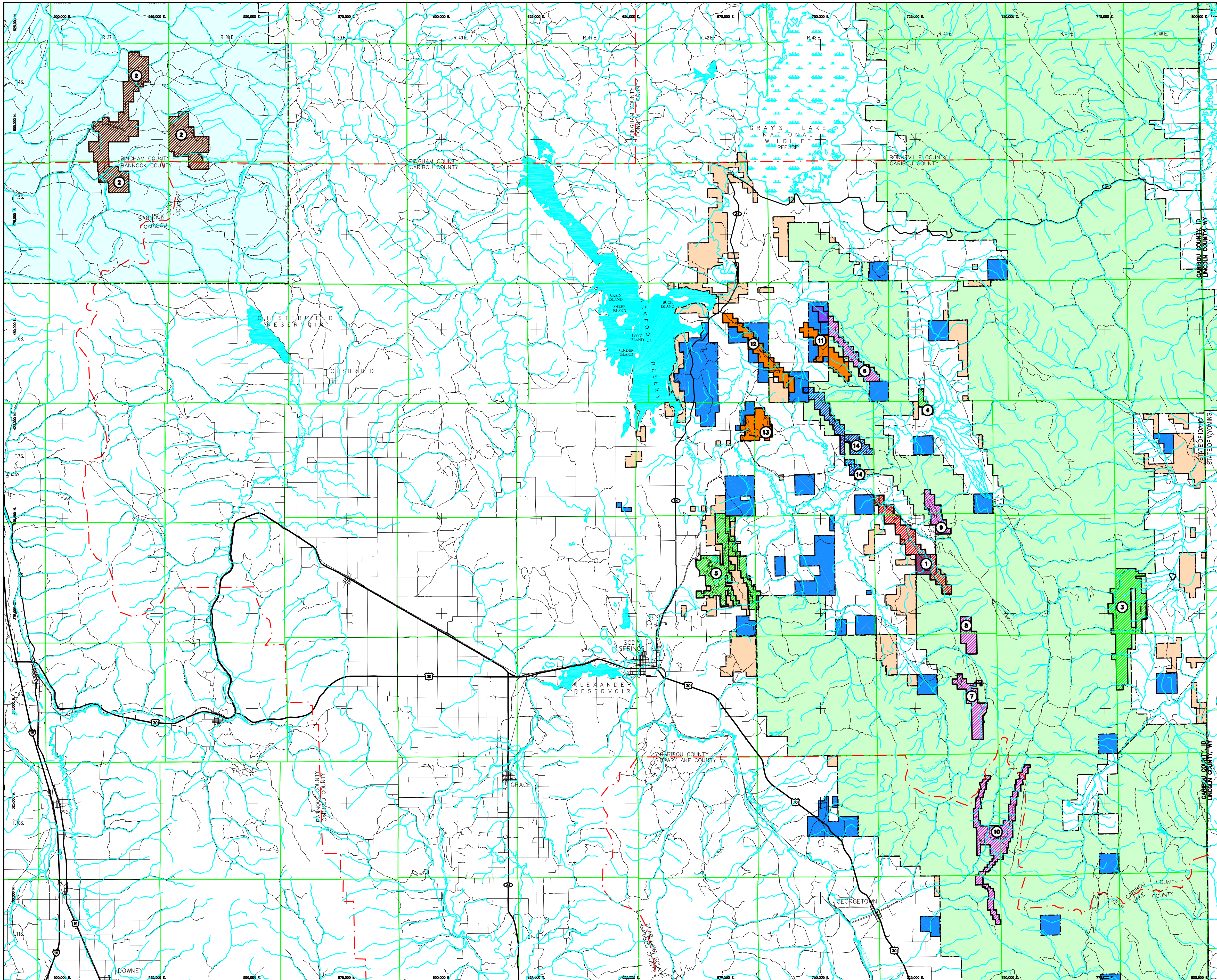
- United States Bureau of Land Management (BLM)
- Idaho Division of Environmental Quality (IDEQ)
- Idaho Department of Lands (IDL)
- Idaho Department of Fish and Game (IDFG)
- United States Bureau of Indian Affairs (BIA)
- United States Fish and Wildlife Service (USFWS)
- United States Environmental Protection Agency (EPA)
- United States Geological Survey (USGS)
- Idaho Division of Health
- Southeastern District Health Department
- Shoshone-Bannock Tribes

The Selenium Subcommittee has retained technical and communications consultants to assist in fulfilling its mission. MW, an environmental technology firm, was hired in April 1997 to assist in the planning and implementation of various investigations and engineering evaluations. MW has contracted technical experts in the areas of selenium biogeochemistry, veterinary toxicology, aquatic ecology, fish nutrition, and ornithology from the University of Idaho to assist in the investigation. The University of Idaho and the University of California at Davis are providing state-of-the-art analytical laboratory services. The Selenium Subcommittee has also retained local technical communications experts in agricultural science and veterinary medicine to assist in the preparation of public education materials and in the organization of public education events. Selenium Working Group member agencies are also actively involved in the Selenium Project in various ways ranging



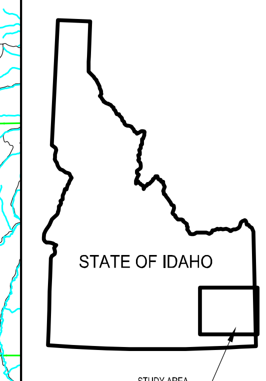
LEGEND

	CONTOURS		ROADS
	CREEKS/RIVERS		RAILROAD
	LAKES		STATE LINE
	MARSH		COUNTY LINE

- NATIONAL FOREST
- BUREAU OF LAND MANAGEMENT
- STATE OF IDAHO
- FORT HALL INDIAN RESERVATION

- ASTARIS PRODUCTION LLC
- FMC CORPORATION AND J.R. SIMPLOT COMPANY
- J.R. SIMPLOT COMPANY
- NU-WEST MINING, INC. OR NU-WEST INDUSTRIES, INC.
- MONSANTO COMPANY
- RHODIA INC.

1	DRY VALLEY MINE	8	CHAMP MINE
2	GAY MINE	9	NORTH MAYBE MINE
3	SMOKY CANYON MINE	10	GEORGETOWN CANYON MINE
4	LANES CREEK MINE	11	ENOCH VALLEY MINE
5	CONDA MINE	12	HENRY MINE
6	RASMUSSEN RIDGE MINE	13	BALLARD MINE
7	MOUNTAIN FUEL MINE	14	WOOLEY VALLEY MINE



MAP KEY

SCALE

12,000' 0 12,000' 24,000'

CONTOUR INTERVAL NA

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued for Draft	12/15/99	J.Weinman	K.Conrath	J.Weinman

IDAHO MINING ASSOCIATION SELENIUM COMMITTEE

PROJECT: 1998 REGIONAL INVESTIGATION REPORT

DRAWING TITLE: SELENIUM PROJECT PHOSPHATE MINES

MONTGOMERY WATSON

Sheet 1 Of 1 Sheets

SCALE: As Shown

DRAWING No. 1-1

AutoCAD FILE: IS-Fig1-1.dwg

PROJECT NUMBER: 1227028.021803

from providing planning, permitting, and technical support to conducting separate, but related studies.

The Selenium Subcommittee has implemented a phased approach for characterizing potential impacts from phosphate-mining activities. Preliminary investigations of surface water and reclaimed waste rock dump vegetation and soils were conducted during 1997. Surface water sampling was conducted in September 1997. Streams downstream of active and historic mining operations were sampled. Mine facility surface waters including mine pit ponds, french drains, waste rock dump seeps, stock ponds, dewatering ponds, and tailings ponds were also sampled. Background locations, streams that are representative of natural conditions, were also identified and sampled. The primary objective of the surface water sampling was to assess surface water quality at select locations to evaluate the extent and magnitude of selenium concentrations in area surface waters. Results of the sampling event were reported in the *Fall 1997 Interim Surface Water Survey Report* (MW, 1998a). Conclusions from this report are summarized below.

- Observed selenium concentrations in surface water ranged from less than the validation-corrected detection limit of 0.00074 milligrams per liter (mg/l; parts per million[ppm]) to 1.55 mg/l. The magnitude of these results are within the range of observations previously documented by or reported to the USFS.

- Selenium concentrations above background values were detected in surface waters directly associated with phosphate-mining activities in the Resource Area. Several monitoring stations had selenium concentrations in excess of 0.05 mg/l, the upper range of a veterinary "advisory level" for livestock drinking water (Howard, 1986). Two stations had concentrations in excess of 0.5 mg/l, the lower range known to cause chronic selenosis in certain mammals (Eisler, 1985).

- The sampling results indicated that water bodies supporting sport fishery populations (Blackfoot River, Lincoln Creek, Little Blackfoot River, North Sage Creek, Ross Fork, Slug Creek, and Spring Creek) were not adversely impacted. The selenium concentrations in these waters were less than the State of Idaho's aquatic cold-water quality standard of 0.005 mg/l. The IDEQ standard was adopted from the EPA's criterion for chronic exposures. East Mill Creek, a known spawning stream, had a reported selenium concentration of 0.0336 mg/l. This concentration is greater than EPA's acute cold-water quality standard of 0.020 mg/l.

During the fall of 1997, vegetation samples were also collected from Conda Mine waste rock dumps and nearby undisturbed sites. The samples were collected to investigate if two 1997 animal kills in the vicinity of the Conda Mine were related to selenosis. Evaluation of the vegetation data resulted in the following conclusions (MW, 1997).

- The observed selenium levels in vegetation collected from Conda Mine sample stations ranged from 0.5 to 50 milligrams per kilogram (mg/kg; parts per million) on a dry-weight basis.

- Vegetation collected from overburden dump stations had elevated selenium levels in comparison to vegetation collected from the former Conda town site and the Caldwell Creek background area. Selenium levels in vegetation collected from three stations located on overburden dumps were greater than 3-8 mg/kg on a dry-weight basis, which is a preliminary risk-based benchmark for the potential of inducing chronic selenosis in livestock. (James et al., 1991)

- Selenium concentrations in vegetation at the Conda Mine, while elevated above background, appear to be below those capable of causing acute selenosis. Shamberger (1986) reported that selenium values greater than 10,000 mg/kg (dry-weight) can cause acute selenosis in livestock.

1.2 1998 REGIONAL INVESTIGATION OBJECTIVES

Results from the evaluation of the 1997 data were used to design the 1998 Regional Investigation. Three general objectives for the 1998 Regional Investigation were developed (MW, 1998b).

4. To characterize the extent and magnitude of selenium and other target element releases from phosphate mine waste rock in a broad range of environmental media including surface water, sediments, groundwater, soil and vegetation.

5. To characterize the threat of releases from waste rock chemical constituents, including selenium and the other target elements, to human health, livestock and aquatic and mammalian wildlife.

6. To initiate a Management Study to develop and identify BMPs for mitigating potential releases of selenium or other target elements associated with historic, current, and future phosphate mine facilities.

This report presents results of the first two regional investigation objectives. Results from the Management Study will be presented in a separate series of reports.

A preliminary, risk-based screening process was used to identify the target elements (MW, 1998b). The characteristics of the extent and magnitude of the six target elements were investigated in a broad range of environmental media including surface water, sediment, groundwater, soil, and vegetation. Inventories of potential stream monitoring sites and mine facilities were completed to identify potential sampling locations. More than 200 potential stream monitoring stations and over 200 mine facilities were identified. The inventory was used to develop a high-quality and cost-effective sampling design.

Following implementation of the 1998 Regional Investigation, an additional concern was identified regarding human health impacts from ingesting Resource Area fish. An addendum outlining a cutthroat trout survey was prepared and a preliminary cutthroat trout investigation was conducted concurrent with the September 1998 water monitoring event to collect fish flesh data to assess potential human health threats.

Table 1-2, *1998 Regional Investigation Characterization Objectives*, presents the characterization objectives and describes the environmental media evaluated during the 1998 investigation. This table also identifies the comparative criteria used to evaluate target element data and refers to other sections in this report where methodologies and results are described.

TABLE 1-2
1998 REGIONAL INVESTIGATION CHARACTERIZATION OBJECTIVES

Objective	Environmental Median	Comparative Criteria	Methodology	Results
Collect high quality defensible data useful for risk assessments	Surface water sediment, groundwater, soil, vegetation, trout	Data validation process	Section 3.3	Section 3.3
Characterize background concentrations of target elements	Surface water, sediment, soil, vegetation	Summary statistics	Section 3.5	Surface Water: Section 4.1.2.1 Sediment: Section 4.2.1.1 Soil: Section 4.4.1.1 Vegetation: Section 4.5.1.1
Characterize extent and magnitude of target element concentrations in the Resource Area	Surface water and groundwater	Maximum Contamination Level (MCL)[1]; aquatic cold-water numeric criterion[2]	Section 3.5	Surface Water: Section 4.1.2 Groundwater: Section 4.3
	Sediments, soil and vegetation	Upper confidence limit (UCL)[3]	Section 3.5	Sediment: Section 4.2.2 Soil: Section 4.4 Vegetation: Section 4.5
	Cutthroat trout	Toxic effects	Section 3.5	Section 4.6
Evaluate potential threat of human health and environment from target element releases	Human health, Cattle, terrestrial wildlife (ungulates, waterfowl, shore birds, marsh-dwelling passerines, and semi-aquatic mammals), and aquatic wildlife (cutthroat trout).	Risk Assessment	Section 3.5	Appendix H

Notes:
1. MCL is the maximum permissible level of a contaminant in water which is delivered to a user of a public water system (EPA, 1994a). These values only apply to groundwater.
2. Aquatic cold-water numeric criteria only applies to surface water.
3. The UCL represents a 95 percent confidence limit on the 95th percentile of the background data.

Section 2

2.0 PROJECT AREA PHYSICAL CHARACTERIZATION

2.1 LOCATION

The 14 former and active mines listed in Table 1-1 lie within a 1,200 square mile area in Caribou, Bingham, Bannock, and Bear Lake counties in southeastern Idaho (Fig. 1-1). Based on variations in relief (increasing from west to east), climate (wetter from west to east), and ore chemistry (phosphorus and trace element contents), the Resource Area has been delineated into three districts. Mines and leases in each district are listed below:

- *Western district* - Gay Mine on the Fort Hall Indian Reservation and phosphate ore lease areas west of the Blackfoot Reservoir.
- *Central district* - the Ballard, Champ, Conda, Dry Valley, Enoch Valley, Georgetown Canyon, Henry, Lanes Creek, Mountain Fuel, North Maybe, Rasmussen Ridge and Wooley Valley Mines and the Dairy Syncline lease tract.
- *Eastern district* - the Smoky Canyon Mine and associated leases (Manning Creek tract), and the Diamond Creek phosphate lease.

2.2 PHYSIOGRAPHY

The project area is characterized by north- and northwest-trending mountain ranges and valleys, typical of Basin and Range physiography. Elevations range from 4,528 feet above mean sea level (MSL) near the Gay Mine to 9,957 feet above MSL on Meade Peak, which is located immediately to the east of the Georgetown Canyon Mine. Local relief of 1,000 to 2,000 feet is common in the central and eastern districts while relief in the western district is typically less than 1,000 feet.

2.3 CLIMATE

The climate of southeastern Idaho is a function of topography, which in turn influences wind patterns, temperature and precipitation. North-to-south trending mountain ranges west of the region create a natural barrier for water-saturated Pacific air masses. This rainshadow effect causes the Snake River Plain region to be semiarid, with a middle-latitude steppe climate. The southeastern portion of the project area tends to be wetter and cooler than other areas due to increasing elevations. Summers are dry with temperatures ranging from warm to hot. Winters are cool to cold.

The fall and winter climates are dominated by cold, dry continental air masses and by cyclonic storms. Precipitation during the cooler months is generally in the form of snow. Springtime precipitation is typically due to cool marine air flowing in from the south. Precipitation in the summer is primarily associated with localized, orographic thunderstorms. Average precipitation increases in an easterly direction. The average precipitation in the western district is approximately 12 inches per year. In the central and eastern districts precipitation ranges from 25 to 35 inches per year, with the heaviest precipitation occurring as winter snow and spring rain.

2.4 GEOLOGY

The project area lies within the northern region of the Basin and Range Physiographic province. The region is characterized by linear, north-trending, fault bounded ranges and basins created by extensional tectonism initiated during the last 10 – 20 million years. Ranges in southeastern Idaho are generally composed of deformed Paleozoic and Mesozoic sedimentary rocks, including thick marine clastic units, cherts and limestones. The valleys are largely in-filled with Quaternary alluvium and colluvium that overlie Pleistocene basalt flows. Thick rhyolite flows of the Snake River Plain region and rhyolite domes south of the Blackfoot Reservoir comprise most of the remaining volcanic sequences in the region.

Massive accumulations of marine sediment occurred during the Paleozoic era over a large area of eastern Idaho, southwestern Montana, northern Utah, and western Idaho. During Permian time the Phosphoria Formation was deposited, forming the western phosphate field, part of which is located in the southeastern Idaho phosphate resource area.

2.4.1 Stratigraphy of Ore-Bearing Units

Generally, mining activities disturb four principal rock units in the project area. The stratigraphy, approximate ages and a description of each unit is described in Table 2-1, *Generalized Stratigraphic Setting of Project Area*.

TABLE 2-1
GENERALIZED STRATIGRAPHIC SETTING OF PROJECT AREA[1]

Unit Name	Age	Description
Dinwoody Formation	Triassic	Interbedded claystone, limestone, and siltstone; ranges from 1,000 to 2,000 feet thick in project area
Phosphoria Formation	Permian	Composed of cherty mudstone, phosphatic mudstone, chert, phosphorite, limestone, and dolomite; phosphorite is the source of phosphate ore and is typically found in the lowermost portion of the formation.
Grandeur Limestone	Permian Pennsylvanian	Massive limestone that is discontinuous in the project area
Wells Formation	Pennsylvanian	Fine to very fine grain quartzitic to calcareous sandstone; approximately 1,500 to 2,000 feet thick in the project area.

Notes: 1. By convention, units are presented from top to bottom as youngest to oldest.

Along the eastern edge of the project area, the Phosphoria Formation corresponds to an ancient ocean shelf area and is more calcareous and less argillaceous than Phosphoria Formation outcrops to the west. A deeper water facies to the west is increasingly carbonaceous and pyritic and grades into cherts (Blatt et al., 1980). Figure 2-1, *Project Area Watersheds and Phosphoria Outcrops,* illustrates Phosphoria formation outcrops within the project area.

The Phosphoria Formation includes four members: Meade Peak Phosphatic Shale, Rex Chert, Cherty Shale, and Retort Phosphatic Shale. The Meade Peak member, which ranges in thickness from about 55 to 200 feet, is the oldest and is either overlain by the Rex Chert or the Cherty Shale. The Retort member is discontinuous and is found in the north and east parts of the investigation area (USGS and USFS, 1977).

2.4.2 Target Element Concentrations of Ore-Bearing Units

The Meade Peak member of the Phosphoria Formation is the source of most of the produced phosphate ore. Concentrations of select target metals in the Meade Peak member are significantly higher than typical concentrations found in other marine sedimentary rocks. Table 2-2, *Target Element Concentrations of the Meade Peak Phosphatic Shale Members,* compares average and maximum concentrations of the six target elements reported in Meade Peak members with continental crustal averages.

Ten historic and four operating mines are located in the region. Phosphate ore (phosphorite) is temporarily stockpiled at the mine sites prior to transport to processing mills near Soda Springs and Pocatello, Idaho, and is not considered to be a significant source of target element releases in the project area. Carbonate rock and mudstone are waste rock and are used to backfill open pits or are disposed in large waste rock dumps at each mine site. Cadmium and selenium concentrations in these waste materials have been reported as being 100 to 1,000 times greater than the averages in continental crust (USGS and USFS, 1977).

TABLE 2-2 TARGET ELEMENT CONCENTRATIONS OF THE MEADE PEAK PHOSPHATIC SHALE MEMBERS[1]							
Constituent (mg/kg)	**Phosphorite**		**Carbonate Rock**		**Mudstone**		**Continental Crust Average (mg/kg)**
	Average (mg/kg)	**Maximum (mg/kg)**	**Average (mg/kg)**	**Maximum (mg/kg)**	**Average (mg/kg)**	**Maximum (mg/kg)**	
Cadmium	90	800	40	150	50	1,000	0.2
Manganese	45	600	85	150	150	1,800	950
Nickel	100	1,000	85	300	150	500	75
Selenium	30	800	40	50	14	1,500	0.05
Vanadium	800	17,000	300	2,000	700	4,000	135
Zinc	250	4,000	200	1,500	300	10,000	70
Notes: 1. Reference: EPA, 1977, Table 1-7, page 1-52.							

2.5 SOILS AND VEGETATION

Variations in soils throughout the project area are largely dependent on topography. Soil chemistry ranges from slightly acidic to slightly alkaline. Soil depths range from a few inches along mountain slopes to over 10 feet thick in the foothills and on valley floors.

Soils in the mountainous regions tend to have loamy A and B horizons that variably grade into clay-rich horizons. The higher altitudes (6,000-9,500 feet) usually result in poorly developed soils that do not support much vegetation. The depths of these soils range from 36 inches on gentle mountain slopes to little or no soil on steep slopes. Vegetation supported by these soils include sagebrush-grass vegetation communities on the ridgetops. Sagebrush-grass-forb vegetation communities abound on south and west facing slopes, while stands of aspen and Douglas fir are common on north and east facing slopes. Erosion potential can be high depending on slope angles and vegetative cover conditions.

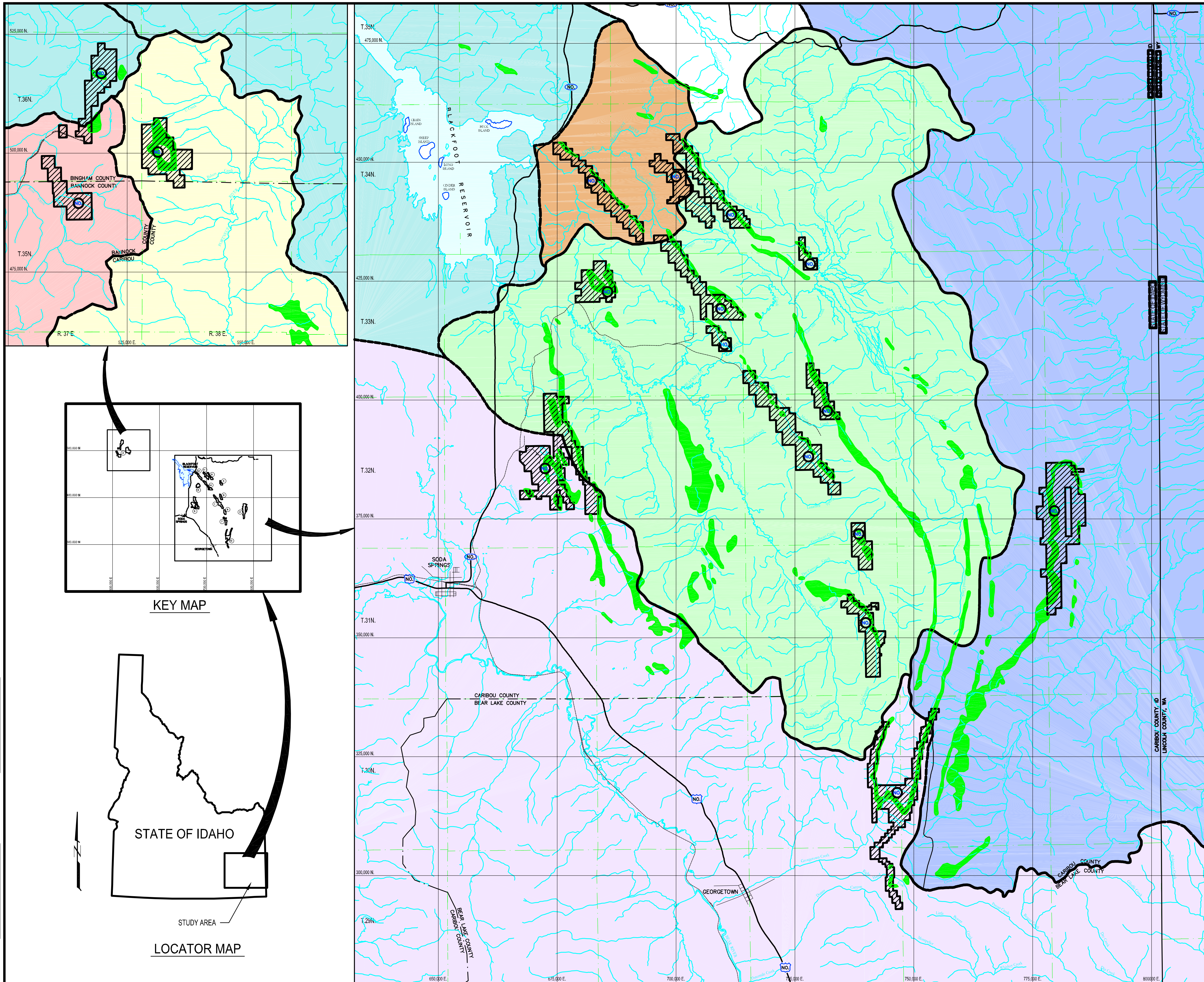
Forestland soils develop under a sub-humid forest canopy that is common in mountainous lands of the Middle Rocky Mountains. Soils are rich in organic matter and are thick and dark colored. The soil is a stony to gravelly loam. Vegetation is thicker in these areas then the mountains because of the sub-humid climate and the high organic content of the soils. Erosion potential is low. Slopes are generally considered to be moderately stable due to the greater degree of vegetation (USGS and USFS, 1977).

Soils in the foothills and valley bottoms generally consist of a loess cap deposited over a bedrock layer. The surface soils range from fine to loamy with a lighter surface color (USGS and USFS, 1977) to a brown, clay-rich silt (MW, 1996). Soils are usually more than 10 feet thick with a high vegetative-productivity potential. Erosion potential is considered low. Many of the soils are easily compacted. Vegetation can be manipulated for good to excellent forage production (USGS and USFS, 1977).

Metals and metalloids are present at background levels in project area soils. Typical concentration ranges of target elements found in soils of the western United States are presented in Table 2-3, *Target Element Concentrations in Western United States Soils*. These concentrations are consistent with national averages and ranges presented in Table 2-2.

The USGS and USFS (1977) conducted geobotanical studies as part of the *Southeastern Idaho Phosphate Resources Final Environmental Impact Statement* (FEIS). These studies indicated that the distribution and concentrations of trace elements in Western district soils was a function of distance from phosphate processing plants in Pocatello, Idaho.

Target element concentrations were elevated in the A-horizon near the processing plants and decreased to the northeast. Thirty miles from the plants, target element concentrations were relatively constant and were considered background. Trace element concentrations in soils around the Soda Springs, Idaho processing plants did not exhibit a clear trend, possibly because of the heterogenity of the soil types at the sampling locations (USGS and USFS, 1977).



LEGEND

DRAINAGE BOUNDARY
STREAMS/CREEKS/RIVERS
ROADS
STATE LINE
COUNTY LINE
RAILROAD
PHOSPHORIA OUTCROP
MINE SITE OUTLINES

MINE SITES

- DRY VALLEY MINE
- GAY MINE
- SMOKY CANYON MINE
- LANES CREEK MINE
- CONDA MINE
- RASMUSSEN RIDGE MINE
- MOUNTAIN FUEL MINE
- CHAMP MINE
- NORTH MAYBE MINE
- GEORGETOWN CANYON MINE
- ENOCH VALLEY MINE
- HENRY MINE
- BALLARD MINE
- WOOLEY VALLEY MINE

WATERSHEDS

- BEAR RIVER
- LITTLE BLACKFOOT RIVER
- LOWER BLACKFOOT RIVER
- UPPER BLACKFOOT RIVER
- PORTNEUF RIVER
- ROSS CREEK
- SALT RIVER

NOTES:
1) MAP DATA FROM USGS, IDAHO-WYOMING - SODA SPRINGS 1:100,000 TOPOGRAPHIC MAP 1982 AND USGS, IDAHO-WYOMING - PRESTON 1:100,000 TOPOGRAPHIC MAP 1983.

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0	Issued for Report	12/15/99	J.Weinman	K.Conrath	J.Weinman

IDAHO MINING ASSOCIATION SELENIUM SUBCOMMITTEE

PROJECT: 1998 REGIONAL INVESTIGATION REPORT

DRAWING TITLE: PROJECT AREA WATERSHEDS AND PHOSPHORIA OUTCROPS

MONTGOMERY WATSON

Sheet 1 Of 1 Sheets

SCALE: AS NOTED

DRAWING No. 2-1

TABLE 2-3 TARGET ELEMENT CONCENTRATIONS IN WESTERN UNITED STATES SOILS		
COPC (mg/kg)	**Mean Concentration in Soils of the Western United States[1] (mg/kg)**	**Range of Concentrations in Soils of the Western United States[1] (mg/kg)**
Cadmium	0.06[2]	0.01 - 0.7[2]
Manganese	380[1]	30 - 5,000[1]
Nickel	15[1]	<5 - 700[1]
Selenium	0.05[3]	0.006 - 80[1]
Vanadium	100[1]	20 - 500[3]
Zinc	55[1]	10 - 2,100[1]

Notes:
1. Schacklette and Boerngen (1984).
2. Worldwide values reported by Lindsay (1979).
3. Hem (1989).

2.6 WATER RESOURCES

Water resource uses in the project area include municipal supplies, industrial use, irrigation, stock watering, recreational use and power generation. Flow in area streams is significantly affected by administration. Phosphate ore extraction does not require large amounts of water. Principal minesite uses are limited to dust abatement, washing equipment and other minor needs. However, the processing plants do use significant amounts of water.

The study area includes parts of four major drainages. The Blackfoot (which includes the Little Blackfoot), Portneuf and Salt Rivers are tributaries to the Snake River, while the Bear River drains into the Great Salt Lake. These four rivers account for 90 percent of the drainage throughout the project area with the remaining 10 percent being drained by smaller tributaries to the Snake River (USGS and USFS, 1977). Figure 2-1 illustrates the major rivers and associated watersheds in the project area.

Stream base flow originates from springs in the mountain and valley areas. These springs are discharge points for ground-water systems that range from isolated alluvial aquifers in small alluviated valleys to large bedrock aquifers in lava fields or extensive sedimentary formations. Many headwater streams at higher elevations only flow during snowmelt runoff, but others are fed by large perennial springs. Groundwater recharge occurs during the snowmelt runoff season.

A study by the Idaho Water Resources Research Institute (1968) indicates that the project area yields about 1.2 million acre-feet of runoff annually. Approximately 50 percent of the water is from headwater areas within national forest lands, with approximately 90 percent of the total runoff resulting from snowmelt. Table 2-4, *Summary of Stream Flow Rates and Drainage Areas,* lists the principle drainages, flow rates and runoff rates of the project area.

TABLE 2-4 SUMMARY OF STREAM FLOW RATES AND DRAINAGE AREAS					
River Station and Period	**Drainage Area (mi^2)[1]**	**Peak Flow Cfs**	**Base Flow cfs**	**Runoff Rate**	
				Peak cfs/ mi^2	**Base cfs/ mi^2**
Bear River (#10068500), 1922-1954, 1967-1997	3,705	4,280[3]	100	1.2	0.03
Blackfoot Station (#13066000), 1975-1998	909	3,220[2]	500	3.5	0.6
Portneuf River (#13073000)	570	1,740[4]	100-200	3.0	0.2-0.4
Salt River (#13027500), 1986-1970	829	5,090[3]	160	6.1	0.2

Notes:
1. Calculated at gauging station.
2. Measured in 1987.
3. Measured in 1986.
4. Measured in 1964.

Source:USGS, 1998.

2.6.1 Surface Water

Two principal river systems drain the Resource Area, the Bear River and the Snake River. The Bear River originates in northeastern Utah, flows across the southwestern corner of Wyoming and enters Idaho south and east of the study area near Border, Wyoming. The southern portion of the Resource Area is located in the Bear River watershed. The only significant Bear River tributary draining a portion of the study area is Georgetown Creek.

The Snake River flows into Idaho from Wyoming at Alpine, Wyoming. It flows northwestward through Palisades Reservoir to Heise, Idaho where it enters the Snake River Plain. The river changes directions west of Heise, flowing southwesterly to American Falls Reservoir. The major Snake River tributaries that drain the study area are the Salt River, Ross Fork, Blackfoot River and Portneuf River. The Salt River collects flow from Crow, Stump and Tygee Creeks, which drain the Eastern district. The Blackfoot River drains most of the Central district and the northern portion of the Western district. The Ross Fork drains the northwestern part of the Western District and the Portneuf River drains the southern half of the Western district. Major Central district tributaries to the Blackfoot River include Lanes, Diamond, Angus, Dry Valley, Slug, and Trail Creeks and the Little Blackfoot River.

Brief descriptions of the principle drainages are described in the following subsections.

2.6.1.1 Bear River Watershed

Surface runoff from the southern portion of the Central district flows to the Bear River. Georgetown Creek is the only perennial stream that drains the project area. Formation Creek, an ephemeral tributary to Soda Spring drains the southwestern part of the Central district. Seven surface water monitoring stations within the Bear River watershed were sampled in 1998. Five of the stations were located on streams while the other two were mine facilities. The Bear River watershed surface water monitoring station locations are shown on Figure 3-1, *Monitoring Locations Sampled in 1998*.

2.6.1.2 Blackfoot River Watershed

The Blackfoot River watershed drains most of the Central district and the northern portion of the Western district. The watershed is divided into upper and lower basins by the Blackfoot Reservoir. Principal streams in the upper basin include Lanes Creek, Diamond Creek, Angus Creek, Dry Valley Creek, Slug Creek, and Trail Creek. The Little Blackfoot River drains directly to the Blackfoot Reservoir
at Henry, Idaho. Runoff from 13 of the 14 mines included in the Selenium Project flows into the Blackfoot River. All runoff from the Ballard, Champ, Dry Valley, Enoch Valley, Henry, Lanes Creek, Mountain Fuel, North Maybe, Rasmussen Ridge and Wooley Valley Mines, and portions of runoff from the Conda Mine drains to the upper Blackfoot. Lincoln Creek, Grizzly Creek and the Gay Mine North Limb Unit drain into the lower Blackfoot River.

The Little Blackfoot River is no longer directly tributary to the upper Blackfoot River. Eleven surface water stations in the Little Blackfoot drainage were sampled in 1998 including six stream stations and five mine facilities. In the upper Blackfoot drainage, 37 surface water stations were sampled in 1998. Stream locations account for 29 of the monitoring stations, while the remaining eight surface water monitoring locations were mine facilities. Figure 3-1 shows 1998 sampling sites.

Three surface water monitoring sites in the lower Blackfoot River basin were monitored in 1998, two stream stations on Lincoln Creek and one on Grizzly Creek. Figure 3-1 also shows the locations of the three lower Blackfoot River basin surface water sites sampled in 1998.

2.6.1.3 Portneuf River and Ross Fork Watersheds

The Portneuf River and Ross Fork drain the Gay Mine East Limb and South 40 units, respectively. The Portneuf River is tributary to American Falls Reservoir downstream of Pocatello, Idaho. The Ross Fork flows directly into American Falls Reservoir upstream of Pocatello. The Ross Fork sites were grouped with the Portneuf River because of the basins exhibit similar physical characteristics and their geographical proximity.

Seven surface water monitoring stations were sampled in these basins during 1998. Two stream sites and two Gay Mine East Limb Unit pit ponds were sampled in the Portneuf drainage and two stream sites and one Gay Mine South 40 Unit pit pond were sampled in the Ross Fork drainage. All three pit ponds are non-discharging facilities. Figure 3-1 shows the locations of the surface water sites sampled in 1998.

2.6.1.4 Salt River Watershed

Crow and Tygee Creeks, tributaries to the Salt River, are the principal streams that drain the project area's Eastern district. Twelve surface water monitoring stations were sampled in 1998. Nine stations were on streams, while the remaining three stations were mine facilities. Figure 3-1 shows the locations of these sites.

2.7 GROUNDWATER

Groundwater in the region can be divided into basin-filling alluvium and bedrock flow systems. Alluvium up to 150 ft. thick in the valleys is recharged by direct precipitation and streamflow. Locally, groundwater in the valleys may be perched on bedrock such as in Lower Dry Valley where static water levels in alluvium and nearby bedrock water wells differ by 100 ft. (BLM, 1999). Alluvial groundwater typically has a horizontal component flowing in the direction of surface drainages and a vertical component.

Phosphate mining occurs entirely within the fault bounded ranges. Ranges are largely composed of folded sedimentary rocks. The Dinwoody, Phosphoria, and Wells formations, the "phosphate sequence", are the principal sedimentary formations from which all phosphate ore is produced. Structures and stratigraphy control much of the groundwater flow systems within these units (Ralston et al., 1980).

A summary of an analysis of groundwater conditions within the southeast Idaho phosphate field is presented below:

Table 2-5
Summary of Groundwater Within Phosphate Sequence[1]

Formation	Characteristics
Dinwoody formation	• Both *upper* (Trdu) and *lower members* (Trdl) support groundwater flow systems
Phosphoria formation	• The cherty shale member (Ppc), the *Rex Chert member* (Ppr) and the *Meade Peak Phosphatic Shale member* (Ppm) do not support significant groundwater flow systems. • Flow systems above the Phosphoria formation are separated from those below the Phosphoria formation. This causes upper flow systems to be local in extent while the lower flow system is regional.
Wells formation	• A groundwater system exists in the *upper member* (Ppwu). • The flow system in the upper member (Ppwu) is separated from flow systems in the Thaynes and Dinwoody formation by the low hydraulic conductivity of the Phosphoria formation and, in particular, the Meade Peak Phosphatic Shale member. • A groundwater flow system exists in the *lower member* (Pwl) of the Wells formation.
Notes: 1. Ralston et al., 1980.	

The Wells formation is present below alluvium in the Dry Valley and is the most transmissive with respect to groundwater of any bedrock unit in the region (BLM, 1999). In general, groundwater flow systems in the bedrock follow the dip of the unit.

The upper Phosphoria formation member, the Rex chert, has low to moderate permeability. The main ore-bearing unit of the Phosphoria formation, the Meade Peak member, is relatively impermeable. Field tests conducted in the 1970's demonstrate that orders of magnitude differences exist in transmissivity and hydraulic conductivity values between fractured and non-fractured members of the Phosphoria formation. Subsequent groundwater tests (McGregor, 1993) performed on phosphate producing members of the Phosphoria formation yield the same ranges in transmissivity as those reported in Ralston et al. (1980).

Fractured limestone beds, and some of the more permeable sandstone beds, are probably the main source of water for numerous springs in the area. These springs are a source of perennial flow for several surface water streams in the region. Eighty-eight springs were identified in a survey of the southeast Idaho phosphate field (Winter, 1980; Ralston et al., 1980). Forty-two flow from the Thaynes or Dinwoody formations at an average discharge rate of 25 gallons per minute (gpm). The Phosphoria formation supported the fewest springs (3) while the eight springs from the Wells formation flowed at the highest average rate, 130 gpm.

Groundwater use in the project area is dependent on several variables including population and land use, availability and quality of surface water and availability and quality of groundwater. In the more remote regions, groundwater use is generally limited to livestock watering. In the surrounding valleys, groundwater is used for livestock watering and mine site water-supply. Mine water uses are primarily for dust abatement or beneficiation. In and around Soda Springs, groundwater is used for municipal supplies, irrigation, industrial uses and domestic supplies. The phosphate ore processing plants use over 5.0 million gallons per day (mgd), mostly from on-site wells. The Soda Springs municipal water-supply comes primarily from Formation Creek and Ledger Creek that are natural springs located northeast of town.

2.8 BIOLOGICAL RESOURCES

This section summarizes vegetation and wildlife resources located in the mining area. Several ecological characterization studies have been completed in the project area. Information on the following ecological characteristics is summarized below.

- Land Use
- Vegetation
- Wildlife, including resident and migratory population for birds, mammals, amphibians, fish, and other aquatic organisms
- Threatened and Endangered Species

2.8.1 Land Use

The project area is sparsely populated with concentrated population centers located in Pocatello, Fort Hall, Montpelier and Soda Springs, Idaho and Afton, Wyoming. A significant portion of project area land is within the Caribou National Forest, the Fort Hall Indian Reservation, or is administered by the BLM. Farming and ranching are the dominant land uses. Phosphate mining has been an ongoing activity in the region since Conda Mine started operations in 1919. Dispersed recreation is also an important regional land use, with the most popular activities being hunting, fishing, and camping.

2.8.2 Vegetation

The vegetation in the project area is transitional between the Great Basin vegetation to the south and the Rocky Mountain vegetation to the north. Six vegetation types are found within the project area (USGS and USFS, 1977). The vegetal types are a result of elevation, moisture, temperature, soil type, slope, and aspect. Table 2-6, *Vegetative Cover Distribution in the Project Area,* summarizes the vegetative communities and the area covered. A listing of plant species found in the project area is presented in Appendix A, *Physical Characterization Information*, Table A.1.

TABLE 2-6
VEGETATIVE COVER DISTRIBUTION IN THE PROJECT AREA

Community	Percent of Area
Conifer-Aspen	30
Mountain Brush	4
Sagebrush-Grass	35
Riparian/Wetland	2
Marshland	6
Agricultural	18
Urban Development	5

The following subsections summarize major vegetal characteristics of the seven cover types identified in Table 2-6.

2.8.2.1 Conifer-Aspen Community

The conifer-aspen community has either mixed-conifer or aspen as the dominant vegetation. Aspen is typically seral, with the conifers being the climax species within this community. While this community does not cover large continuous areas, it is the second most common community within the project area. The community is most often found at higher elevations on the north- and east-facing slopes. Common conifers include Douglas fir, limber and lodgepole pines, subalpine fir, and Englemann spruce.

2.8.2.2 Mountain Brush Community

The mountain brush community is dominated by shrub species, including bitterbrush, serviceberry, snowberry, chokecherry, mountain maple, mountain mahogany, juniper, and ninebark. Other species found include big sagebrush, arrowleaf balsamroot, bluebunch wheatgrass, and Indian ricegrass. This cover type is found in a variety of sites but is usually present at lower elevations and on the south- and west-facing mountain slopes.

2.8.2.3 Sagebrush-Grass Community

The sagebrush-grass community is found at the lowest elevations in the project area. This is the most prevalent community covering about 35 percent of the project area. Sagebrush is the dominant woody-stem species. Other species include bitterbrush, serviceberry, snowberry, Idaho fescue, blue-bunch wheatgrass, squirrel tail, sandberg bluegrass, black sage, rabbitbrush, and Indian ricegrass.

2.8.2.4 Riparian Community

Found along stream banks, other water bodies, and in poorly drained canyon and valley bottoms, it is dependent on a high water table. The riparian/wetland community includes willows, sedges, rushes, and similar grasses. The community generally has a willow overstory. Agricultural practices and mechanical treatment has reduced riparian densities from its historic range.

2.8.2.5 Marshland Community

The marshland community occurs in areas inundated during all or most of the growing season. This community is found in swamps, marshes, shallow potholes, ox-bow lakes and along peripheries of large water bodies. This community is divided into two categories; emergent and submergent. Emergent plants include cattails, rushes and sedges. Common submergent plants include coontain, pondweed, a variety of mosses and waterlily.

2.8.2.6 Agricultural and Urban Lands

Agricultural and urban lands are classified as a modified cover community. The agricultural community varies dependent on type of crop grown. Approximately 18 percent of the project area is used for agricultural production. Grains, grass, alfalfa hay, and pasture are the most common types with a mixture of potatoes, sugar beets, and corn throughout the region. A significant percentage of the agricultural lands occupy valley bottoms which were historically covered by riparian and marshland communities or upland slopes that were historically a sagebrush-grass communities.

2.8.3 Wildlife

There are many mammals, birds, amphibians and reptiles, insects, and aquatic biota that reside within the project area. Previous investigations have indicated that the project area supports or contains habitat for up to 75 species of mammals, 272 species of birds, 16 species of reptiles, 16 species of fish and seven species of amphibians (USGS and USFS, 1977, USFS, 1985 and 1997; ICCDB, 1999, Data Base). Appendix A presents several lists that identify mammalin, avian, amphibian and reptilian species that have been found in Bannock, Bear Lake, Bingham, and Caribou counties (ICCDB, 1999). Table A.2 presents a listing of mammalian species, Table A.3 presents a list of bird species, while Table A.4 presents a listing of amphibians and reptiles.

2.8.3.1 Mammals

Elk, mule deer and moose are common large ungulates in the project area. Regional studies conducted by the Idaho Fish and Game indicate that most elk tend to be nomadic, but do not migrate long distances between summer and winter ranges (Kuck, 1984). Kuck (1984) also reported that moose appear to be widely dispersed in aspen and conifer communities year round. It appears that mule deer spend spring, summer and fall months in the higher elevations and migrate in the winter to lower elevations that hold less snow (Kvale, 1980; Kuck; 1984).

Mountain lions, bobcat, black bear and coyote are the largest carnivores in the project area. Mountain lions generally are solitary and widely dispersed and tend to be found were deer and elk are numerous. Black bears use all habitats found in the project area. Coyote, the most common predator in the area, also utilizes all habitat types. Bobcats are smaller predators that are also dispersed across all habitat types. Other common small predators include short-tail weasel, long-tail weasel, mink, badger, striped skunk, and red fox.

Smaller mammals typically found include several species of rabbits, mice, voles, ground squirrels and bats as well as beaver, muskrat, otter, yellow-bellied marmot, and porcupine (ICCDB, 1999).

2.8.3.2 Birds

Various studies suggest that as many as 272 different bird species frequent habitats found in the project area (USGS and USFS, 1977; ICCDB, 1999). A listing of birds that are thought to utilize habitats in the project area is presented in Table A.3. Approximately 25 species of raptors are common, including the bald eagle, peregrine falcon, prairie falcon, osprey, goshawk, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, marsh hawk, pigeon hawk, and sparrow hawk. These birds of prey subsist mainly on small rodents, fish, reptiles, and carrion.

There are eight species of owls that nest in the project area. Among these species are the barn owl, screech owl, flammulated owl, burrowing owl, great gray owl, great horned owl, long-eared owl, and saw-whet owl. Owls prey mainly upon small rodents and birds.

The Pacific waterfowl flyway crosses the project area and numerous waterfowl migrate through the area in the spring and fall. The mallard and pintail are the primary waterfowl species that breed in the area. Other breeding waterfowl include canvasback, redhead, cinnamon teal, gadwall, shoveler, green-winged teal, widgeon, and Canadian geese.

An estimated 4,000 sandhill cranes nest in the project area, which is one of the larger sandhill crane nesting populations in the lower United States. Other shorebirds that have been identified in the project area include heron, egrets, terns, ibis grebes, coots, avocet, curlew and bittern.
Several species of upland game birds including ruffed grouse, blue grouse and sage grouse are found in various habitats within the project area (ICCDB, 1999). Numerous song and insectivorous birds also are found throughout all vegetation types in the project area. The most common of these birds include Say's phoebe, western meadowlark, western kingbird, swallows and nighthhawks. It is believed that these populations constitute a large portion of raptor's prey.

2.8.3.3 Amphibians and Reptiles

Sixteen 16 species of reptiles and seven amphibian species have been identified as utilizing habitat within the project area (ICCDB, 1999). A list of the species is presented in Appendix A, Table A.4.

2.8.3.4 Aquatic Resources

The project area is defined by two major riverine systems, the Bear River and the Snake River. There are approximately 111 named streams. Other major streams in the area include the Blackfoot, Portneuf and Salt Rivers, all tributaries to the Snake River. This river and stream system supports an abundant aquatic biota population including benthic macroinvertebrates, periphyton, and fish.

Yellowstone cutthroat (Oncorhynchus clarki bouvieri) are the indigenous salmonid species in the Blackfoot River system. Cutthroat from several other demes have been introducted in the drainage including Bear Lake and Henry's Lake and finespotted cutthroat from the Snake River system (ICCDB, 1999). In the upper Salt River system, the Snake River finespotted cutthroat (Oncorhynchus clarki spp) is the prinary subspecies of concern (ICCDB, 1999). Non-indigenous salmonids present in the study area include brook trout (Salvelinus fontinalis), brown trout (Salmo trutta) and rainbow trout (Onocorhynchus mykiss). Other fish fauna include families of Cyprididae (chubs), Catostomidae (suckers) and Cottidae (sculpin). Past IDFG studies indicated that the majority of salmonids found in the upper Blackfoot River were wild cutthroat (IDFG, 1978-1980). Cutthroat life-forms ranged from newly emerged to adult (spent spawners). A list of species is presented in Appendix A, Table A.5.

2.8.4 Threatened and Endangered Species

Several plant and animals species that are classified as threatened or endangered under the Endangered Species Act of 1973 may exist, or are thought to be present as seasonal migrants in the project area (USFWS, 1999). The species include the bald eagle (threatened), peregrine falcon (endangered), gray wolf (endangered), whooping crane (endangered) and Ute ladies' tresses (Spiranthes diluvialis [threatened]). In addition, the Canada lynx has been proposed for listing as an endangered species (USFWS, 1998).

In addition to the listed threatened and endangered species, there are several species classified as sensitive by Federal and State agencies. Sensitive species with suitable habitat present in the project area include northern goshawk, Columbian sharp-tailed grouse, western big-eared bat, wolverine, spotted frog, Trumpeter swan, Harlequin duck, great gray owl, flammulated owl, boreal own, threetoed woodpecker, spotted bat, Snake River finespotted cutthroat, Yellowstone and Bonneville cutthroat trout, Idaho sedge, slick-spot peppergrass, starveling milkvetch, Payson's bladderpod and Cache beardtongue.

2.8.5 Bird and Mammal Management Indicator Species

The Selenium Working Group selected several Management Indicator Species (MIS) which are being used to assist with the assessment of the environmental health of the project area. MIS is "a species elected because its welfare is presumed to be an indicator of the welfare of other species using the same habitat." It is a species whose condition can be used to assess the impacts of management actions in a particular area. The Selenium Working Group selected several MIS which are being used to assist with the assessment of the environmental health of the project area. Table 2-7, *Management Indicator Species for the Project Area*, presents the MIS, the required habitat, and the rationale for selection as an MIS.

TABLE 2-7
MANAGEMENT INDICATOR SPECIES FOR THE PROJECT AREA

MIS Species	Associated Habitat Types	Rationale for Selection
Moose	Early forest succession (aspen, Douglas-fir, lodgepole, other conifer, mountain brush, sagebrush-grass)	Economically and socially important, easily monitored; occur on all or most management area. If their habitat requirements are adequately met, adequate horizontal and vertical habitat diversity will be provided for most other wildlife species inhabiting the area.
Mallard	Open water and marsh areas	Most common waterfowl in project area; easily monitored.
Snipe	Shore bird	Common shore-bird; worst case for exposure due to foraging habitats.
Red-winged blackbird	Marsh-dwelling passerine	Special habitat needs; needs stable riparian/marshland vegetation type.
Muskrat	Semi-aquatic	Common omnivorous mammal; needs population of benthic and terrestrial invertebrates and primary producers to survive; part of food chain to carnivorous mammals, raptors, and large carnivorous birds.
Notes:	MIS - Management Indicator Species	

Section 3

3.0 METHODOLOGY

This section describes the types and locations of media sampled in 1998, the sampling procedures, the screening method used to identify the contaminants of potential concern (COPC), the data validation procedures and data analyses methodologies. The 1998 regional investigation included characterization of the media in the following list.

- Surface water (streams, seeps, french drains, stock ponds, and tailings ponds)
- Sediment (streams, seeps, french drains, and stock ponds)
- Groundwater (water-supply wells)
- Soil (waste rock dumps and seeps)
- Vegetation (waste rock dumps and seeps)
- Trout fillet

3.1 SAMPLE LOCATIONS

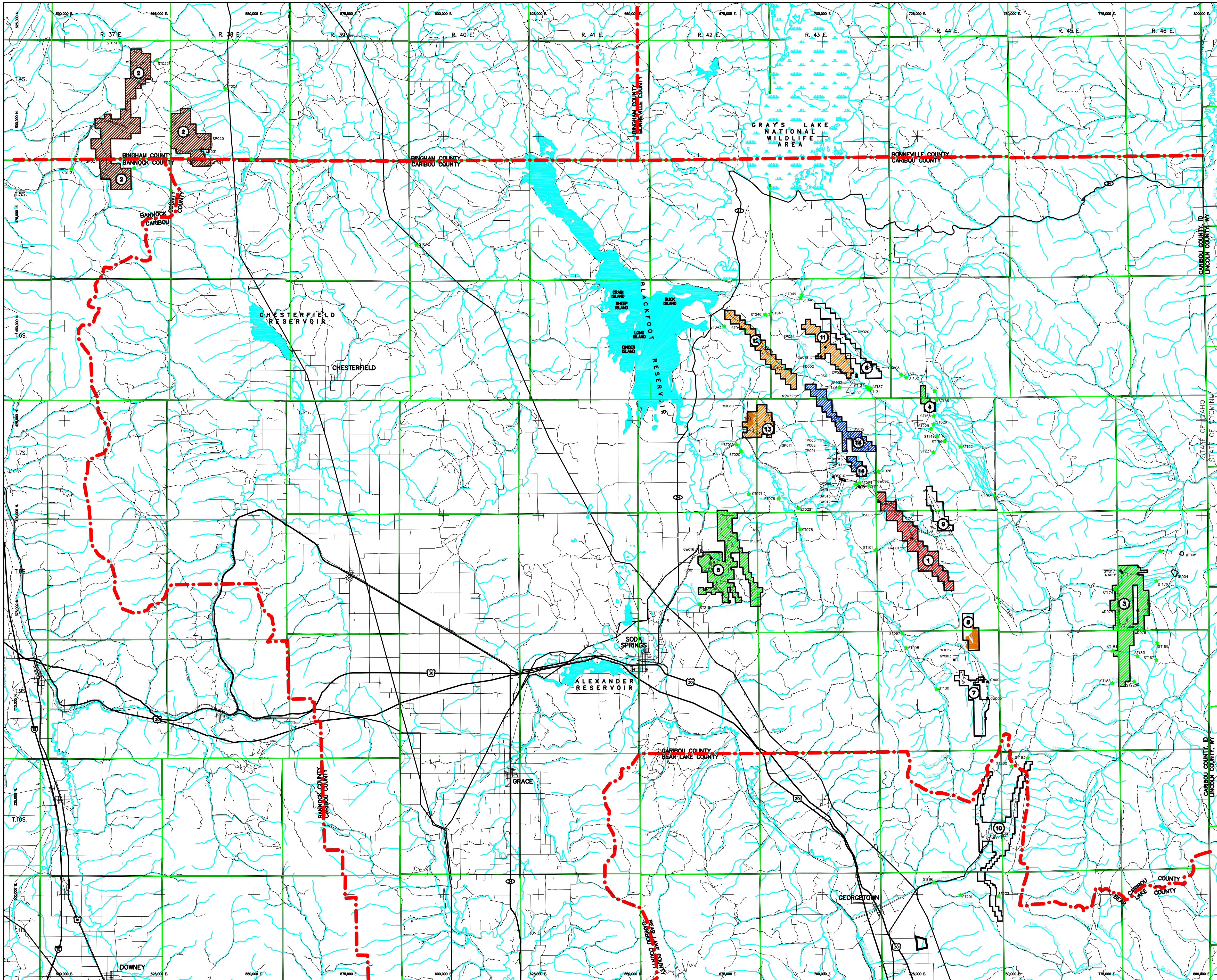
3.1.1 Stream Surface Water and Sediment

Approximately 225 potential project area stream monitoring stations were identified on USGS topographic maps and compiled onto a master inventory. The inventory of potential stream monitoring stations is presented in Appendix A in Table A.6. The stream monitoring station inventory is organized to present station locations, in descending order, from west-to-east and clockwise within the investigation area. For each watershed, the major river or stream is listed first and each potential station is presented in a downstream-to-upstream order. Then each tributary is listed with potential stations in a similar manner.

One of the primary objectives of the 1998 Regional Investigation was to define across the project area the extent of elevated levels of selenium and other target elements. However, it was determined that sampling each of the 225 potential monitoring stations would be prohibitively time-consuming and expensive. It was also felt that random sampling of stream monitoring locations was also impractical because 1997 data collected on behalf of IMA indicated that selenium concentrations in stream waters exhibit a high degree of spatial variability (MW, 1998a). Therefore, the Selenium Working Group developed a sampling design for the 1998 sampling effort that would provide adequate resolution to characterize the extent of streams affected by phosphate mining activities. The sampling design was based on an outside-in approach. The outside-in approach is a systematic method to identify the mine facilities that are impacting surface waters. The results of the 1998 monitoring will be used to select future investigation monitoring locations. The outside-in approach was designed using the following criteria.

- Each drainage downstream of a mine facility was sampled.
- A stream was sampled at the point that was furthermost upstream, but still downstream of the mine facility, that supported a fishery.
- If a lower order tributary flowed into the stream, then a sample was also collected on the mainstem upstream of that, and any other, tributary inflow that drained a mine facility.
- Numerous stations were established along the upper Blackfoot River to identify COPC loadings from the tributaries that drain the phosphate mine sites.

Table 3-1, *Stream Monitoring Stations Sampled During 1998,* presents the stream monitoring stations that were sampled in 1998. The locations of the monitoring sites are shown on Figure 3-1, *Monitoring Locations Sampled in 1998.* Fifty-seven separate stream locations were sampled during two 1998 sampling events. Fifty-four sites were sampled for water column physical and chemical data in May.



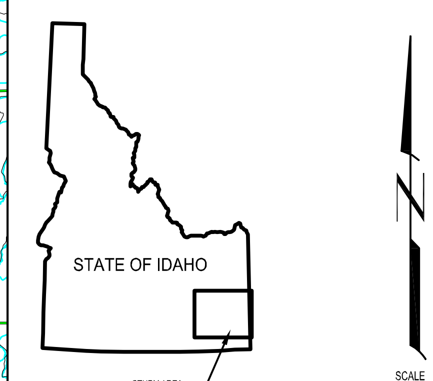
LEGEND

CONTOURS	ROADS
CREEKS/RIVERS	RAILROAD
LAKES	STATE LINE
MARSH	COUNTY LINE

ST156 SURFACE WATER SAMPLING
MP001 MINE PIT LOCATION
SP001/TP001 STOCKPOND LOCATION/TAILINGS POND
WD001 WASTE ROCK DUMP LOCATION
GW001 PRODUCTION WELL
DS001 WASTE ROCK DUMP SEEP

FMC CORPORATION
FMC CORPORATION AND J.R. SIMPLOT COMPANY
J.R. SIMPLOT COMPANY
NU-WEST MINING, INC. OR NU-WEST INDUSTRIES, INC.
P4 PRODUCTION LLC
RHODIA INC.

1 DRY VALLEY MINE	8 CHAMP MINE
2 GAY MINE	9 NORTH MAYBE MINE
3 SMOKY CANYON MINE	10 GEORGETOWN CANYON MINE
4 LANES CREEK MINE	11 ENOCH VALLEY MINE
5 CONDA MINE	12 HENRY MINE
6 RASMUSSEN RIDGE MINE	13 BALLARD MINE
7 MOUNTAIN FUEL MINE	14 WOOLEY VALLEY MINE



MAP KEY

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CONTOUR INTERVAL NA

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY

IDAHO MINING ASSOCIATION SELENIUM SUBCOMMITTEE

PROJECT: 1998 REGIONAL INVESTIGATION REPORT

DRAWING TITLE: MONITORING LOCATIONS SAMPLED IN 1998

MONTGOMERY WATSON

Sheet 1 Of 1 Sheets
SCALE: As Shown
DRAWING No. 3-1

AutoCAD FILE: Surfmonitor.dwg PROJECT NUMBER: 1227028.021807

TABLE 3-1 STREAM MONITORING STATIONS SAMPLED DURING 1998		
Station Number	**Drainage**	**Description**
ST001	Portneuf River	Downstream of Bakers Creek
ST004		Upstream of U Creek
ST013	Ross Fork	Downstream of Danielson Creek
ST015		Upstream of South 40 Unit
ST031	Lincoln Creek	Downstream of Dry Hollow Creek
ST033		Upstream of North Limb Unit
ST019	Blackfoot River	Downstream of Ballard Creek
ST020		Downstream of State Land Creek
ST022		Downstream of Wooley Valley Creek
ST023		Downstream of Dry Valley Creek, FMC's BF1
ST024		Upstream of Dry Valley Creek, FMC's BF2
ST026		Upstream of Wooley Range Ridge Creek
ST229		Downstream of East Mill Creek
ST042	Grizzly Creek	Below Phosphoria Formation Outcrop
ST043	Little Blackfoot River	Downstream of Long Valley Creek
ST044		Downstream of Henry Mine
ST046		Downstream of Enoch Valley Mine
ST047		Upstream of Enoch Valley Mine
ST048		Downstream of Reese Creek
ST049		Upstream of Reese Creek
ST071	Trail Creek	Downstream of un-named tributaries
ST076		Upstream of Blackfoot River
ST078		Upstream of Camp G Creek
ST097	Slug Creek	Downstream of Goodheart Creek
ST098		Upstream of Goodheart Creek
ST100		Upstream of Dry Basin Creek
ST101	Caldwell Creek	Downstream of Phosphoria Formation Outcrop
ST113	Dry Valley Creek	Upstream of Blackfoot River
ST129	Angus Creek	Downstream of Wooley Valley Mine
ST131	Rasmussen Creek	Upstream of Angus Creek
ST132		Upstream of No-Name Creek
ST137	No-Name Creek	Upstream of Angus Creek
ST149	East Mill Creek	Upstream of Spring Creek on North Fork
ST150		Upstream of Spring Creek on South Fork
ST227		At Fish Sampling Reach
ST152	Diamond Creek	Downstream of Kendall Creek
ST153		Upstream of Kendall Creek
ST155	Lanes Creek	Downstream of 6500 Feet Creek
ST156		Downstream of Sheep Creek
ST161	Sheep Creek	Upstream of Lanes Creek
ST162		Downstream of West Fork Sheep Creek
ST163		Upstream of West Fork Sheep Creek
ST173	Smoky Creek	Downstream of Smoky Canyon Mine at FS Station
ST174		Downstream of Tailings Ponds , S-B&M-5
ST176		Upstream of Tailings Ponds, S-B&M-4
ST183	Sage Creek	Downstream of Smoky Canyon Mine
ST184		Upstream of Smoky Canyon Mine
ST185	South Fork Sage Creek	Downstream of Phosphoria Formation Outcrop
ST228		At Fish Sampling Reach
ST187	North Fork Sage Creek	Downstream of Pole Canyon
ST188		Upstream of Pole Canyon
ST193	South Fork Deer Creek	Downstream of Georgetown Canyon Mine
ST196	Georgetown Creek	Downstream of Georgetown Canyon Mine
ST200		Upstream of Georgetown Canyon Mine
ST201	Right Hand Fork, Georgetown Creek	Downstream of Georgetown Canyon Mine
ST202		Upstream of Georgetown Canyon Mine
ST218	Formation Creek	At headwaters

The East Mill Creek station (ST227) and the South Fork Sage Creek station (ST228) had not yet been established in May and the South Fork Deer Creek site (ST193) was inaccessible due to snow cover. In September, 53 stream sites were sampled for water column and sediment data. The No Name Creek station (ST137) and Georgetown Creek station (ST200) were both dry. The two East Mill Creek sites above Spring Creek (stations ST149 and ST150) were replaced with the sample location at the fish sampling reach (ST227). Monitoring locations ST227 and ST228 were established in conjunction with the September salmonid sampling effort.

3.1.2 Mine Facility Surface Water and Sediment

Five waste rock dump seeps, two french drains, nine miscellaneous ponds and five tailings ponds were sampled as part of the 1998 regional investigation. Table 3-2, *Facilities Sampled During 1998,* identifies those mine facilities that were sampled for surface water expressions during 1998. The locations of the mine facilities sampled for surface water are shown Figure 3-1. The only facility not sampled for water column physical and chemical data in May was the Conda Mine West Limb waste dump seep (DS015). In September, all the facilities with the exception of the Wooley Valley Mine Unit III and IV overburden dump seeps (DS011 and DS012, respectively) and the Ballard Mine Upper Elk Pond (SP011) which were dry, were sampled for water column data. Sediment samples were also collected during September at the waste rock dump seeps, french drains and miscellaneous ponds.

TABLE 3-2
FACILITIES SAMPLED DURING 1998

Type of Facility	Facility Name	District	Station Number
Waste Rock Dump	Gay Mine North Limb O/P Fill	Western	WD019
	Gay Mine East Limb Dump 4E	Western	WD031
	Gay Mine East Limb Dump 19	Western	WD034
	Champ Mine Dump	Central	WD052
	Ballard Mine Pit #1 Overburden Dump #1	Central	WD080
	Henry Mine Center Pit #2 Canyon Fill Dump	Central	WD089
	Smoky Canyon Mine A Pit Backfill	Eastern	WD074
	Smoky Canyon Mine Waste Dump A1	Eastern	WD075
	Smoky Canyon Mine Pole Canyon Waste Dump	Eastern	WD076
French Drain	Conda Mine French Drain	Central	FD001
	Henry Mine South Pit Overburden Dump Limestone Drain	Central	FD002
Seep	Dry Valley Mine South B Dump Seep	Central	DS003
	Wooley Valley Mine Unit I Overburden Dump Seep	Central	DS010
	Wooley Valley Mine Unit III Overburden Dump Seep	Central	DS011
	Wooley Valley Mine Unit IV Overburden Dump Seep	Central	DS012
	Conda Mine Waste Dump West Limb Seep	Central	DS015
Stock Pond	Gay Mine W Pit Lake	Western	SP025
	Gay Mine Z Pit Lake	Western	SP026
	Gay Mine JD Pit Lake	Western	SP027
	Wooley Valley Mine Unit IV Pit Pond	Central	MP022
	Ballard Mine Upper Elk Pond	Central	SP011
	Enoch Valley Mine North Pond	Central	SP024
Miscellaneous Pond	Central Farmers Plant Thickener	Central	MF001
	Dry Valley Mine Pit Dewatering Pond	Central	MF002
Tailings Pond	Wooley Valley Mine Tailings Pond #1	Central	TP001
	Wooley Valley Mine Tailings Pond #2	Central	TP002
	Wooley Valley Mine Tailings Pond #3	Central	TP003
	Smoky Canyon Mine Tailings Pond #1	Eastern	TP004
	Smoky Canyon Mine Tailings Pond #2	Eastern	TP005
Water-Supply Wells	Dry Valley Mine Shop Water Well	Central	GW001
	Hunzeker Well	Central	GW002
	Upper Dry Valley Stock Well #1	Central	GW003
	Upper Dry Valley Stock Well #2	Central	GW004
	Upper Dry Valley Stock Well #3	Central	GW005
	Rasmussen Ridge Mine Dust Control Well #1	Central	GW006
	Rasmussen Ridge Mine Dust Control Well #2	Central	GW007
	Rasmussen Ridge Mine Shop/Office Well	Central	GW008
	Rasmussen Ridge Mine Wash Plant Well #1	Central	GW009
	Rasmussen Ridge Mine Wash Plant Well #2	Central	GW010
	Rasmussen Ridge Mine Wash Plant Well #3	Central	GW011
	Rasmussen Ridge Mine Wash Plant Well #4	Central	GW012
	Rasmussen Ridge Mine Wash Plant Well #5	Central	GW013
	Rasmussen Ridge Mine House Well	Central	GW014
	Rasmussen Ridge Mine Laboratory Well	Central	GW015
	Conda Mine Water Supply Well #11	Central	GW016
	Enoch Valley Mine Shop/Office Well	Central	GW017
	Enoch Valley Mine Dust Control Well	Central	GW018
	Smoky Canyon Mine Industrial Supply Well	Eastern	GW019
	Smoky Canyon Mine Potable Supply Well	Eastern	GW020

3.1.3 Groundwater

Twenty groundwater wells were included in the facilities inventory (MW, 1998b). However, only 18 wells were sampled in May, while in September, only 17 groundwater samples were collected. Table 3-2 also lists the groundwater wells that were sampled during 1998. Figure 3-1 shows the locations of the groundwater wells monitored during the 1998 sampling effort.

3.1.4 Soil and Vegetation

Surface soil and vegetation samples were collected from 9 waste rock dumps and 5 dump seeps during July 1998. Table 3-2 also includes a list of the waste rock dumps and seeps that were sampled for soil and vegetation analyses. The locations of the waste rock piles and seeps sampled for soil and vegetation are also shown on Figure 3-1. Five randomly selected locations, or quadrates, were sampled on each waste rock dump for a total of 45 soil and vegetation samples, respectively. Each quadrate covered 100-square feet (ft^2). Each quadrate was divided into 100 1-ft^2 subsamples. A random number generator was used to select the 5 subsamples from each quadrate. A 1- ft^2 sampling frame was utilized to delineate subsample locations. One soil and one vegetation sample was collected at each dump seep.

In addition to the mine dumps and seeps, three regional background stations were also sampled for soil and vegetation. The three regional background stations were Grizzly Creek (ST042), Caldwell Creek (ST101), and South Fork Sage Creek (ST185). Figure 3-1 also shows were the three background stations were located. Five soil and vegetation samples, respectively, were collected at each background location for a total of 15 background soil and vegetation samples, respectively.

3.2 CONTAMINANTS OF POTENTIAL CONCERN

The 1998 SAP (MW, 1998b) presented a risk-based screening process that was used to identify the contaminants of potential concern (COPC). The COPC screening process is presented in Appendix B. The process is meant to be conservative and retain several constituents that are not expected to pose a human health or environmental risk. The characterization of human health and environmental risk caused by releases of the chemical constituents is being assessed through a risk assessment process.

Water quality samples collected by FMC and the USFS from Maybe Creek and Dry Valley Creek monitoring locations were used to identify the COPCs. The screening process included the development of surface water screening criteria and COPC screening. Separate screening criteria were identified for aquatic receptors, avian and mammalian riparian receptors and mammalian terrestrial receptors.

Aquatic screening criteria were based on freshwater aquatic toxicity benchmarks published by the EPA and other sources. Riparian and terrestrial screening criteria were developed based on indicator species that are representative of riparian and terrestrial receptors potentially exposed to project surface waters. The indicator species were selected by the Selenium Working Group. Riparian receptors include waterfowl, which are represented by the mallard duck, and mammals that utilize riparian habitat, which are represented by the muskrat. The terrestrial indicator species are livestock including cattle, horse and sheep.

The screening process identified the following six constituents as the Selenium Project COPCs.

- cadmium
- manganese
- nickel
- selenium
- vanadium
- zinc

3.3 SAMPLING PROCEDURES

This section presents an overview of the sampling methods employed in the collection of surface water, sediment, groundwater, waste rock soil, waste rock vegetation, and salmonid samples. Samples were collected and analyzed pursuant to the methods and standard operating procedures (SOPs) presented in the 1998 SAP (MW, 1998b).

Where appropriate, each sample location was field marked by a wooden surveyor's stake marked with the station number. Each sample location was photo-documented with picture and roll number(s) recorded in the field notebook and on the sample collection form. Sample location coordinates were determined with a global positioning system (GPS) receiver. Upon arrival at each sampling location, the GPS unit was turned on and operated in averaging mode during sample collection to establish the most accurate coordinates possible. Coordinates were recorded in field notebooks and on data collection forms.

Sample container labels were completed using the protocol described in the 1998 SAP. The following information was recorded on field notes and data forms.

- Sample location, ID, and time
- Sample type
- Field parameters (if applicable)
- Weather
- Vegetation and livestock/wildlife activity
- Any modifications to the sample collection procedures
- Quality assurance/quality control samples (QA/QC) (if applicable)

At the end of each day, samples were stored in a secure refrigerator at the Conda Pump Station. Sample chain-of-custody forms were filled out daily and samples were shipped to the University of Idaho laboratory via ground courier for delivery on the next business day. Field equipment was stored in a secure room at the Conda Pump Station or in a locked motel room when not in use.

3.3.1 Surface Water Sampling Procedures

Surface water samples were collected using the following SOPs that were presented in the 1998 SAP.

- SOP-NW-9.1 *Collection of Surface Water Quality Samples*
- SOP-NW-9.2a *Surface Water Flow Measurements Using Man-Portable Devices or Estimation Techniques*

The following procedures were followed during all surface water sampling events.

- Collection of QA/QC samples occurred at a minimum rate of 10 percent. For example, if from 1 to 10 primary samples were collected during a sampling event, then one QA/QC suite was collected; if from 11 to 20 primary samples were collected, then two QA/QC suites were collected.

- A QA/QC suite consisted of three primary samples, a duplicate sample and an equipment rinsate sample. Primary and equipment rinsate samples were analyzed at the Holm Research Center at the University of Idaho. The duplicate sample was analyzed at the University of California, Davis.

- QA/QC samples were collected to represent the range of sampling events, sampling teams, field conditions, and sample equipment variability.

- The equipment rinsate sample was collected by rinsing decontaminated sampling equipment with deionized water in a manner similar to actual sample collection. The equipment rinsate sample was prepared in an identical manner as the primary sample. However, equipment rinsate samples were only analyzed for the six target elements.

- One primary replicate sample was used for matrix spike analysis. The matrix spike results were used as part of the data validation procedures.

- All sampling equipment was decontaminated following sample collection prior to vacating a site and moving on the next location.

- All samples were submitted to the University of Idaho and University of California, Davis laboratories under standard Chain-of-Custody procedures.

Surface water samples were analyzed for the parameters presented in Table 3-3, *Surface Water Sample Analytical Suite*.

TABLE 3-3
SURFACE WATER SAMPLE ANALYTICAL SUITE

Parameter	Method[1]	Upper Tolerance Bound[2]	Reporting Units	Holding Time
Target Elements				
Cadmium	200.7, ICP	0.0053/0.0030	mg/l	6 months
Manganese	200.7, ICP	0.031/0.014	mg/l	6 months
Nickel	200.7, ICP	0.017/0.021	mg/l	6 months
Selenium	Hydride Vapor, ICP[3]	0.0015/0.0013	mg/l	6 months
Vanadium	200.7, ICP	0.0027/0.040	mg/l	6 months
Zinc	200.7, ICP	0.010/0.015	mg/l	6 months
Other Analyses				
Alkalinity Bicarbonate Carbonate	310.1	0.90/1.70	mg/l as $CaCO_3$	14 days
Calcium	200.7, ICP	10/0.851	mg/l	6 months
Chloride	300.0, Ion Chromatography	0.14/0.551	mg/l	28 days
Hardness	Calculation	na	mg/l	na
Iron	200.7, ICP	0.085/0.066	mg/l	6 months
Magnesium	200.7, ICP	2.0/0.021	mg/l	6 months
Potassium	200.7, ICP	3.5/0.610	mg/l	6 months
Sodium	200.7, ICP	3.2/0.580	mg/l	6 months
Sulfate	300.0 Ion Chromatography	0.061/0.100	mg/l	28 days

Notes:
1. Standard EPA method for analysis of inorganic constituents as modified by University of Idaho, Holm Research Center.
2. The first value is the upper tolerance bound (UTB) for the May sampling event. The second value is the UTB for the September sampling event. The method for calculating the UTBs is presented in subsection 3.4.1
3. The selenium method was developed by Tracy and Moller (1990); as presented in Appendix C of the 1998 QAPP (MW, 1998b).

na – not applicable
mg/l - milligrams per liter

3.3.1.1 Field Parameter Measurement Procedures

The following field water quality parameters were measured.

- pH
- Conductivity
- Temperature
- Dissolved Oxygen
- Turbidity
- Eh

Field parameter measurements were made in-situ, whenever possible. If an in-situ measurement was not possible, then the measurement was made stream-side from a 1-liter container. Field parameter values were recorded on field data forms and in field notebooks.

Field meters were used in accordance with the manufacturer's instructions. Conductivity meters and turbidimeters were calibrated daily. Meters measuring pH, Eh, and dissolved oxygen, were calibrated at each station. Thermisters were calibrated once during the sampling event. At the monitoring stations where QA/QC samples were collected, pH, Eh and turbidity meters were re-calibrated between collection of each of the three primary samples.

3.3.1.2 Stream Sampling Procedures

Fifty-four stream sites were sampled during the May monitoring event for water column physical and chemical data, while in September 53 sites were sampled for water column data. Samples for laboratory analysis were collected in accordance with SOP-NW-9.1. Samples were only collected at sites with flowing water. Sample sites lacking sufficient flow for sample collection were recorded as "no flow" in the field notebook and field data forms.

When multiple monitoring stations were located on the same stream, sampling began at the furthermost location downstream and progressed upstream. If a tributary was sampled, the downstream sample on the main stream was collected prior to the tributary sample. Samples were generally collected at approximately 0.6 of the total depth using a horizontal Kemmerer sampler, or equivalent device. In shallow streams, a polyethylene dipper was used to collect the sample. The sampler always stood downstream of the sample collection device to prevent substrate sediments from contaminating the sample.

In streams that were less than 10 feet wide, the sample was collected from the channel thalweg. The water collection container was lowered into the water, being careful so not to collect floating debris or disturb the substrate. After filling, sample aliquots were transferred into the appropriate, pre-labeled sample bottles. The process was repeated until all sample bottles were filled. In streams greater than 10 feet wide, three water subsamples were collected along a line perpendicular to the stream flow. Subsamples were collected at approximately ¼, ½, and ¾ the distance across the stream channel. The subsamples were composited into a churn splitter and aliquots transferred to the appropriate, pre-labeled sample bottles. All samples were placed in a chilled cooler after collection and stored in a secure refrigerator until shipment to the laboratories.

Samples collected for selenium analysis were unfiltered. The sample aliquot was transferred directly into a laboratory-certified clean polyethylene bottle. The bottle was acidified to a pH of less than two with ultra-pure nitric acid. Samples submitted to the laboratory for anion analyses were also unfiltered, but unacidified aliquots. Alkalinity measurements were made in the laboratory on an unfiltered aliquot. Anion analyses for chloride and sulfate were made on subsamples that were laboratory filtered using a vacuum-type filter apparatus and a disposable 0.45 μm filter. Trace metal and cation samples were also submitted, in laboratory-certified clean polyethylene bottles, to the laboratory as unfiltered aliquots where they were also filtered with a vacuum-type filter apparatus and a disposable 0.45 μm filter.

Laboratory results from 1997 investigation surface water samples indicated that there were no significant selenium concentration differences between filtered (dissolved-fraction) and unfiltered (total-fraction) samples (MW, 1998a). A limited number of both filtered and unfiltered samples were collected during both 1998 monitoring events to confirm the 1997 conclusion. Filtered/unfiltered splits for selenium analyses were collected at ten and five stations in May and September, respectively. Filtering was completed in the field at these stations using a hand-held vacuum-type filtering apparatus and a disposable 0.45 μm filter.

3.3.1.3 Stream Flow Measurements

Flow measurements or estimates, if applicable, were recorded at each surface water monitoring station using the methods presented in SOP-NW-9.2a. Flow rates were typically calculated using the velocity-area method (Rantz et al., 1982). If the depth of water was less than 0.2 feet, flow was estimated using a measured surface velocity and discharge was calculated using the stream cross-sectional area. If it was too dangerous to physically measure flow during peak run-off periods, the flow rate was visually estimated. In-stream flow measurements were obtained after water quality samples were collected.

3.3.1.4 Pond Sampling Procedures

Five tailings ponds and nine miscellaneous, non-tailings ponds were sampled. Samples were collected from the mine dewatering ponds, stock ponds, tailing ponds, and mine pits using a polyethylene dipper. The sampler waded into the water to knee-depth using care to minimize sediment suspension. The sample was collected towards the center of the pond beyond any sediment plume caused by wading. Care was also taken to minimize collection of algae or other floating debris. Subsamples were composited into a churn splitter and sample aliquots were transferred to the appropriate, pre-labeled sample bottles.

Pond samples were analyzed for the same ionic-fraction as were the stream samples. Total, unfiltered, aliquots were submitted for selenium analysis. Alkalinity measurements were also taken from an unfiltered aliquot. Chloride, sulfate, cation and trace metal measurements were taken from laboratory filtered aliquots.

3.3.1.5 Seep Sampling Procedures

Seep and french drain samples were collected immediately downstream of the discharge point. A 250 milliliter (ml) beaker was used to collect subsamples that were composited in a churn splitter. Sample aliquots were transferred from the churn splitter to the appropriate, pre-labeled sample bottles.

Seep samples were also analyzed for the same ionic-fraction as the other surface water samples. Total, unfiltered, aliquots were submitted for selenium analysis. Alkalinity measurements were also recorded from an unfiltered aliquot. Chloride, sulfate, cation and trace metal measurements were taken from laboratory filtered aliquots.

3.3.2 Sediment Collection

Sediments were sampled at stream monitoring stations, seeps, and stock ponds during the September sampling event. Sediment samples were collected following instructions presented in SOP-NW-9.3, *Collection of Sediment Samples*, that were presented in the 1998 SAP (MW, 1998b). Sediment samples were analyzed for the parameters identified in Table 3-4, *Sediment Sample Analytical Suite*.

The following procedures were followed during all sediment sampling tasks.

- All sampling equipment was decontaminated following sample collection prior to vacating a site and moving on the next monitoring location.

- All samples were submitted to the University of Idaho laboratory under standard Chain-of-Custody procedures.

3.3.2.1 Stream Sediment Sampling

Sediment samples were collected at stream monitoring stations during the September sampling event. A total of 53 stream sediment samples were collected. A two-inch diameter soil corer was used to collect sediment samples. Three sediment subsamples were collected at each station and composited into a single sample. Depending on conditions, subsamples were collected either perpendicular or parallel to the direction of flow.

TABLE 3-4
SEDIMENT SAMPLE ANALYTICAL SUITE

Parameter	Analytical Method[1]	Upper Tolerance Bound[2]	Reporting Units	Holding Time
Target Elements				
Cadmium	3050/6010 Series, ICP	0.31	mg/kg	na
Manganese	3050/6010 Series, ICP	4.8	mg/kg	na
Nickel	3050/6010 Series, ICP	2.3	mg/kg	na
Selenium	Hydride Vapor, ICP[3]	0.22	mg/kg	na
Vanadium	3050/6010 Series, ICP	3.0	mg/kg	na
Zinc	3050/6010 Series, ICP	8.1	mg/kg	na
Other Analyses				
Calcium	3050/6010 Series, ICP	5100	mg/kg	na
Iron	3050/6010 Series, ICP	14	mg/kg	na
Magnesium	3050/6010 Series, ICP	15	mg/kg	na
Potassium	3050/6010 Series, ICP	87	mg/kg	na
Sodium	3050/6010 Series, ICP	34	mg/kg	na
Sulfate	0.08 M Calcium Phosphate extraction	2.6	mg/kg	na
Cation Exchange Capacity	USDA No. 60 (19)	na	meq/l	na
Organic Carbon	USDA No. 60 (24)	0.1	Percent	na
Particle Size Distribution	ASA No. 9 15-4.2.2	0.1	Percent	na

Notes:
1. Standard EPA methods for analysis of inorganic constituents as modified by University of Idaho, Holm Research Center.
2. The procedure for calculating the upper tolerance bounds is presented in subsection 3.4.1.
3. The selenium method was developed by Tracy and Moller (1990) as presented in Appendix C of the 1998 QAPP (MW, 1998b).

na – not applicable
mg/kg – milligram per kilogram

The corer was advanced into the stream substrate to approximately 6-inches depth. If the substrate material inhibited coring, a grab sample of surficial material was collected by scooping sediments with the corer. Excess water was poured from the core and the sediment was transferred to a 1-gallon, zip-lock baggie or a dedicated, plastic sample tube. Following collection, each sample was double bagged to prevent cross-contamination prior to being stored in an iced cooler.

3.3.2.2 Pond and Seep Sediment Sampling

Sediment samples were collected from five waste rock dump seeps, the two french drain outfalls, and the seven stock ponds. The five tailings ponds and two miscellaneous ponds were not sampled for sediments. Three sediment subsamples were collected from each pond or seep and composited into a single sample. The sediment subsamples were collected on a 120 degree-triangular grid, approximately three-to-four feet apart around the point from where the water quality sample was collected. Subsamples were collected either by advancing the corer to approximately 6-inches deep or by using the corer to grab surficial material. Subsamples were drained of excess water and transferred to either the plastic sample container or a 1-gallon zip-lock baggie. All samples were double bagged to prevent cross-contamination.

3.3.3 Well Sampling Procedures

Groundwater samples were collected following instructions presented in SOP-NW-5.2, *Collection of Groundwater Quality Samples*, that was presented in the 1998 SAP (MW, 1998b).

The following procedures were followed during all groundwater sampling tasks.

- Collection of QA/QC samples occurred at a minimum rate of 10 percent. For example, if from 1 to 10 primary samples were collected during a sampling event, then one QA/QC suite was collected; if from 11 to 20 primary samples were collected, then two QA/QC suites were collected.
- A QA/QC suite consisted of three primary samples, a duplicate sample and an equipment rinsate. Primary and equipment rinsate samples were analyzed at the Holm Research Center at the University of Idaho. The duplicate sample was analyzed at the University of California, Davis.
- QA/QC samples were collected to represent the range of sampling events, sampling teams, field conditions, and sample equipment variability.
- The equipment rinsate sample was collected by rinsing decontaminated sampling equipment with deionized water in a manner similar to actual sample collection. The equipment rinsate sample was prepared in an identical manner as the primary sample. However, equipment rinsate samples were only analyzed for the six target elements.
- One primary replicate sample was used for matrix spike analysis. The matrix spike results were used as part of the data validation procedure.
- All sampling equipment was decontaminated following sample collection prior to vacating a site and moving on the next location.
- All samples were submitted to the University of Idaho and University of California, Davis laboratories under standard Chain-of-Custody procedures.

Groundwater samples were analyzed for the parameters presented in Table 3-5, *Groundwater Sample Analytical Suite*.

With the exception of one private water well and three stock wells, all wells were located on mine property. The mine wells are generally used for industrial purposes. All wells were purged prior to sample collection. If a well was not in continuous operation, the well was purged until the following field parameters stabilized.

- Temperature
- pH
- Dissolved oxygen
- Conductivity
- Turbidity

Field parameters were checked every 20 minutes while the well purged. Stabilization generally occurred within three readings. Purge data and field parameter readings were recorded on the groundwater field data form and in the field notebook. Field parameter measurements were collected at the well head from a 1-liter sample container that was slowly filled to minimize aeration.
Field meters were used in accordance with the manufacturer's instructions. Conductivity meters and turbidimeters were calibrated daily. Meters measuring pH, Eh, and dissolved oxygen, were calibrated at each station. Thermisters were calibrated once during the field effort. At stations where QA/QC samples were collected, pH, Eh and turbidity meters were re-calibrated between collection of each replicate sample.

TABLE 3-5
GROUNDWATER SAMPLE ANALYTICAL SUITE

Parameter	Method[1]	Upper Tolerance Bound[2]	Reporting Units	Holding Time
Target Elements				
Cadmium	200.7, ICP	0.0053/0.0030	mg/l	6 months
Manganese	200.7, ICP	0.031/0.014	mg/l	6 months
Nickel	200.7, ICP	0.017/0.021	mg/l	6 months
Selenium	Hydride Vapor, ICP[3]	0.0015/0.0013	mg/l	6 months
Vanadium	200.7, ICP	0.0027/0.040	mg/l	6 months
Zinc	200.7, ICP	0.010/0.015	mg/l	6 months
Other Analyses				
Alkalinity Bicarbonate Carbonate	310.1	0.90/1.70	mg/l as $CaCO_3$	14 days
Calcium	200.7, ICP	10/0.851	mg/l	6 months
Chloride	300.0, Ion Chromatography	0.14/0.551	mg/l	28 days
Iron	200.7, ICP	0.085/0.066	mg/l	6 months
Magnesium	200.7, ICP	2.0/0.021	mg/l	6 months
Potassium	200.7, ICP	3.5/0.610	mg/l	6 months
Sodium	200.7, ICP	3.2/0.580	mg/l	6 months
Sulfate	3.00.0 ion chromatography	0.061/0.100	mg/l	28 days

Notes:
1. Standard EPA methods for analysis of inorganic constituents as modified by University of Idaho, Holm Research Center.
2. The first value is the upper tolerance bound (UTB) for the May samples, the second is appropriate for September samples. The procedure for calculating the UTBs is presented in subsection 3.4.1.
3. The selenium method was developed by Tracy and Moller (1990), as presented in Appendix C of the 1998 QAPP (MW, 1998b).

mg/l – milligrams per liter

Groundwater geochemical analyses were made of the same ionic-fraction as the surface water samples. Total, unfiltered, aliquots were submitted for selenium analysis. Alkalinity measurements were also recorded from an unfiltered aliquot. Chloride, sulfate, cation and trace metal measurements were taken from laboratory filtered aliquots.

3.3.4 Soil Sampling Procedures

Soil samples were collected from nine waste rock dumps and five dump seeps. In addition, soil samples were also collected at the three background stations. Soil samples were collected following protocols presented in SOP-NW-7.1, *Collection of Surface Soil Samples*, that was presented in the 1998 SAP (MW, 1998b). A total of 45 waste rock dump and 5 dump seep vegetation samples were collected. Five samples were also collected from each background station for a total of 15 background vegetation samples.

Waste dump sample locations were selected by placing a grid pattern over each dump and randomly selecting a grid using a random number generator. Each gird represented a 100-ft^2 quadrate. Five samples were collected from each waste rock dump quadrate. A stake was randomly placed within the quadrate and its location recorded with a GPS receiver. Seep samples were variable based on the vegetative cover. Only one sample was collected from each dump seep quadrate.

The five waste rock dump sample locations within each quadrate were selected by generating a series of random x-y coordinates. Each coordinate was determined by measuring the appropriate distance from the quadrate stake along both the x- and y-axis with a 100-foot engineer's tape. Each coordinate represented the northwest corner of the sample site. A rigid 1-ft^2 sampling frame was placed at the coordinate corner and oriented parallel to the y-axis.

At a random point within each grid, a two-inch long, two-inch diameter core was advanced into the soil manually using a 5-pound hammer. After the core reached a depth of two inches the hammer was used to withdraw the core from the ground and the core sampler was disassembled. In cases where the core could not be advanced two inches, decontaminated hand tools were used to excavate an area roughly two inches in diameter and two inches deep. The collected soil was transferred into a No. 12 sieve with a collection pan attached. Vegetation was removed from the sieve and soil was gently shaken from any roots present. Sample characteristics were recorded in the field notebook and on the data collection form. The sieve was covered and then manually agitated for approximately one minute.

After one minute of sieving, materials retained on the sieve were discarded. Soil that passed through the sieve was transferred from the collection pan using a decontaminated stainless steel spoon, or dedicated plastic weighing boat, to a one-pound, plastic-lined bag. This procedure was repeated for each grid until a minimum of 32 ounces of soil was collected.

Soil samples were analyzed for the parameters identified in Table 3-6, *Soil Sample Analytical Suite*.

3.3.5 Vegetation Sampling Procedures

The same nine, randomly-selected waste rock dumps and five dump seeps were also sampled for herbaceous vegetation. In addition, vegetation samples were also collected at the three regional background stations. Vegetation soil locations on each dump were selected using the same random number coordinate system used to select soil sample locations. Forty-five waste rock dump, five dump seeps, and 15 background vegetation samples were collected. Vegetation samples were collected following protocols presented in SOP-NW-19.0, *Collection of Vegetation Samples* (MW, 1998b).

Each random coordinate designated the northwest corner of sample site. A 1-ft^2 sampling frame was used to delineate the grid. All herbaceous plant tissue rooted within the frame was clipped with stainless steel shears or torn by hand to a point about one inch above the ground surface. A minimum of 100 grams (wet weight) of herbaceous plant tissue was collected at each location. The collected leaf and stem tissue was transferred into a 1-gallon zip-lock plastic bag. The bag used as the sample container was weighed prior to tissue collection so that the sample mass could be recorded.

The vegetation samples were analyzed for the parameters listed in Table 3-7, *Vegetation Sample Analytical Suite*.

TABLE 3-6 SOIL SAMPLE ANALYTICAL SUITE				
Parameter	**Analytical Method[1]**	**Upper Tolerance Bound[2]**	**Reporting Units**	**Holding Time**
Target Elements				
Cadmium	3050/6000 Series, ICP	0.58	mg/kg	na
Manganese	3050/6000 Series, ICP	6.5	mg/kg	na
Nickel	3050/6000 Series, ICP	1.6	mg/kg	na
Selenium	Hydride Vapor, ICP[3]	0.17	mg/kg	na
Vanadium	3050/6000 Series, ICP	1.9	mg/kg	na
Zinc	3050/6000 Series, ICP	6.8	mg/kg	na
Other Analyses				
Calcium	3050/6000 Series, ICP	490	mg/kg	na
Iron	3050/6000 Series, ICP	16	mg/kg	na
Magnesium	3050/6000 Series, ICP	42	mg/kg	na
Ammonia – Nitrogen	2 M KCL Extraction	na	mg/kg	na
Nitrate-Nitrogen	2 M KCL Extraction	na	mg/kg	na
Phosphorus (on Sodium Bicarbonate)	O.S. $NaHCO_3$ (Olsen P) Extraction	2.5	mg/kg	na
Potassium	3050/6000 Series, ICP	110	mg/kg	na
Sodium	3050/6000 Series, ICP	62	mg/kg	na
Sulfate	0.08 M Calcuim Phosphate Extraction	3.2	mg/kg	na
pH (saturated paste)	USDA No. 60 (21a)	0.1	units	na
Cation Exchange Capacity	USDA No. 60 (19)	na	meq/l	na
Moisture Content	ASTM D2216-90	0.1	percent	na
Organic Carbon	USDA No. 60 (24)	0.1	percent	na
Particle Size Distribution	ASA No. 9 15-4.2.2	na	percent	na

Notes:
1. Standard EPA methods for analysis of inorganic constituents as modified by University of Idaho, Holm Research Center.
2. procedures for calculating upper tolerance bound values is presented in subsection 3.4.1.
3. The selenium method was developed by Tracy and Moller (1990) as presented in Appendix C of the1998 QAPP (MW, 1998b).

na - not applicable
mg/kg - milligram per kilogram

TABLE 3-7 VEGETATION SAMPLE ANALYTICAL SUITE				
Parameter	**Analytical Method[1]**	**Upper Tolerance Bound[2]**	**Reporting Units**	**Holding Time**
Target Elements				
Cadmium	Micro-digestion ICP	0.19	mg/kg	na
Manganese	Micro-digestion ICP	0.29	mg/kg	na
Nickel	Micro-digestion ICP	0.76	mg/kg	na
Selenium	Hydride Vapor, ICP[3]	0.088	mg/kg	na
Vanadium	Micro-digestion ICP	0.67	mg/kg	na
Zinc	Micro-digestion ICP	2.5	mg/kg	na
Other Analyses				
Iron	Micro-digestion ICP	3.9	mg/kg	na
Sulfate	0.08 M Calcium Phosphate extraction	300	mg/kg	na
Moisture Content	ASTM D2216-90	na	Percent	na

Notes:
1. The miro-digestion, ICP method was develop by Anderson (1996) as presented in Appendix C of the 1998 QAPP (MW, 1998b).
2. Procedure for calculating upper tolerance bound values is presented in subsection 3.4.1
3. The selenium method was developed by Tracy and Moller (1990) as presented in Appendix C of the1998 QAPP (MW, 1998b).

na – not applicable
mg/kg - milligram per kilogram

3.3.6 Salmonid Sampling Procedures

The intent of salmonid sampling was to collect cutthroat trout from several locations in the project area. However, brook and brown trout were also collected. Salmonids were collected using a portable, backpack electroshocker on East Mill and South Fork Sage creeks, and using a boat-mounted electroshocker in the Blackfoot River. The three locations where salmonid were sampled were ST026 (Blackfoot River upstream of Wooley Range Ridge Creek) The electroshockers were operated by IDFG personnel who held the scientific collection permit. For the creeks, the operator waded the stream, working in an upstream direction. As fish were stunned and floated to the surface they were collected with dip nets by assistants trailing the operator. Collected fish were transferred to a bucket. For the river, the boat was drifted downstream slowly under the control of the operator while an assistant collected stunned and surfaced fish with a dip net and transferred these fish into a live well.

The first three trout, 6-inches in length or longer, collected at each fish sampling location were submitted for laboratory analyses. For East Mill Creek, no fish of 6-inches in length were obtained. Consequently, the first three fish, all of which were in excess of 4-inches in length, were retained. The muscle tissues (fillets with skin on) were analyzed for target element concentrations.

3.4 QUALITY ASSURANCE ANALYSIS AND DATA VALIDATION METHODOLOGY

Rigorous quality assurance/quality control (QA/QC) and data validation techniques were used in accordance with EPA guidelines (1994a; 1995a; 1996a) to assure that accurate results were obtained. These methods were applied to reduce or eliminate any potential bias resulting from sample collection or laboratory procedures. The following sections describe the QA/QC analysis and data validation methodology used during the 1998 regional investigation.

3.4.1 Data Validation Methodology

Data validation was performed on analytical results reported by the laboratories. The methodology used was developed in accordance with EPA guidance (1994a; 1996a). Validation procedures are described in SOP-NW-18.1, *Data Validation,* which is included in the 1998 SAP (MW, 1998b). The validation process quantified field and laboratory uncertainties and corrected the data for discovered errors to best represent actual field concentrations. The formulas used in the QA/QC data validation procedure are presented in Appendix C, *Data Validation Calculations,* Table C.1. Tables C.2 through C.7 present the individual correction factors for each analyte by sampling event and environmental media. The specific methodology used for data validation is described below.

Prior to data validation, a database was created containing all laboratory results including raw data below the laboratory method detection limit. Laboratory and equipment blank results, laboratory standard results, and laboratory matrix spike recovery results were also included in the database which resulted in a database containing all analyses performed by the laboratories.

The first step taken in the data validation process was a review of the laboratory blank data. Ideally, all laboratory blank results should be equal to zero, however this rarely occurs. Quite often, a small laboratory procedure error or equipment error affects the result and a very small number is reported. To correct this uncertainty, each data value in the data set was reduced by the average of all of the laboratory blank concentrations. This results in the average of the corrected laboratory blank results being zero.

Laboratory standard and spike recovery results were used to compare the known spike and standard concentrations to the average of the concentrations reported by the laboratory. A linear regression analysis was performed on these data with the y-intersection forced through zero. The slope of the regression line represents the laboratory's ability to recover the actual concentration of a sample as a percentage. Each sample was corrected for the laboratory recovery rate by dividing the concentration by this percentage to account for the error in the actual versus reported concentrations. Once the reported concentration was corrected for the laboratory blank and recovery rate, it is referred to as the laboratory-quality-assurance-corrected concentration.

Field-related QA/QC data were also reviewed and quantified. The field QA/QC validation procedure was based on the equipment blank results and the approach was similar to the methodology described above for evaluating the laboratory blank results. The average of the equipment blank results was calculated and subtracted from the concentration of each sample collected in the field (i.e. all samples in the data set except the laboratory QA/QC samples). This resulted in the average of the corrected equipment blank results being zero.

The effect of matrix interference in the samples was evaluated and quantified through the review of matrix spike results. For each matrix spike sample, the recovered spike amount was calculated by subtracting the original sample concentration from the spiked sample result. These matrix spike recoveries were then averaged and compared to the known spike concentration. The matrix spike percent recovery was determined by a simple ratio, dividing the average recovery by the known spike concentration. Since the samples had previously been corrected for the laboratory recovery rate, the matrix percent recovery rate may be based on matrix interference. Each sample result in the data set was corrected for this effect of matrix interference by dividing the concentration by the percent recovery rate.

Incorporating the data validation methodologies presented above results in a field-and-laboratory-quality-assurance-corrected concentrations that best represent actual concentrations. The validated constituent concentrations are presented in the summary tables included in Appendix D, *Validated Water Sediment and Fish Data,* and Appendix E, *Validated Soil and Vegetation*.

After the field-and-laboratory-quality-assurance-corrected concentrations were determined, it was necessary to determine at what concentration level a sample could be differentiated from the blank results. An upper tolerance bound (UTB) was calculated for this purpose. The UTB is a value that represents the detection limit for a constituent that was calculated on the 95% confidence limit on the blank value means. This value is the concentration of an element that can not be distinguished from background interference. Appendix C, Tables C.8 through C.13, present the calculations of the UTB for each analyte analyzed, by sampling event, for each environmental media. Validated sample concentrations presented in Appendix D and Appendix E that are below the UTB are shown in italics, while concentrations above the UTB are in bold. UTB values are independent of regulatory compliance concentrations that have been established to assure the health and safety of humans and the environment. That is, a sample concentration could be above the UTB, but not exceed either the cold-water aquatic life numeric standard or the maximum contaminant level (MCL). On the other hand, if the UTB for an analyte is greater than the regulatory standard and a sample concentration is greater than the regulatory criteria, it is not possible to determine if the concentration is a true exceedence.

3.4.2 Quality Assurance Analysis

QA/QC samples were taken at a minimum of ten percent of the sample stations. The QA/QC stations were randomly selected by the field teams so that at least one QA/QC stations was located within each on the three mining districts. The QA/QC suite consisted of five sub-samples: three primary samples, a duplicate sample, and an equipment rinsate. The three primary and equipment rinsate samples were analyzed at the University of Idaho Holm Research Center. The duplicate sample was analyzed by the project QA/QC laboratory at the University of California, Davis. Analytical results from the two laboratories were compared using a 95% confidence interval to calculate if the reported values were statistically similar. A comparison of the QA/QC analytical results indicates that University of California, Davis results were generally within the University of Idaho prediction intervals. Exceptions where the University of California, Davis results were outside the University of Idaho prediction intervals include May surface and groundwater cadmium concentrations and September surface and groundwater cadmium, manganese, nickel, vanadium and zinc concentrations. Results of the QA comparisons are presented in Appendix C, Table C.14 through C.18.

3.5 DATA ANALYSES METHODOLOGIES

Various data analyses techniques were used to evaluate laboratory and field data. These methods were used to evaluate if the data from potentially impacted sites were elevated above either regulatory criteria or natural, background conditions. In addition, a risk measure analysis was used to determine if a receptor population is at risk due to target element releases from phosphate-mining facilities. The following subsections describe the data analyses methodologies used to analyze data collected during the 1998 regional investigation.

3.5.1 Data Analysis Objectives

Several data analyses objectives were identified for this project. The first objective was to evaluate data to determine if concentrations exist above either regulatory criteria or natural, background conditions. The second objective was to determine whether or not a receptor population is at risk due to target element releases. To achieve the objectives, several statistical analyses were performed. The statistical tests are provided in Appendix F, *Summary Statistic Calculations,* of this report. The following list summarizes the data analysis objectives.

- Develop summary statistics describing the data populations.
- Compare surface water to aquatic biota cold-water numeric standards and groundwater data to maximum contaminant levels (MCL) to determine if values exceeded the regulatory criteria.
- Compare surficial soil, sediment, and vegetation data to background concentrations to determine if concentrations in these median are elevated above background values.
- Utilize cutthroat trout data to prepare a preliminary human health risk assessment.
- Determine the environmental hazard quotients (EQH) for the receptor populations.

3.5.2 Summary Statistics

The following summary statistics were calculated for each media sampled. Summary statistics for surface water samples are organized by watershed. Summary statistics were also calculated for background samples.

- Number of samples
- Number greater than the upper tolerance bound
- Minimum, mean, maximum, 95th percentile of the data populations
- Number greater than the background and regulatory criteria (if applicable)

3.5.3 Regulatory Criteria

Regulatory numeric criteria for surface water and groundwater have been established for the following four target elements (EPA, 1994a).

- Selenium
- Cadmium
- Nickel
- Zinc

There are no promulgated criteria for either manganese or vanadium. In addition, there are no promulgated standards for target element concentrations in sediment, surficial soils, or vegetation.

These criteria are based on values promulgated under the Clean Water Act Section 303(C)(2)(B) for protection of human health and the aquatic environment. The EPA has established both MCLs and aquatic biota numeric standards. The MCL is the maximum permissible level of a contaminant in water which is delivered to any user of a public water system (EPA, 1994a). The aquatic biota cold-water standard is a hardness-specific chronic water quality criterion for cadmium, nickel and zinc. The criterion for selenium is a fixed numeric value. A chronic standard is that concentration of a contaminant not to be exceeded for either a single representative sample or as an average of all samples collected during a thirty-day period. Table 3.8, *Promulgated Numeric Criteria for Select Target Elements*, presents the MCL and aquatic biota cold-water standards for selenium, cadmium, nickel and zinc.

3.5.4 Comparison to Background

There are no promulgated standards for target element concentrations in sediment, soils, or vegetation. Consequently, baseline conditions were used as a threshold value against which the data were compared to determine if the data were elevated relative to background.

A 95% upper confidence limit (UCL) was calculated using data from background sites for sediment, soil, and vegetation samples. The UCL represents a 95 percent confidence limit on the 95th percentile of the background data. Three background sediment samples were used to calculate the sediment UCL. Fifteen soil and vegetation samples were used to calculate the soil and vegetation UCLs. Table 3-9, *Sediment, Soil and Vegetation Upper Confidence Limits*, presents the UCLs for selenium, cadmium, manganese, nickel, vanadium, and zinc for sediment, soil and vegetation. The UCLs were used as a threshold value against which data were compared to evaluate concentrations from potentially impacted sites were elevated relative to background.

TABLE 3-8
PROMULGATED NUMERIC CRITERIA FOR SELECT TARGET ELEMENTS

Element	MCL (mg/l)[1]	Aquatic Biota Cold-Water Standard[2] (mg/l)
Selenium	0.05	0.005
Cadmium	0.005	Hardness-specific[3]
Nickel	0.1	Hardness-specific[3]
Zinc	5.0[4]	Hardness-specific[3]

Notes:
1. The MCL standards apply to groundwater (EPA,1994a).
2. The aquatic biota cold-water standards apply to surface water.
3. Hardness-specific criteria were established for each surface water monitoring station for each sampling event. The criteria were presented in Appendix D, Table D.24.
4. Secondary drinking water MCL (EPA, 1994a).

TABLE 3-9 SEDIMENT, SOIL AND VEGETATION UPPER CONFIDENCE LIMITS			
Element	**Sediment (mg/kg)**	**Surficial Soil (mg/kg)**	**Vegetation (mg/kg)**
Selenium	2.3	8	0.85
Cadmium	8.8	23	2.5
Manganese	8861	2500	84.5
Nickel	81.8	1000	1.9
Vanadium	69	120	1.3
Zinc	216	450	49.9

3.5.5 Risk Assessment Measures

A risk measure analysis was used to determine if receptor populations are at risk due to target element releases from phosphate-mining facilities. Appropriate risk measure analyses were used to determine the environmental hazard quotient (EHQ) or, for circumstances where target elements have similar toxicological endpoints and effects, the environmental hazard index (EHI). The uncertainties inherent in this investigation were acknowledged by incorporating them into the risk models by means of stochastic analysis. The estimates of the EHQ or EHI were presented as frequency distributions.

Section 4

4.0 1998 SAMPLING RESULTS

4.1 SURFACE WATER

In 1998, surface water monitoring was conducted at 78 stations including 57 stream sites, five waste dump seeps, two french drains, nine miscellaneous ponds and five tailings ponds. Stream monitoring stations sampled during 1998 are identified in Table 3-1 and mine facilities sampling locations are identified in Table 3-2. Surface water monitoring stations are shown on Figure 3-1.

Samples were analyzed for the target elements selenium, cadmium, manganese, nickel, vanadium, and zinc. Field measurements included conductivity, dissolved oxygen, oxygen reduction potential (ORP), pH, temperature and turbidity. Flow measurements were recorded at stream, seep and french drain locations.

4.1.1 Surface Water Field Data

This subsection provides a brief summary of surface water field parameter measurements collected during May and September of 1998. Table 4-1, *Surface Water Field Parameter Sample Results*, summarizes the range of field data collected during 1998. Appendix D, Tables D.1 through D.6 lists the 1998 field parameter data. Field parameters were recorded at surface water monitoring stations with the following exceptions. In May, measurements were not collected at the Conda Mine West Limb Seep (DS015), at South Fork Deer Creek (ST193); or at the East Mill Creek (ST227) and South Fork Sage Creek (ST228) fish sampling locations. During September, values were not reported for the Wooley Valley Mine Unit III and Unit IV overburden dump seeps (DS011 and DS012), the Ballard Mine Upper Elk Pond (SP011), No Name Creek (ST137), the two East Mill Creek sites (ST149 and ST150), and Georgetown Creek upstream of the Georgetown Canyon Mine (ST200).

TABLE 4-1
SURFACE WATER FIELD PARAMETER SAMPLE RESULTS

Parameter	Stream Locations		Other Surface Water Locations[1]	
	May	September	May	September
Temperature (°C)	4.4 – 14	7.3 – 18	4.9 – 15	6.7 – 22
Conductivity (µS/cm)	130 – 1000	300 – 1100	130 – 1000	160 – 3200
pH (std. units)	7.1 – 9.3	6.1 – 8.8	6.9 – 9.6	6.7 – 10.6
Dissolved Oxygen (mg/l)	2.8 – 11[2]	5.6 –12	5.6 – 12	3.0 – 11
Turbidity (NTU)	0.19 – 30	0.57 – 13	0.14 - 27	0.88 – 25
Oxygen reduction potential (mV)	20 – 320	-77 – 210[3]	180 - 310	-34 - 1200[3]

Notes:
1. Includes waste rock dump seeps, french drains, tailings ponds and other ponds.
2. A dissolved oxygen measurement of 2.8 was reported at ST218, Formation Creek at headwaters. This monitoring location is where groundwater discharges to the surface at Formation Spring.
3. Problems with the oxygen reduction potential (ORP) meter were reported and this range of values is qualified as estimated. Negative values for surface water may reflect instrument problems or measurement errors.

Water temperatures in May were generally lower than values measured during the September monitoring event. Surface water conductivity measurements associated with mine facility sites typically indicated a slight increase from May to September. The maximum reported value at a mine facility in May was 1000 micro-Siemens per centimeter (µS/cm). This value was measured at the Gay Mine JD

Pit pond (SP027). In September, the maximum value of 3200 μS/cm was recorded at Conda Mine West Limb dump seep (DS015). The maximum stream conductivity values in both May and September were recorded at the Lincoln Creek below Dry Hollow Creek (ST031) monitoring location (1000 and 1100 μS/cm, respectively) .

Ponds and mine pits generally had the highest pH values during both monitoring events. May pH values generally ranged from 8.5 to 9.5 standard units, while the maximum September value was approximately 11 standard units. Seeps and french drains reported the lowest pH values. The pH of these samples were generally circum-neutral, ranging from 6.7 to 7.7 standard units. Surface water pH values generally ranged from 7.5 to 8.8 standard units.

The lowest dissolved oxygen measurement in May was recorded at Formation Creek (ST218). This monitoring location was located at Formation Spring and field measurements were collected from water as it discharged as a surface expression of groundwater. In September, the two french drains had the lowest dissolved oxygen values.

Stream and mine facility monitoring stations reported similar turbidity values. Turbidity values were slightly higher in May relative to September values. Oxygen reduction potential (ORP) values from stream and mine facility monitoring stations were also similar during the May and September events. The relatively low, negative ORP values reported during September may be a result of equipment problems.

4.1.2 Target Elements

The following subsections present 1998 surface water sampling results for the six target elements (selenium, cadmium, manganese, nickel, vanadium, and zinc). Validated laboratory results for the 1998 surface water sampling are presented in Appendix D, Tables D.7 through D.12, for selenium, cadmium, manganese, nickel, vanadium, and zinc, respectively.

Table 4-2, *1998 Surface Water Sample Summary Statistics*, presents summary statistics for stream and mine facility monitoring stations. Appendix G, *Selenium and Cadmium Data Frequency Histograms,* presents frequency histograms for selenium and cadmium data by sampling event for both stream and mine facility monitoring locations.

Selenium and Cadmium

In May, 23 of 37 non-background stream surface water selenium concentrations were greater than the UTB value. The selenium concentration in 12 of the 23 samples exceeded the aquatic cold-water criteria. Ten of the May stream samples exceeding the cold-water criterion were collected from the Blackfoot River watershed. The other two were on Georgetown Creek and North Fork Sage Creek. Fifteen of 21 mine facilities had selenium concentrations that were greater than both the UTB value and the aquatic cold-water criteria in May. Waste rock dump seeps and french drains typically had the highest selenium concentrations.

TABLE 4-2 1998 SURFACE WATER SAMPLE SUMMARY STATISTICS								
Parameter[1]	**Number of Samples**	**UTB[2]**	**Number Greater Than UTB**	**Minimum[3]**	**Mean[4]**	**Maximum**	**Cold-Water Criteria[5]**	**Number Greater Than Background and Criteria[6]**
Streams – May Monitoring Event								
Selenium	37	0.0016	23	-0.00065	0.018	0.26	0.0050	12
Cadmium	37	0.0081	0	-0.0029	0.001	0.0047	0.00070-0.0029	0
Manganese	37	0.18	24	-0.00075	0.046	0.42	na	na
Nickel	37	0.024	4	-0.0089	0.005	0.030	0.10-0.51	0
Vanadium	37	0.035	2	-0.025	-0.001	0.028	na	na
Zinc	37	0.045	5	-0.0090	0.008	0.13	0.07-0.34	0
Streams – September Monitoring Event								
Selenium	37	0.0020	2	-0.00089	0.001	0.032	0.0050	1
Cadmium	37	0.0046	0	-0.0035	0.0003	0.0045	0.0014-0.0029	0
Manganese	37	0.51	1	-0.0041	0.068	0.53	na	na
Nickel	37	0.028	2	-0.017	0.006	0.030	0.22-0.51	2
Vanadium	37	0.049	0	-0.034	0.010	0.18	na	na
Zinc	37	0.017	0	-0.0063	0.003	0.012	0.15-0.34	0
Mine Facilities – May Monitoring Event								
Selenium	21	0.0016	18	0.00047	0.210	2.0	0.0050	15
Cadmium	21	0.0081	2	-0.0014	0.005	0.030	0.0007-0.0029	2
Manganese	21	0.18	3	0.00057	0.121	1.3	na	na
Nickel	21	0.024	5	-0.0013	0.050	0.46	0.10-0.51	0
Vanadium	21	0.035	8	-0.010	0.034	0.10	na	na
Zinc	21	0.045	6	-0.00042	0.152	1.5	0.07-0.34	2
Mine Facilities – September Monitoring Event								
Selenium	18	0.0020	14	-0.00028	0.102	1.3	0.005	12
Cadmium	18	0.0046	2	-0.0022	0.003	0.028	0.0008-0.0029	2
Manganese	18	0.51	1	0.0017	0.116	1.5	na	na
Nickel	18	0.028	6	0.0046	0.044	0.48	0.12-0.51	0
Vanadium	18	0.049	10	0.0043	0.056	0.18	na	na
Zinc	18	0.017	5	-0.0012	0.095	1.4	0.08-0.34	1

Notes:
1. All units are milligrams per liter (mg/l).
2. UTB = Upper Tolerance Bound (See subsection 3.4.1 for discussion on UTBs)
3. Negative numbers represent less than detection limit values as calculated after data validation.
4. Mean values were calculated using results that include negative numbers, therefore the means may be negative or zero. Mean values are reported to the nearest 0.001 mg/l (ppb).
5. Aquatic biota cold-water numeric standard: A range of values signifies hardness-specific criteria. Hardness-specific criteria are presented in Appendix D, Table D.24.
6. Values were only designated as an exceedance if the value exceeded both the UTB and the criteria.

In September, East Mill Creek (ST227) was the only stream location that exceeded the selenium cold-water criteria. The measured concentration in this sample was 0.032 mg/l. The other 35 September stream water column samples were less than the selenium UTB value. Twelve of 18 mine facilities reported selenium concentrations greater than the criterion and UTB value in September. Every mine facility that exceeded the criterion in May also exceeded it in September, with the exception of the locations that were dry.

Cadmium concentrations in May stream water column samples were all less than the UTB value of 0.0081 mg/l. Sample concentrations needed to exceed both the UTB and the cold-water criterion in order to be considered an exceedance. Consequently, there were no exceedances of the criterion in

May. Table D.24 in Appendix D presents the hardness-specific cadmium criterion for each site. Nineteen of 21 mine facilities had May water column cadmium concentrations less than the UTB value

In September, all 37 non-background stream samples contained cadmium concentrations less than the UTB value of 0.0046 mg/l. Three facilities had cadmium concentrations greater than the cold-water criteria. However, because the reported concentrations were also less than the UTB, they were not true exceedances. In order to determine if these concentrations were true exceedances, the hardness-dependent criterion the UTB for this analyte would need to be lowered. Two of 18 mine facilities had cadmium concentrations greater than the hardness-dependent criteria and UTB in September. Both locations are non-discharging facilities. The maximum cadmium concentration reported at mine facilities during September was 0.028 mg/l (TP005).

Manganese, Nickel, Vanadium and Zinc

Only two stream samples collected during 1998 had nickel or zinc values that exceeded both the UTB and the cold-water criteria. There are no promulgated cold-water criteria for manganese or vanadium. There is a secondary drinking water standard for manganese. All surface water concentrations were significantly lower than the value of the manganese standard. Between 90 and 100 percent of samples had concentrations of nickel, vanadium and zinc that were less than their corresponding UTB value. Concentrations of nickel and zinc in mine facility samples were also generally less than cold-water criteria. Samples collected in May from two mine facilities had a zinc concentration exceeding the hardness-dependent criteria. Both facilities were non-discharging.

4.1.2.1 Background Water Quality Conditions

Table 4-3, *1998 Surface Water Background Sample Summary Statistics*, presents the summary statistics for background samples of surface water concentrations of target analytes. Table 4-4, *Background Surface Water Monitoring Locations*, lists the background surface water sites. A monitoring site was originally considered background if it was located downstream of a Phosphoria outcrop in a watershed that was unimpacted by phosphate mining. The operational definition was changed after the draft version of this report to include sites upstream of phosphate mining activities.

TABLE 4-3 1998 SURFACE WATER BACKGROUND SAMPLE SUMMARY STATISTICS				
Parameter[1]	**Number of Samples**	**Minimum[2]**	**Maximum**	**Background UTB[3]**
Streams – May Monitoring Event				
Selenium	16	-0.00043	0.00084	0.0016
Cadmium	16	-0.0034	0.0040	0.0081
Manganese	16	-0.00053	0.18	0.18
Nickel	16	-0.0036	0.026	0.024
Vanadium	16	-0.019	0.020	0.035
Zinc	16	-0.0078	0.065	0.045
Streams – September Monitoring Event				
Selenium	15	-0.00089	0.0020	0.0020
Cadmium	15	-0.0027	0.0029	0.0046
Manganese	15	0.0014	0.33	0.51
Nickel	15	-0.010	0.017	0.028
Vanadium	15	-0.028	0.021	0.049
Zinc	15	-0.0068	0.0082	0.017

Notes:
1. All units are milligrams per liter (mg/l).
2. Negative numbers represent less than detection limit values as calculated after data validation.
3. UTB = Upper Tolerance Bound (See subsection 3.4.1 for discussion on UTBs).

There were no background stations that exceeded the cold-water criterion for selenium in either May or September. The maximum sample and UTB values reported for selenium were both 0.0020 mg/l for the September sampling event.

Four background samples had May cadmium concentrations that were greater than the hardness-specific criterion. The maximum cadmium value reported in the May background samples was 0.0040 mg/l. However, the May cadmium UTB was approximately two times greater than the reported maximum cadmium value. The maximum value for cadmium in September was reported at 0.0029 mg/l.

TABLE 4-4 Background Surface Water Monitoring Locations	
Station Number	**Station Description**
ST004	Portneuf River upstream of U Creek
ST015	Ross Fork upstream of South 40 Unit
ST033	Lincoln Creek upstream of North Limb Unit
ST042	Grizzly Creek downstream of Phosphoria Formation outcrop
ST048	Little Blackfoot River downstream of Reese Creek
ST049	Little Blackfoot River upstream of Reese Creek
ST100	Slug Creek upstream of Dry Basin Creek
ST101	Caldwell Creek downstream of Phosphoria Formation outcrop
ST153	Diamond Creek upstream of Kendall Creek
ST163	Sheep Creek upstream of West Fork Sheep Creek
ST184	Sage Creek upstream of Smoky Canyon Mine
ST185	South Fork Sage Creek downstream of Phosphoria Formation outcrop
ST188	North Fork Sage Creek upstream of Pole Canyon Creek
ST200[1]	Georgetown Creek upstream of Georgetown Canyon Mine
ST202	Right Hand Fork Georgetown Creek upstream of Georgetown Canyon Mine
ST218	Formation Creek at headwaters

Notes: 1. ST200 was dry in September.

This value was equal to the hardness-dependent criterion upper value that ranged from 0.0015 to 0.0029 mg/l. All September cadmium concentrations in background samples were less than the UTB value of 0.0046 mg/l.

No other target analytes in the background samples exceeded their respective cold-water criteria in May or September. In May, one sample had a nickel concentration that exceeded the nickel UTB value of 0.024 mg/l. No other target analyte concentrations exceeded their respective UTBs in May or September.

4.1.2.2 Portneuf River and Ross Creek Watersheds

Seven surface water stations were sampled in the Portneuf River and Ross Creek watersheds during 1998. Four of the sites were stream locations and the remaining three locations were pit lakes. The station locations are shown on Figure 4-1

None of the stream samples contained selenium concentrations exceeding the cold-water criterion. The May samples collected from stream monitoring sites ST013 (Ross Creek downstream of Danielson Creek) and ST015 (Ross Creek upstream of Gay Mine South 40 Unit) reported cadmium concentrations greater than the hardness-specific criteria. However, in both cases, the measured and calculated criterion values were less than the UTB value and, therefore, were not considered true exceedances. None of the other target elements had measured concentrations that were greater than their respective criteria.

Figure 4-2, *Cadmium Data from Western District*, shows sample locations and cadmium concentrations from various media in the Portneuf and Ross Creek watersheds.

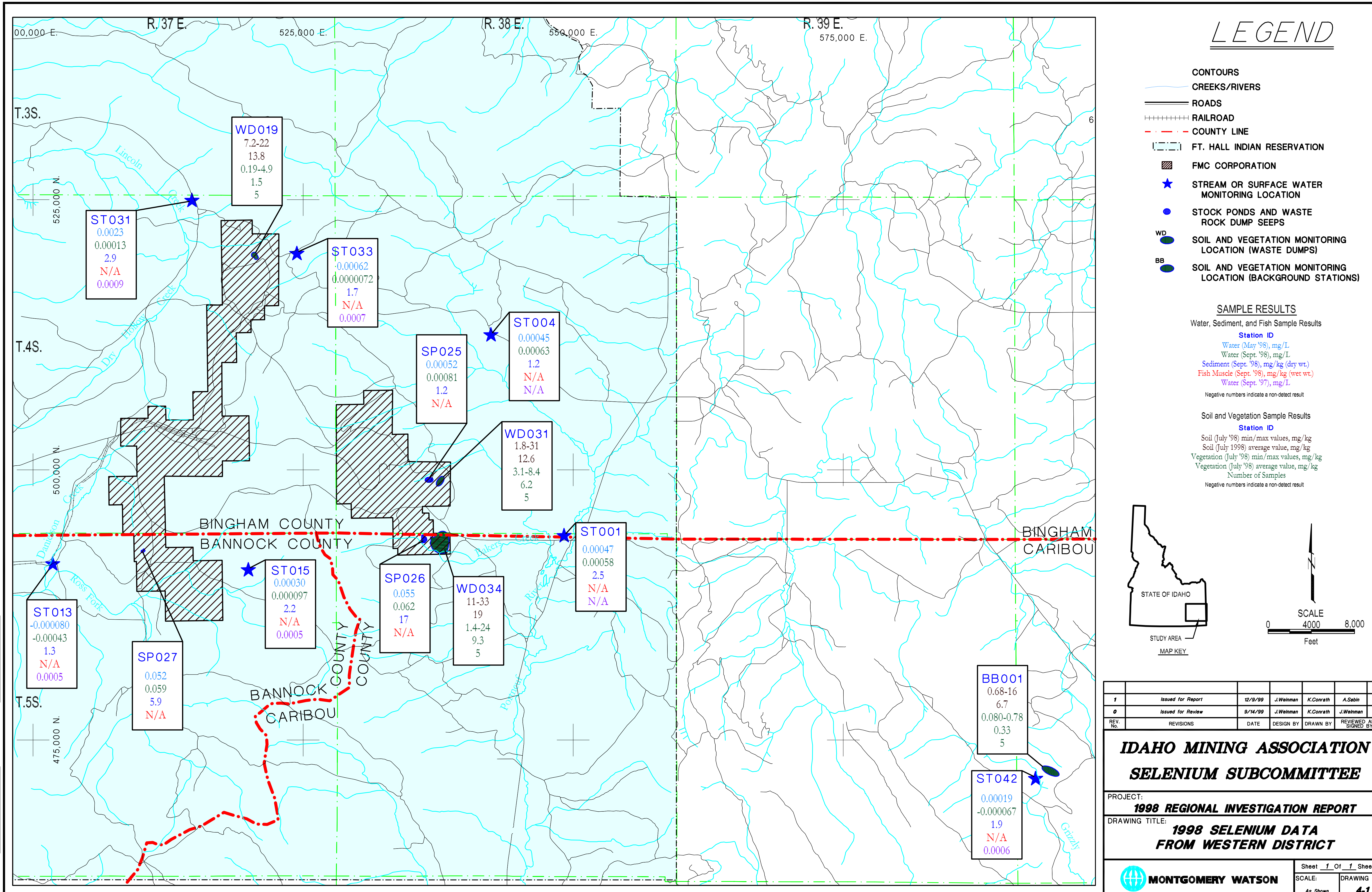
In general, with the exception of selenium and manganese, target element concentrations from mine facility samples were less than UTB values. Two Gay Mine pit ponds had selenium concentrations greater than the cold-water criterion in both May and September. All other target element concentrations in pit lake samples were less than their respective criteria. Table 4-5, *Portneuf River and Ross Creek Watersheds 1998 Pit Pond Surface Water Sample Results,* summarizes samples results that exceeded the cold-water criteria.

TABLE 4-5
PORTNEUF RIVER AND ROSS CREEK WATERSHEDS
1998 PIT POND SURFACE WATER SAMPLE RESULTS

Station	Parameter	Sample Result		Cold-Water Criteria
		May	September	
SP026	Selenium	0.055	0.062	0.005
SP027	Selenium	0.052	0.059	0.005

4.1.2.3 Blackfoot River Watershed

Forty-two surface water-monitoring stations were sampled in the Blackfoot River watershed in 1998. All but three of the monitoring stations were located upstream of Blackfoot Reservoir. The Grizzly Creek site and the two Lincoln Creek sites (ST031 and ST033) were located on tributaries that drain to the Blackfoot River downstream of the reservoir. Of the remaining 39 surface water monitoring sites in the watershed, 29 were stream-monitoring locations and ten were mine facility surface water monitoring stations.



LEGEND
CONTOURS
CREEKS/RIVERS
ROADS
RAILROAD
COUNTY LINE
FT. HALL INDIAN RESERVATION
FMC CORPORATION
STREAM OR SURFACE WATER MONITORING LOCATION
STOCK PONDS AND WASTE ROCK DUMP SEEPS
WD
SOIL AND VEGETATION MONITORING LOCATION (WASTE DUMPS)
BB
SOIL AND VEGETATION MONITORING LOCATION (BACKGROUND STATIONS)
SAMPLE RESULTS
Water, Sediment, and Fish Sample Results
Station ID
Water (May '98), mg/L
Water (Sept. '98), mg/L
Sediment (Sept. '98), mg/kg (dry wt.)
Fish Muscle (Sept. '98), mg/kg (wet wt.)
Water (Sept. '97), mg/L
Negative numbers indicate a non-detect result
Soil and Vegetation Sample Results
Station ID
Soil (July '98) min/max values, mg/kg
Soil (July 1998) average value, mg/kg
Vegetation (July '98) min/max values, mg/kg
Vegetation (July '98) average value, mg/kg
Number of Samples
Negative numbers indicate a non-detect result
R. 37 E.
R. 38 E.
R. 39 E.
525,000 E.
550,000 E.
575,000 E.
T.3S.
T.4S.
T.5S.
525,000 N.
500,000 N.
475,000 N.
WD019
7.2-22
13.8
0.19-4.9
1.5
5
ST031
0.0023
0.00013
2.9
N/A
0.0009
ST033
-0.00062
0.0000072
1.7
N/A
0.0007
ST004
0.00045
0.00063
1.2
N/A
N/A
SP025
0.00052
0.00081
1.2
N/A
WD031
1.8-31
12.6
3.1-8.4
6.2
5
ST001
0.00047
0.00058
2.5
N/A
N/A
BINGHAM COUNTY
BANNOCK COUNTY
BINGHAM
CARIBOU
ST013
-0.000080
-0.00043
1.3
N/A
0.0005
ST015
0.00030
0.000097
2.2
N/A
0.0005
SP026
0.055
0.062
17
N/A
WD034
11-33
19
1.4-24
9.3
5
SP027
0.052
0.059
5.9
N/A
BANNOCK COUNTY
CARIBOU COUNTY
BB001
0.68-16
6.7
0.080-0.78
0.33
5
ST042
0.00019
-0.000067
1.9
N/A
0.0006
Lincoln Creek
Dry Hollow Creek
Danielson Creek
Ross Fork
Grizzly
STATE OF IDAHO
STUDY AREA
MAP KEY
SCALE
0
4000
8,000
Feet
1 | Issued for Report | 12/9/99 | J.Weinman | K.Conrath | A.Sabin
0 | Issued for Review | 9/14/99 | J.Weinman | K.Conrath | J.Weinman
REV. No. | REVISIONS | DATE | DESIGN BY | DRAWN BY | REVIEWED AND SIGNED BY
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1998 REGIONAL INVESTIGATION REPORT
DRAWING TITLE:
1998 SELENIUM DATA FROM WESTERN DISTRICT
MONTGOMERY WATSON
Sheet 1 Of 1 Sheets
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PROJECT NUMBER: 1227028.021804
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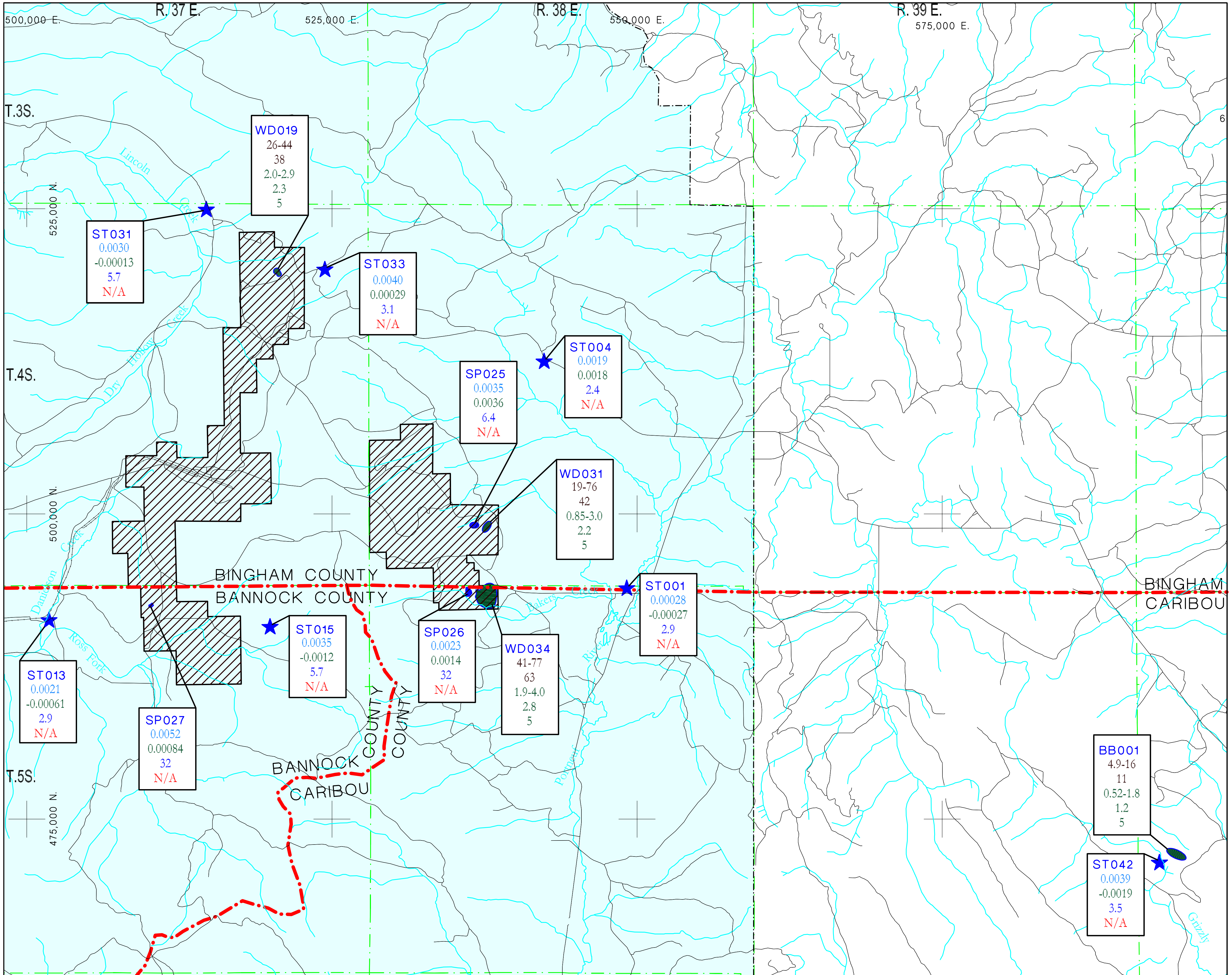

LEGEND

CREEKS/RIVERS
ROADS
RAILROAD
COUNTY LINE
FT. HALL INDIAN RESERVATION
FMC CORPORATION
STREAM OR SURFACE WATER MONITORING LOCATION
STOCK PONDS AND WASTE ROCK DUMP SEEPS
WD SOIL AND VEGETATION MONITORING LOCATION (WASTE DUMPS)
BB SOIL AND VEGETATION MONITORING LOCATION (BACKGROUND STATIONS)

SAMPLE RESULTS

Water, Sediment, and Fish Sample Results
Station ID
Water (May '98), mg/L
Water (Sept. '98), mg/L
Sediment (Sept. '98), mg/kg (dry wt.)
Fish Muscle (Sept. '98), mg/kg (wet wt.)
Water (Sept. '97), mg/L
Negative numbers indicate a non-detect result

Soil and Vegetation Sample Results
Station ID
Soil (July '98) min/max values, mg/kg
Soil (July 1998) average value, mg/kg
Vegetation (July '98) min/max values, mg/kg
Vegetation (July '98) average value, mg/kg
Number of Samples
Negative numbers indicate a non-detect result

STATE OF IDAHO
STUDY AREA
MAP KEY

N

SCALE
0 4000 8,000
Feet

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued for Review	12/6/99	J.Weinman	K.Conrath	J.Weinman

IDAHO MINING ASSOCIATION
SELENIUM SUBCOMMITTEE

PROJECT:
1998 REGIONAL INVESTIGATION REPORT

DRAWING TITLE:
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MONTGOMERY WATSON

Sheet 1 Of 1 Sheets
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AutoCAD FILE: 98CAD-WEST.DWG
PROJECT NUMBER: 1227028.021804

Selenium was the only COPC with a measured concentration that exceeded a cold-water criterion. The selenium concentration was greater than 0.005 mg/l in 11 different Blackfoot River watershed stream water column samples. Figures 4-3, *1998 Selenium Data from Central District*, and 4-4, *1998 Cadmium Data from Central District*, presents Central district stream water selenium and cadmium concentration data, respectively. Table 4-6, *Blackfoot River Watershed 1998 Stream Surface Water Sample Results*, summarizes 1998 samples that exceeded cold-water criteria in the watershed.

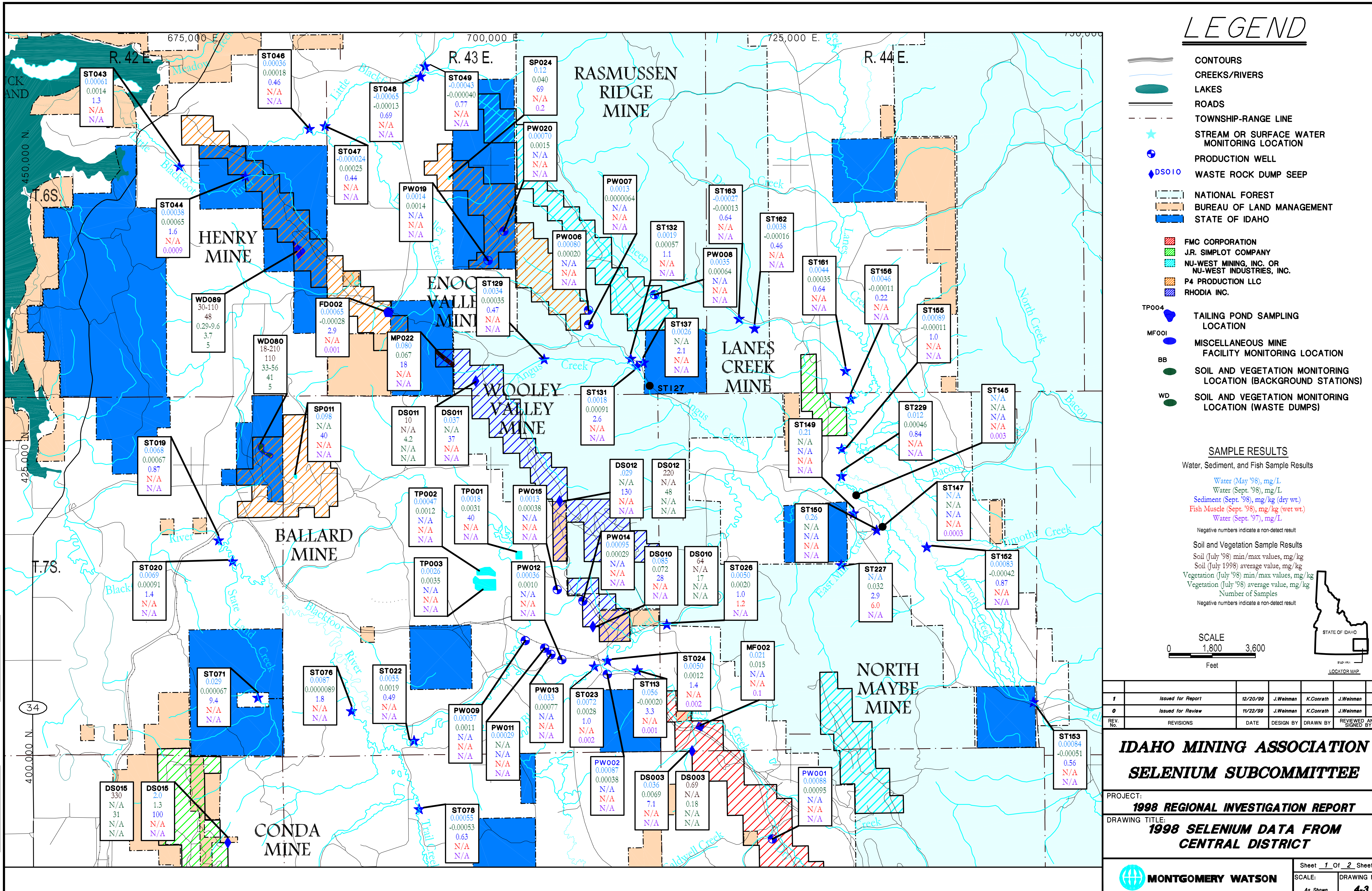
TABLE 4-6
BLACKFOOT RIVER WATERSHED
1998 STREAM SURFACE WATER SAMPLE RESULTS

Station	Parameter	Sample Results		Selenium Criteria	Cadmium Criteria[1]
					September
		May	September		
ST019	Selenium	0.0068		0.005	
ST020	Selenium	0.0069		0.005	
ST022	Selenium	0.0055		0.005	
ST023	Selenium	0.0072		0.005	
ST024	Cadmium		0.0041		0.0017
ST229	Selenium	0.012		0.005	
ST071	Selenium	0.029		0.005	
ST076	Selenium	0.0087		0.005	
ST113	Selenium	0.056		0.005	
ST149	Selenium	0.21		0.005	
ST150	Selenium	0.26		0.005	
ST227	Selenium		0.032	0.005	

Notes:
1. The cold-water criterion is a hardness-dependent value. Calculations for determining the criterion are presented in Appendix D, Table D.24.
2. Blank spaces indicate that the reported value was less than the water quality numeric criteria.

Ten selenium exceedances occurred in May and the eleventh was in September The only September exceedance was measured at ST227, the East Mill Creek sties associated with the trout sampling reach. This location was not sampled in May. However, both of the East Mill Creek sites (ST149 and ST150) samples in May had selenium concentrations greater than the 0.005 mg/l criterion. East Mill Creek drains the North Maybe Mine.

In addition to East Mill Creek, other tributaries to the Blackfoot River with elevated selenium concentrations included Dry Valley Creek, State Land Creek, and Trail Creek. The Dry Valley Creek surface water monitoring station is downstream of both the South Maybe and Dry Valley mines. Data collected in September 1997 indicates that drainage from the South Maybe Mine contributes most of the selenium observed in Dry Valley Creek (MW, 1998a). State Land Creek and Trail Creek drain the eastern aspect of the Conda Mine.



675,000 E.
700,000 E.
725,000 E.
R. 42 E.
R. 43 E.
R. 44 E.
T.6S.
T.7S.
450,000 N.
425,000 N.
400,000 N.
RASMUSSEN RIDGE MINE
HENRY MINE
ENOCH VALLEY MINE
WOOLEY VALLEY MINE
LANES CREEK MINE
BALLARD MINE
NORTH MAYBE MINE
CONDA MINE
ST043 0.00061 0.0014 1.3 N/A N/A
ST046 0.00036 0.00018 0.46 N/A N/A
ST048 -0.00065 -0.00013 0.69 N/A N/A
ST049 -0.00043 -0.000040 0.77 N/A N/A
SP024 0.12 0.040 69 N/A 0.2
PW020 0.00070 0.0015 N/A N/A N/A
ST047 -0.000024 0.00025 0.44 N/A N/A
ST044 0.00038 0.00065 1.6 N/A 0.0009
PW019 0.0014 0.0014 N/A N/A N/A
PW007 0.0013 0.0000064 N/A N/A N/A
ST163 -0.00027 -0.00013 0.64 N/A N/A
ST162 0.0038 -0.00016 0.46 N/A N/A
ST132 0.0019 0.00057 1.1 N/A N/A
PW006 0.00080 0.00020 N/A N/A N/A
PW008 0.0035 0.00064 N/A N/A N/A
ST161 0.0044 0.00035 0.64 N/A N/A
ST156 0.0046 -0.00011 0.22 N/A N/A
ST155 0.00089 -0.00011 1.0 N/A N/A
WD089 30-110 48 0.29-9.6 3.7 5
FD002 0.00065 -0.00028 2.9 N/A 0.001
ST129 0.0034 0.00035 0.47 N/A N/A
ST137 0.0026 N/A 2.1 N/A N/A
WD080 18-210 110 33-56 41 5
MP022 0.080 0.067 18 N/A N/A
ST127
ST131 0.0018 0.00091 2.6 N/A N/A
SP011 0.098 N/A 40 N/A N/A
DS011 10 N/A 4.2 N/A N/A
DS011 0.037 N/A 37 N/A N/A
ST145 N/A N/A N/A N/A 0.003
ST229 0.012 0.00046 0.84 N/A N/A
ST149 0.21 N/A N/A N/A N/A
ST019 0.0068 0.00067 0.87 N/A N/A
DS012 .029 N/A 130 N/A N/A
DS012 220 N/A 48 N/A N/A
TP002 0.00047 0.0012 N/A N/A N/A
TP001 0.0018 0.0031 40 N/A N/A
PW015 0.0013 0.00038 N/A N/A N/A
ST147 N/A N/A N/A N/A 0.0003
ST150 0.26 N/A N/A N/A N/A
PW014 0.00095 0.00029 N/A N/A N/A
DS010 0.085 0.072 28 N/A N/A
DS010 64 N/A 17 N/A N/A
ST026 0.0050 0.0020 1.0 1.2 N/A
ST227 N/A 0.032 2.9 6.0 N/A
ST152 0.00083 -0.00042 0.87 N/A N/A
ST020 0.0069 0.00091 1.4 N/A N/A
TP003 0.0026 0.0035 N/A N/A N/A
PW012 0.00036 0.0010 N/A N/A N/A
MF002 0.021 0.015 N/A N/A 0.1
ST024 0.0050 0.0012 1.4 N/A 0.002
ST071 0.029 0.000067 9.4 N/A N/A
ST076 0.0087 0.0000089 1.8 N/A N/A
ST022 0.0055 0.0019 0.49 N/A N/A
PW013 0.033 0.00077 N/A N/A N/A
ST023 0.0072 0.0028 1.0 N/A 0.002
ST113 0.056 -0.00020 3.3 N/A 0.001
PW009 0.00037 0.0011 N/A N/A N/A
PW011 0.00029 N/A N/A N/A N/A
ST153 0.00084 -0.00051 0.56 N/A N/A
PW002 0.00087 0.00038 N/A N/A N/A
DS003 0.036 0.0069 7.1 N/A N/A
DS003 0.69 N/A 0.18 N/A N/A
PW001 0.00088 0.00095 N/A N/A N/A
DS015 330 N/A 31 N/A N/A
DS015 2.0 1.3 100 N/A N/A
ST078 0.00055 -0.00053 0.63 N/A N/A
34
LEGEND
CONTOURS
CREEKS/RIVERS
LAKES
ROADS
TOWNSHIP-RANGE LINE
STREAM OR SURFACE WATER MONITORING LOCATION
PRODUCTION WELL
DS010 WASTE ROCK DUMP SEEP
NATIONAL FOREST
BUREAU OF LAND MANAGEMENT
STATE OF IDAHO
FMC CORPORATION
J.R. SIMPLOT COMPANY
NU-WEST MINING, INC. OR NU-WEST INDUSTRIES, INC.
P4 PRODUCTION LLC
RHODIA INC.
TP004 TAILING POND SAMPLING LOCATION
MF001 MISCELLANEOUS MINE FACILITY MONITORING LOCATION
BB SOIL AND VEGETATION MONITORING LOCATION (BACKGROUND STATIONS)
WD SOIL AND VEGETATION MONITORING LOCATION (WASTE DUMPS)
SAMPLE RESULTS
Water, Sediment, and Fish Sample Results
Water (May '98), mg/L
Water (Sept. '98), mg/L
Sediment (Sept. '98), mg/kg (dry wt.)
Fish Muscle (Sept. '98), mg/kg (wet wt.)
Water (Sept. '97), mg/L
Negative numbers indicate a non-detect result
Soil and Vegetation Sample Results
Soil (July '98) min/max values, mg/kg
Soil (July 1998) average value, mg/kg
Vegetation (July '98) min/max values, mg/kg
Vegetation (July '98) average value, mg/kg
Number of Samples
Negative numbers indicate a non-detect result
SCALE
0 1,800 3,600
Feet
STATE OF IDAHO
LOCATOR MAP
1 Issued for Report 12/20/99 J.Weinman K.Conrath J.Weinman
0 Issued for Review 11/22/99 J.Weinman K.Conrath J.Weinman
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MONTGOMERY WATSON
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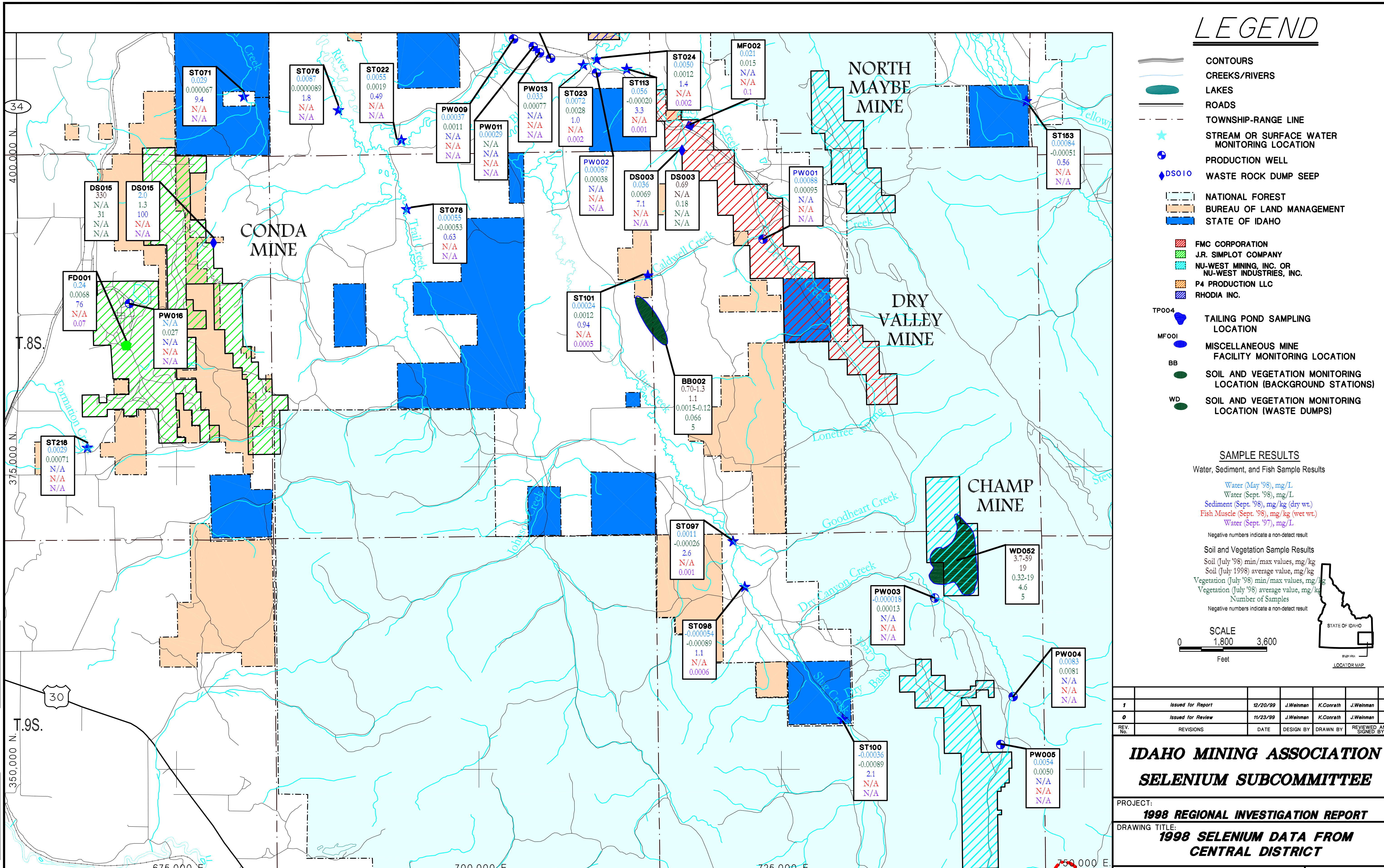

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1	Issued for Report	12/20/99	J.Weinman	K.Conrath	J.Weinman
0	Issued for Review	11/23/99	J.Weinman	K.Conrath	J.Weinman

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MONTGOMERY WATSON

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PROJECT NUMBER: 1227028.021804
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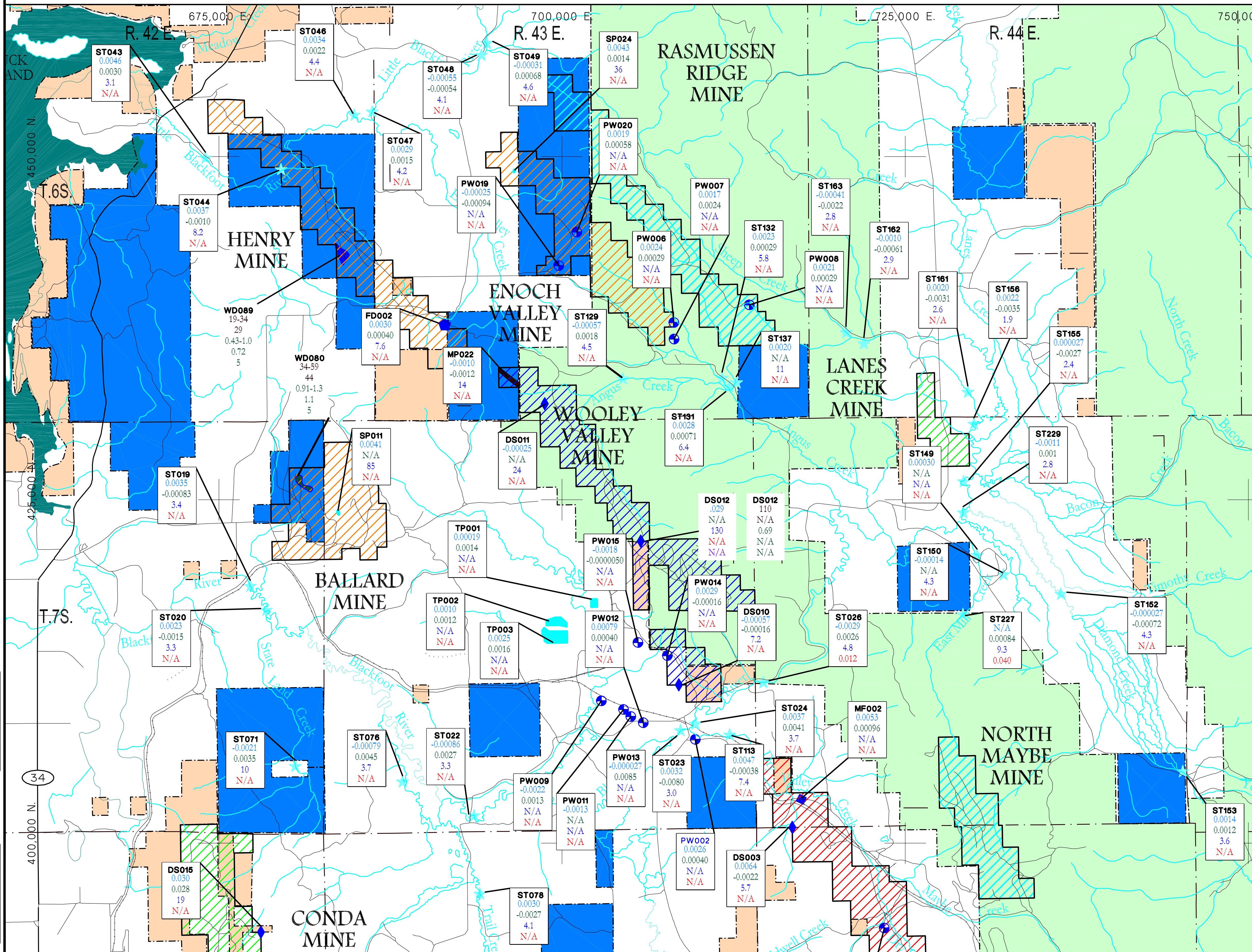

LEGEND

- CONTOURS
- CREEKS/RIVERS
- LAKES
- ROADS
- TOWNSHIP-RANGE LINE
- STREAM OR SURFACE WATER MONITORING LOCATION
- DS010 WASTE ROCK DUMP SEEP
- PRODUCTION WELL
- FRENCH DRAIN
- NATIONAL FOREST
- BUREAU OF LAND MANAGEMENT
- STATE OF IDAHO
- FMC CORPORATION
- J.R. SIMPLOT COMPANY
- NU-WEST MINING, INC. OR NU-WEST INDUSTRIES, INC.
- P4 PRODUCTION LLC
- RHODIA INC.
- BB002 SOIL AND VEGETATION MONITORING LOCATION (BACKGROUND STATIONS)
- WD SOIL AND VEGETATION MONITORING LOCATION (WASTE DUMPS)
- MF001 MISCELLANEOUS MINE FACILITY MONITORING LOCATION

SAMPLE RESULTS

Water, Sediment, and Fish Sample Results

Water (May '98), mg/L
Water (Sept. '98), mg/L
Sediment (Sept. '98), mg/kg (dry wt.)
Fish Muscle (Sept. '98), mg/kg (wet wt.)
Water (Sept. '97), mg/L
Negative numbers indicate a non-detect result

Soil and Vegetation Sample Results

Soil (July '98) min/max values, mg/kg
Soil (July 1998) average value, mg/kg
Vegetation (July '98) min/max values, mg/kg
Vegetation (July '98) average value, mg/kg
Number of Samples
Negative numbers indicate a non-detect result

SCALE
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Feet

STATE OF IDAHO
LOCATOR MAP

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1	Issued for Report	12/20/99	J.Weinman	K.Conrath	J.Weinman
0	Issued for Review	11/22/99	J.Weinman	K.Conrath	J.Weinman

IDAHO MINING ASSOCIATION
SELENIUM SUBCOMMITTEE

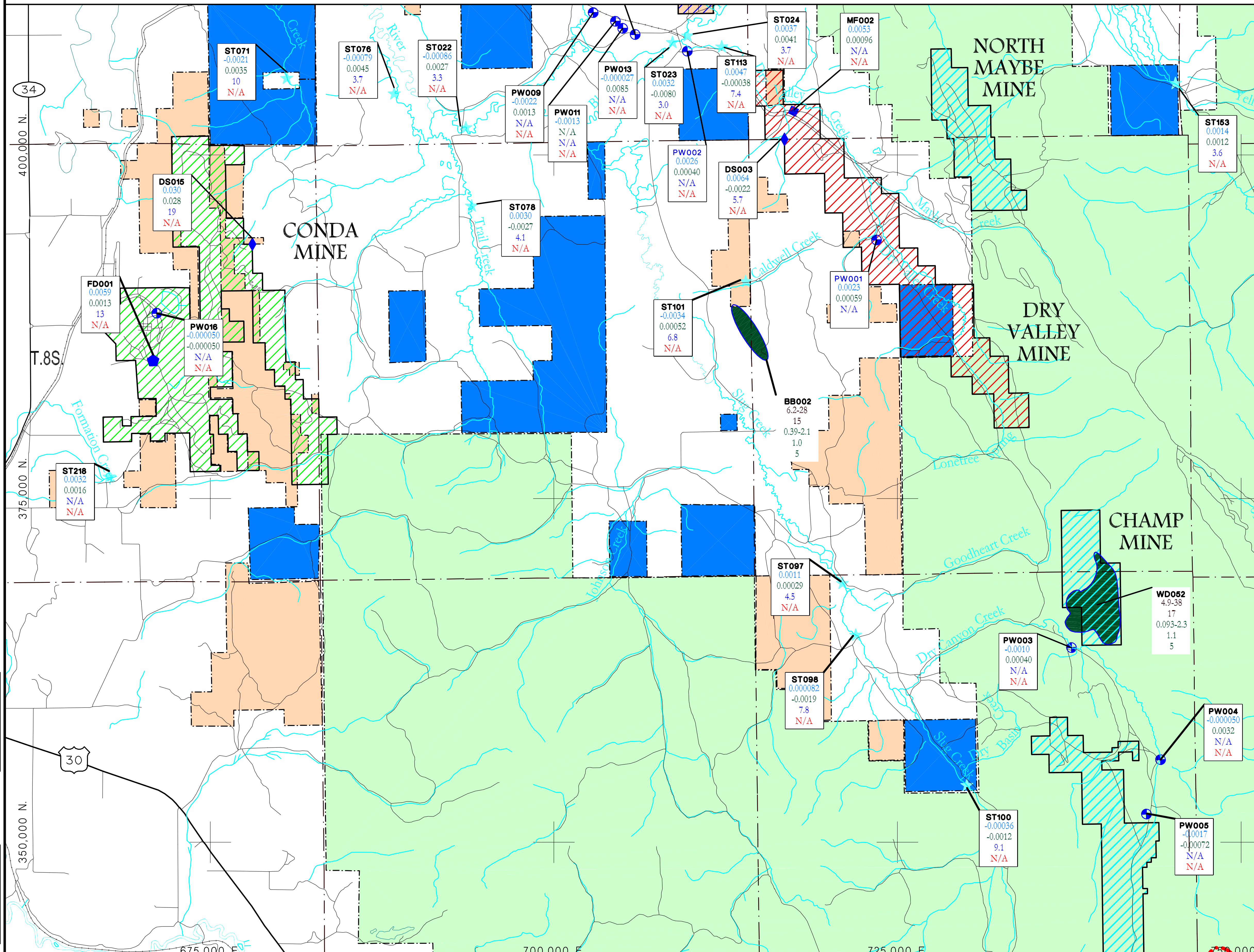
PROJECT:
1998 REGIONAL INVESTIGATION REPORT

DRAWING TITLE:
1998 CADMIUM DATA FROM CENTRAL DISTRICT

MONTGOMERY WATSON

Sheet 1 Of 2 Sheets
SCALE: As Shown
DRAWING No. 4-4

PROJECT NUMBER: 1227028.021604
AutoCAD FILE: 98cad-cen.dwg



LEGEND

- CONTOURS
- CREEKS/RIVERS
- LAKES
- ROADS
- TOWNSHIP-RANGE LINE
- STREAM OR SURFACE WATER MONITORING LOCATION
- DS010 WASTE ROCK DUMP SEEP
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- BB002 SOIL AND VEGETATION MONITORING LOCATION (BACKGROUND STATIONS)
- WD SOIL AND VEGETATION MONITORING LOCATION (WASTE DUMPS)
- MF001 MISCELLANEOUS MINE FACILITY MONITORING LOCATION

SAMPLE RESULTS

Water, Sediment, and Fish Sample Results

Water (May '98), mg/L
Water (Sept. '98), mg/L
Sediment (Sept. '98), mg/kg (dry wt.)
Fish Muscle (Sept. '98), mg/kg (wet wt.)
Water (Sept. '97), mg/L

Negative numbers indicate a non-detect result

Soil and Vegetation Sample Results

Soil (July '98) min/max values, mg/kg
Soil (July 1998) average value, mg/kg
Vegetation (July '98) min/max values, mg/kg
Vegetation (July '98) average value, mg/kg
Number of Samples

Negative numbers indicate a non-detect result

SCALE 0 1,800 3,600 Feet

STATE OF IDAHO
LOCATOR MAP

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1	Issued for Report	12/20/99	J.Weinman	K.Conrath	J.Weinman
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IDAHO MINING ASSOCIATION SELENIUM SUBCOMMITTEE

PROJECT: **1998 REGIONAL INVESTIGATION REPORT**

DRAWING TITLE: **1998 CADMIUM DATA FROM CENTRAL DISTRICT**

MONTGOMERY WATSON

Sheet 2 Of 2 Sheets

SCALE: As Shown

DRAWING No. 4-4

PROJECT NUMBER: 1227028.021804

AutoCAD FILE: 98cad-cen.dwg

Several surface water samples contained cadmium concentrations in May that exceeded the hardness-specific criteria. In all cases the reported concentration and the criteria were less than the UTB and, therefore, these samples were not considered true exceedances. l District stream water selenium and cadmium concentrations, respectively. Nine different mine facilities had target element concentrations that exceeded the cold-water criteria. With the exception of one cadmium and one zinc sample, all of the exceedances were for selenium. All five waste rock dump seeps sampled in May reported selenium exceedances. In September, the three seeps that were flowing had selenium concentrations greater than the criteria. Selenium was the only target element in September that exceeded the criteria in mine facility samples.

The Conda Mine West Limb dump seep (DS015) had the highest reported selenium concentrations in 1998. The May value was 1.3 mg/l and in September the concentration was 2.0 mg/l. The September sample also had the highest conductivity value of any 1998 samples.

Table 4-7 *Blackfoot River Watershed Mine Facility Surface Water Sample Results*, summarizes, by station and target element, the cold-water criteria exceedances.

TABLE 4-7
BLACKFOOT RIVER WATERSHED
MINE FACILITY SURFACE WATER SAMPLE RESULTS

Station	Parameters	Sample Result		Selenium Criterion	Cold-water Criterion[1]	
		May	September		May	September
DS003	Selenium	0.036	0.0069	0.005		
DS010	Selenium	0.085	0.072	0.005		
DS011	Selenium	0.037		0.005		
DS012	Selenium	1.4		0.005		
DS012	Zinc	1.1			0.98	
DS015	Selenium	2	1.3	0.005		
DS015	Cadmium	0.030			0.028	0.011
FD001	Selenium	0.24	0.068	0.005		
MF002	Selenium	0.021	0.015	0.005		
MP022	Selenium	0.08	0.067	0.005		
SP011	Selenium	0.098		0.005		

Notes: 1. The cold-water criterion is a hardness-dependent value. Calculations for determining the criterion are presented in Appendix D, Table D.24.
Blank spaces indicate that the reported value was less than the water quality criterion.

4.1.2.4 Little Blackfoot River Watershed

Nine surface water-monitoring stations in the Little Blackfoot River watershed were sampled during 1998. Of the nine stations, six were stream sites and three were mine facilities. Surface water station locations are shown Figure 3-1. Figure 4-3 and 4-4 present 1998 selenium and cadmium concentrations in watershed surface water samples.

In general, stream samples reported concentrations less than UTB values. The exception was manganese. Six of twelve samples had concentrations greater than the UTB. Monitoring station ST049, Little Blackfoot River upstream of Reese Creek, had the highest reported manganese values in both May and September. None of the Little Blackfoot River watershed stream samples contained concentrations exceeding water quality criteria. While several May stream station samples had cadmium concentrations greater than the hardness-specific criteria, in all cases, the measured cadmium concentration and the calculated criterion value were less than the UTB. Therefore, these were not considered true exceedances.

The Enoch Valley Mine North Pond (SP024) and the Wooley Valley Mine Unit IV Pit Pond (MP022) were the only mine facilities in the Little Blackfoot watershed that had COPC concentrations that were greater than the cold-water criteria. Both facilities had selenium concentrations greater than the selenium cold-water criterion in May and September. None of the mine facility samples had cadmium, nickel or zinc concentrations that exceeded the hardness-dependent criterion. The May sample from SP024 had a cadmium concentration greater than the criterion. However, both the measured and calculated criterion values were less than both the UTB and, therefore, the value was not considered a true exceedance. Table 4-8, *Little Blackfoot River Watershed 1998 Mine Facility Surface Water Sample Results*, summarizes mine facility samples that exceeded the numeric criterion.

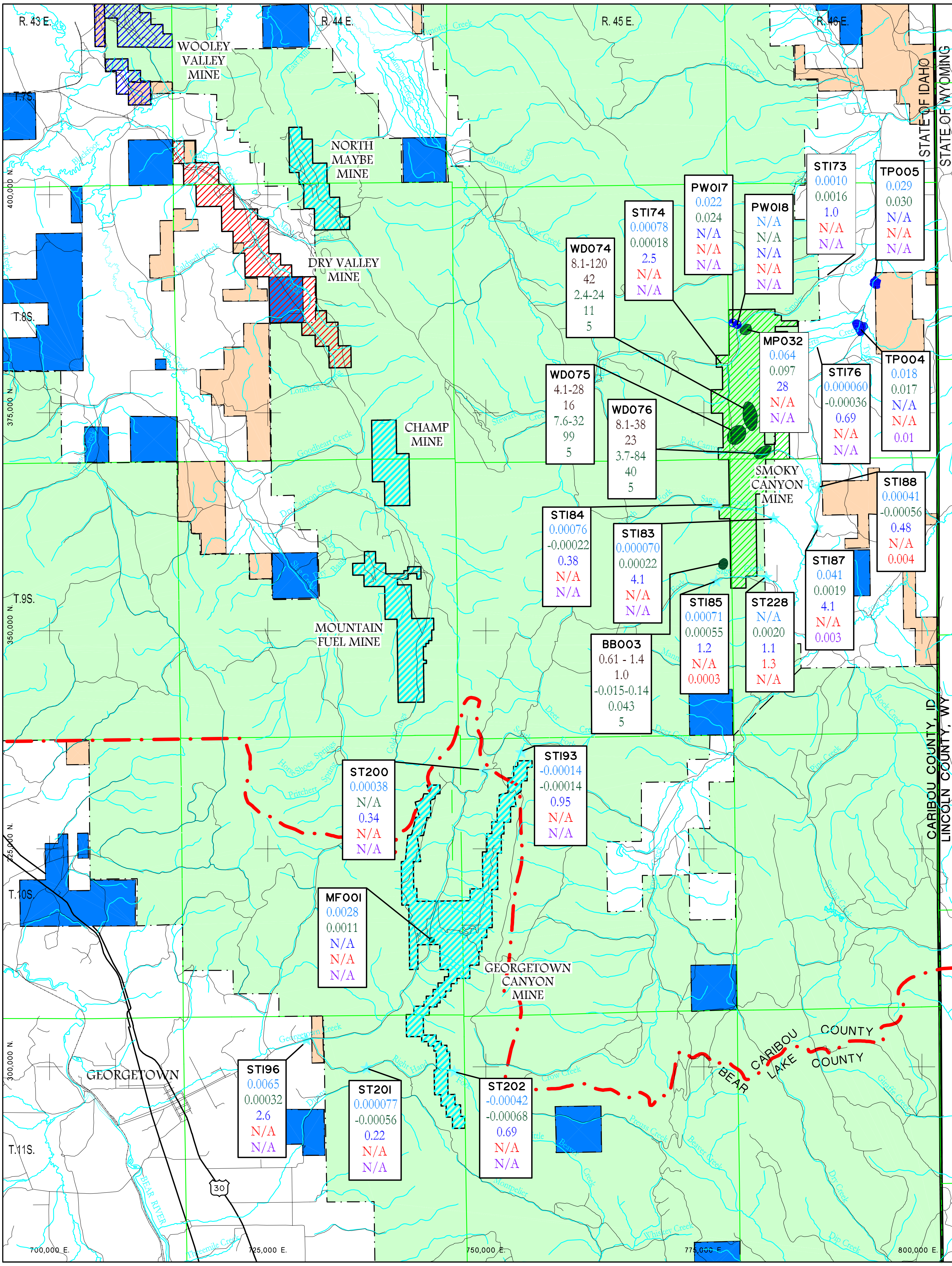
TABLE 4-8
LITTLE BLACKFOOT RIVER WATERSHED
1998 MINE FACILITY SURFACE WATER SAMPLE RESULTS

Station	Parameter	Sample Result		Selenium Criterion
		May	September	
SP024	Selenium	0.12	0.04	0.005
MP022	Selenium	0.08	0.067	0.005

4.1.2.5 Bear River Watershed

Seven surface water monitoring stations in the Bear River watershed were sampled during 1998 including five stream monitoring stations and two mine facility stations. The station locations are shown on Figure 3-1. Figure 4-5, *Selenium Data from Smoky Canyon Mine and Georgetown Canyon Min*e and Figure 4-6, *Cadmium Data from Smoky Canyon Mine and Georgetown Canyon Mine,* present 1998 stream and mine facility selenium and cadmium results for the watershed (with the exception of the Conda Mine french drain [FD001] and Formation Creek [ST218] which are shown on Figures 4-3 and 4-4).

In general, stream samples contained concentrations of target elements less than UTB values. The exceptions were Georgetown Creek downstream of the Georgetown Canyon Mine (ST196) and Formation Creek at the headwaters (ST218). In May, the Georgetown Creek selenium concentration was 0.0065 mg/l. The September selenium concentration at Georgetown Creek was less than both the UTB and the criterion. While the Formation Creek May sample had reportable nickel and zinc values, the concentrations were less than the hardness-specific criteria. None of the other target



LEGEND

- CONTOURS
- CREEKS/RIVERS
- ROADS
- RAILROAD
- STATE LINE
- COUNTY LINE
- NATIONAL FOREST
- STATE OF IDAHO
- BUREAU OF LAND MANAGEMENT
- STREAM OR SURFACE WATER MONITORING LOCATION
- TP004 TAILING POND SAMPLING LOCATION
- FMC CORPORATION
- J.R. SIMPLOT COMPANY
- NU-WEST MINING, INC. OR NU-WEST INDUSTRIES, INC.
- RHODIA INC.
- WD SOIL AND VEGETATION MONITORING LOCATION (WASTE DUMPS)
- BB SOIL AND VEGETATION MONITORING LOCATION (BACKGROUND STATIONS)
- MF MISCELLANEOUS FACILITIES
- PRODUCTION WELL

SAMPLE RESULTS

Water, Sediment, and Fish Sample Results

Water (May '98), mg/L
Water (Sept. '98), mg/L
Sediment (Sept. '98), mg/kg (dry wt.)
Fish Muscle (Sept. '98), mg/kg (wet wt.)
Water (Sept. '97), mg/L
Negative numbers indicate a non-detect result

Soil and Vegetation Sample Results

Soil (July '98) min/max values, mg/kg
Soil (July 1998) average value, mg/kg
Vegetation (July '98) min/max values, mg/kg
Vegetation (July '98) average value, mg/kg
Number of Samples
Negative numbers indicate a non-detect result

STATE OF IDAHO
STUDY AREA
MAP KEY

SCALE
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Feet

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0	Issued for Review	12/6/99	J.Weinman	K.Conrath	J.Weinman

IDAHO MINING ASSOCIATION
SELENIUM SUBCOMMITTEE

PROJECT: 1998 REGIONAL INVESTIGATION REPORT

DRAWING TITLE: 1998 SELENIUM DATA FROM SMOKY CANYON MINE AND GEORGETOWN CANYON MINE

MONTGOMERY WATSON

Sheet 1 Of 1 Sheets
SCALE: As Shown
DRAWING No. 4-5

PROJECT NUMBER: 1227028.021804
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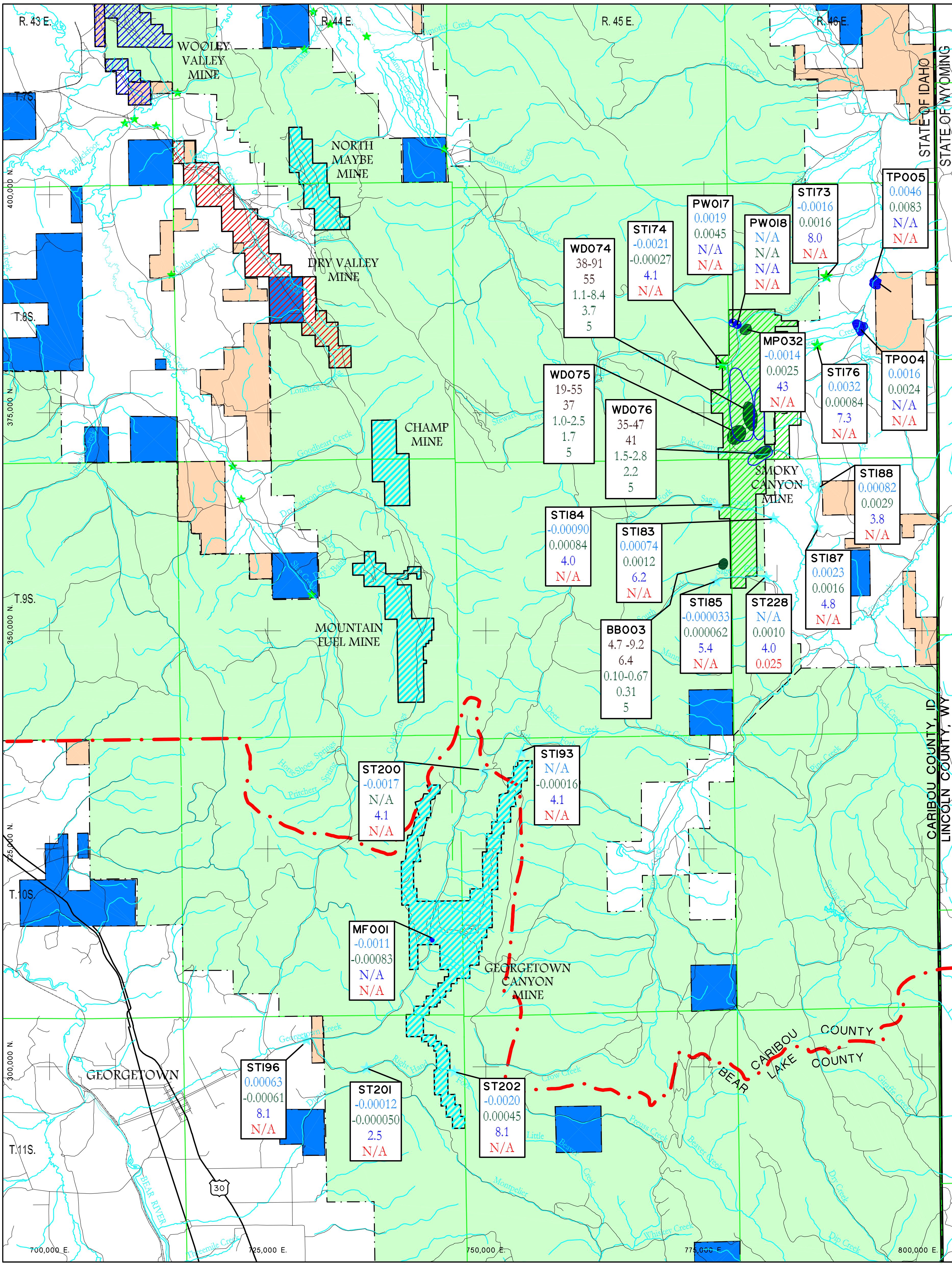

LEGEND

- CONTOURS
- CREEKS/RIVERS
- ROADS
- RAILROAD
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- BUREAU OF LAND MANAGEMENT
- STREAM OR SURFACE WATER MONITORING LOCATION
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- PRODUCTION WELL
- TP004 TAILING POND SAMPLING LOCATION
- MF001 MISCELLANEOUS MINE FACILITY MONITORING LOCATION

SAMPLE RESULTS

Water, Sediment, and Fish Sample Results

Water (May '98), mg/L
Water (Sept. '98), mg/L
Sediment (Sept. '98), mg/kg (dry wt.)
Fish Muscle (Sept. '98), mg/kg (wet wt.)
Water (Sept. '97), mg/L
Negative numbers indicate a non-detect result

Soil and Vegetation Sample Results

Soil (July '98) min/max values, mg/kg
Soil (July 1998) average value, mg/kg
Vegetation (July '98) min/max values, mg/kg
Vegetation (July '98) average value, mg/kg
Number of Samples
Negative numbers indicate a non-detect result

STATE OF IDAHO
STUDY AREA
MAP KEY

SCALE
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Feet

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0	Issued for Review	11/11/99	J.Weinman	K.Conrath	J.Weinman

IDAHO MINING ASSOCIATION SELENIUM SUBCOMMITTEE

PROJECT:
1998 REGIONAL INVESTIGATION REPORT

DRAWING TITLE:
1998 CADMIUM DATA FROM SMOKY CANYON MINE AND GEORGETOWN CANYON MINE

MONTGOMERY WATSON

Sheet 1 Of 1 Sheets
SCALE: As Shown
DRAWING No. 4-6

PROJECT NUMBER: 1227028.021804
AutoCAD FILE: 98-CAD-SC.DWG

element concentrations in stream samples from the Bear River watershed were greater than the hardness-dependent criteria.

One mine facility located in the watershed had a surface water concentrations that exceeded the selenium cold-water criterion. Selenium concentrations at the Conda Mine French Drain (FD001) were 0.24 mg/l and 0.068 mg/l in May and September, respectively. The french drain also had a cadmium concentration greater than the hardness-specific criterion in May. However, both the measured and calculated criterion values were less than the UTB value and, therefore, this value is not considered a true exceedance. None of the other target element concentrations in mine facility surface water samples collected during 1998 were greater than the hardness-specified criteria. Table 4-9, *Bear River Watershed 1998 Sampling Results*, summarizes data that exceeded the numeric criterion during 1998.

TABLE 4-9
BEAR RIVER WATERSHED 1998 SAMPLING RESULTS

Station	Parameter	Sample Result		Cold-Water Criterion
		May	September	
ST196	Selenium	0.0065		0.005
FD001	Selenium	0.24	0.068	0.005

4.1.2.6 Salt River Watershed

Ten of the Salt River watershed surface water monitoring stations sampled in 1998 were stream-monitoring sites and three were mine facility surface water monitoring locations. The station locations are shown on Figure 3-1.

In general, stream water column COPC concentrations in the Salt River watershed were less than the UTB values. The exception was manganese, which had 11 of 18 samples with concentrations greater than the UTB. Monitoring station ST187, North Fork Sage Creek, downstream of Pole Creek, had the highest reported manganese values in the watershed in both May and September. The North Fork Sage Creek Station (ST187) also reported a selenium concentration greater than the cold-water criteria in May. This was the only stream sample from within the watershed with a concentration exceeding the criteria for any of the six target elements.

All three mine facility monitoring stations had selenium concentrations greater than the cold-water criterion. In all cases, both the May and September selenium concentrations were greater than 0.005 mg/l. The September cadmium concentration in the Smoky Canyon Mine Tailings Pond #2 sample exceeded the cadmium hardness-specific criterion. Several other mine facility samples contained cadmium concentrations greater than the hardness-specified criterion. However, the measured and calculated criterion values in these samples were less than the UTB and, therefore, were not considered true exceedances. In general, manganese, nickel, vanadium and zinc concentrations in the mine facility samples were greater than the corresponding UTB values. However, none of the concentrations exceeded the respective criteria.

Figures 4-5 and 4-6 present 1998 selenium and cadmium results for Salt River watershed stream monitoring and mine facility stations. Table 4-10, *Salt River Watershed 1998 Surface Water Sampling Results*, summarizes the 1998 samples with concentrations greater than the numeric criterion.

TABLE 4-10 SALT RIVER WATERSHED 1998 SURFACE WATER SAMPLING RESULTS					
Station	Parameter	Sample Results		Selenium Criterion	Cadmium Criterion[1]
		May	September		September
ST187	Selenium	0.041		0.005	
MP032	Selenium	0.064	0.097	0.005	
TP004	Selenium	0.018	0.017	0.005	
TP005	Selenium	0.029	0.03	0.005	
TP005	Cadmium		0.0083		0.0016

Notes: 1.The cold-water criterion is a hardness-dependent value. Calculations for determining the criterion are presented in Appendix D, Table D-24.
2. Blank spaces indicate that the reported value was less than the water quality criterion.

4.2 SEDIMENT

Sediment samples were collected during September 1998 at 54 stream, five waste rock dump seeps, two french drains, and seven stock pond surface water monitoring stations. Sediment samples were not collected at tailings pond stations. There are no promulgated sediment standards for concentrations of the six target elements. Surface water monitoring stations are presented in Table 3-1, and mine facilities are identified in Table 3-2. The locations of the monitoring stations are shown on Figure 3-1.

4.2.1 Target Element Concentrations in Sediments

The following sections summarize 1998 surface water sediment sampling results for the six target elements (selenium, cadmium, manganese, nickel, vanadium and zinc). Sediment samples were only collected during September. Validated laboratory results for the 1998 sediment sampling are presented Appendix D, Tables D.7 through D.12, for selenium, cadmium, manganese, nickel, vanadium and zinc, respectively. Table 4-11, *1998 Sediment Summary Statistics*, presents summary statistics for stream and mine facility sediment data.

TABLE 4-11 1998 SEDIMENT SAMPLE SUMMARY STATISTICS								
Parameter[1]	Number of Samples	UTB[2]	Number Less than UTB	Minimum	Mean	Maximum	UCL[3]	Number Greater Than UCL
Streams								
Selenium	54	0.22	0	0.22	2.0	9.4	2.3	11
Cadmium	54	0.31	0	1.8	5.0	11	8.8	4
Manganese	54	4.8	0	4.9	1086	6500	8861	0
Nickel	54	2.3	0	12	39	97	81.8	1
Vanadium	54	3.0	0	16	50	95	69	9
Zinc	54	8.1	0	20	88	270	216	2
Mine Facilities								
Selenium	14	0.22	0	1.2	48	240	2.3	13
Cadmium	14	0.31	0	5.7	39	130	8.8	10
Manganese	14	4.8	0	72	1212	6000	8861	0
Nickel	14	2.3	0	36	182	630	81.8	7
Vanadium	14	3.0	0	55	317	1000	69	11
Zinc	14	8.1	0	130	774	2100	216	11

Notes:
1. All units are milligrams per kilogram (mg/kg).
2. UTB = Upper Tolerance Bound (See subsection 3.4.1 for discussion on UTBs)
3. UCL = Upper Confidence Limit (See subsection 3.5.4 for discussion of UCLs). The UCL represents the upper 95th percent confidence interval on the 95th percentile of the background data.

The sediment concentration UTBs were relatively low when compared to concentrations occurring in natural, background sediments. Consequently, most sediment sample concentrations exceeded the UTBs indicating that the analytes exist at levels greater than detection limits.

4.2.1.1 Sediment Concentration in Background Samples

Sediment samples were collected at three background monitoring stations. A ninety-five percent upper confidence limit (UCL) on the ninety-fifth percentile was calculated using background concentration data. The UCL is the threshold value used to indicate when a sample concentration is elevated above background and may be impacted by phosphate-mining activities.

The methodology used to calculate the UCL's is presented in subsection 3.5.4. Table 4-11 presents sediment UCL values.

4.2.1.2 Portneuf River and Ross Fork Watersheds Sediment

In general, target element concentrations in Portneuf River and Ross Fork stream sediments were less than UCL values. The sediment sample collected from the monitoring station, Portneuf River upstream of Baker Creek (ST001) had a selenium sediment concentration greater than the UCL. One sample had a vanadium concentration that was slightly elevated above the UCL value. These were the only stream sediment samples from the watershed with target element concentrations exceeding the UCL. Table 4-12, *Portneuf River and Ross Fork Watershed 1998 Stream Sediment Data*, summarizes the sediment data reported for the watersheds. Figures 4-1 and 4-2 illustrates sample locations and selenium and cadmium concentrations from various media the Portmeuf and Ross Fork watershed.

TABLE 4-12
PORTNEUF RIVER AND ROSS FORK WATERSHED
1998 STREAM SEDIMENT DATA

Parameter	Range (mg/kg)	Mean (mg/kg)	UCL Values (mg/kg)[1]	Number of Samples	Number of Exceedances
Selenium	1.3 – 2.5	1.8	2.3	4	1
Cadmium	2.4 – 5.7	3.5	8.8	4	0
Manganese	280 – 590	420	8861	4	0
Nickel	12 – 40	22	81.8	4	0
Vanadium	26 – 71	41	69	4	1
Zinc	35 – 150	73.5	216	4	0

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

Sediment target element concentrations collected from the Gay Mine Z Pit Lake and JD Pit Lake were greater than the UCL values. Of the remaining target element concentrations in sediment collected from the Gay Mine W Pit Lake, only vanadium concentrations were greater than the respective UCL values. The Gay Mine Z Pit Lake generally had the highest reported target element sediment concentrations.

Table 4-13, *Portneuf River and Ross Fork Watershed 1998 Mine Facility Sediment Data*, summarizes the 1998 sediment data reported for the mine facility sediments and the associated number of samples greater than the UCL.

TABLE 4-13 PORTNEUF RIVER AND ROSS FORK WATERSHED 1998 MINE FACILITY SEDIMENT DATA					
Parameter	**Range (mg/kg)**	**Mean (mg/kg)**	**UCL Values (mg/kg)[1]**	**Number of Samples**	**Number Greater than UCL**
Selenium	1.2 – 17	8.0	2.3	3	2
Cadmium	6.4 – 130	56.1	8.8	3	2
Manganese	80 – 690	353	8861	3	
Nickel	40 – 170	90.3	81.8	3	2
Vanadium	77 – 490	242	69	3	3
Zinc	130 – 830	520	216	3	2

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

Blank cells indicate that the reported concentrations did not exceed the UCL value.

4.2.1.3 Blackfoot River Watershed Sediment

Sediment samples were collected from 38 Blackfoot River surface water monitoring stations. All but three of the locations are located upstream of the Blackfoot Reservoir. Grizzly Creek (ST042) and the two Lincoln Creek sites (ST031 and ST033) are located on tributaries draining to the Blackfoot River downstream of Blackfoot Reservoir. The Grizzly Creek station is a background site. The Caldwell Creek monitoring station (ST101), which is located on a tributary to Slug Creek, is also a background location. The station locations are shown on Figure 3-1. Table 4-15, *Blackfoot River Watershed 1998 Mine Facility Sediment Data,* summarizes the watershed mine facility sediment data.

In general, target element concentrations in Blackfoot River watershed stream sediments were less than corresponding UCL values, with the exception of monitoring stations located on tributary streams downstream of discharging mine facilities. Six stream stations located in the watershed reported sediment selenium concentrations greater than the UCL value. The Lincoln Creek (ST031) and East Mill Creek (ST228) sites both had the maximum measured selenium concentration of 2.9 mg/kg. Four stream sediment samples had cadmium concentrations exceeding the UCL value. Five sediment samples had vanadium concentrations greater than the UCL value. Two sites reported zinc concentrations greater than the UCL value.

Figures 4-3 and 4-4 present 1998 selenium and cadmium sediment concentration data for monitoring stations in the upper Blackfoot River. The Grizzly Creek and Lincoln Creek station sediment data are presented on Figures 4-1 and 4-2 for selenium and cadmium, respectively. Table 4-14, *Blackfoot River Watershed 1998 Stream Sediment Data,* summarizes the 1998 sediment data measured in stream samples.

TABLE 4-14 BLACKFOOT RIVER WATERSHED 1998 STREAM SEDIMENT DATA					
Parameter	**Range (mg/kg)**	**Mean (mg/kg)**	**UCL Values (mg/kg)[1]**	**Number of Samples**	**Number Greater than UCL**
Selenium	0.22 – 9.4	1.6	2.3	38	6
Cadmium	1.9 – 11	4.9	8.8	38	4
Manganese	130 – 2000	763	8861	38	0
Nickel	20 – 97	42.2	81.8	38	1
Vanadium	24 – 85	50.7	69	38	5
Zinc	22 – 270	93	216	38	2

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

Sediments collected from mine facilities generally had target element concentrations that exceeded the UCL values. Selenium concentrations in all six sediment samples collected from watershed mine facilities were greater than the UCL value. Four of six mine facilities had cadmium, vanadium and zinc concentrations in sediment greater than the UCL values, while three of six mine facilities had nickel concentrations that exceeded the UCL.

TABLE 4-15
BLACKFOOT RIVER WATERSHED
1998 MINE FACILITY SEDIMENT DATA

Parameter	Range (mg/kg)	Mean (mg/kg)	UCL Values (mg/kg)[1]	Number of Samples	Number Greater than UCL
Selenium	7.1 – 100	43.8	2.3	6	6
Cadmium	5.7 – 85	29.2	8.8	6	4
Manganese	72 – 740	371	8861	6	0
Nickel	36 – 330	147	81.8	6	3
Vanadium	55 – 1000	324	69	6	4
Zinc	140 – 1800	698	216	6	4

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

4.2.1.4 Little Blackfoot River Watershed Sediment

Sediment samples were collected from nine surface water monitoring stations located in the Little Blackfoot River watershed. Six of the stations were stream sites and three were mine facilities. The station locations are shown on Figure 3-1.

None of the stream sediment samples had target element concentrations greater than the UCL value with the exception of the vanadium value measured at the station ST044 (Little Blackfoot River downstream of Henry Mine). Figures 4-3 and 4-4 present the 1998 selenium and cadmium sediment data from the Little Blackfoot River watershed. Table 4-16, *Little Blackfoot River Watershed 1998 Stream Sediment Data*, summarizes the 1998 stream sediment data.

TABLE 4-16
LITTLE BLACKFOOT RIVER WATERSHED
1998 STREAM SEDIMENT DATA

Parameter	Range (mg/kg)	Mean (mg/kg)	UCL Values (mg/kg)[1]	Number of Samples	Number of Exceedances
Cadmium	3.1 – 8.2	4.8	8.8	6	0
Manganese	120 – 2000	610	8861	6	0
Nickel	22 – 69	42.5	81.8	6	0
Selenium	0.44 – 1.6	0.88	2.3	6	0
Vanadium	39 – 95	59.3	69	6	1
Zinc	67 – 120	85.2	216	6	0

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

With the exception of manganese, mine facility sediment concentrations were typically higher than the UCL values. All mine facilities reported selenium and zinc concentrations in sediment greater than UCL values and two of three mine facilities had cadmium and vanadium sediment concentrations exceeding UCL's. Table 4-17, *Little Blackfoot River Watershed 1998 Mine Facility Sediment Data*, summarizes the 1998 sediment data measured in mine facility samples.

TABLE 4-17 LITTLE BLACKFOOT RIVER WATERSHED 1998 MINE FACILITY SEDIMENT DATA					
Parameter	**Range (mg/kg)**	**Mean (mg/kg)**	**UCL Values (mg/kg)[1]**	**Number of Samples**	**Number of Exceedances**
Selenium	2.9 – 240	73.4	2.3	3	3
Cadmium	7.2 – 130	42.3	8.8	3	2
Manganese	230 – 5800	1578	8861	3	0
Nickel	58 – 630	232	81.8	3	1
Vanadium	62 – 780	314	69	3	2
Zinc	220 – 2100	852	216	3	3

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

4.2.1.5 Bear River Watershed Sediment

Five surface water monitoring stations in the Bear River watershed were sampled for sediment during 1998 including four stream monitoring stations and one mine facility surface water station. The Georgetown Creek site ST200 and Central Farmers Plant Thickener (station MF001) were not sampled for sediment. The station locations are shown on Figure 3-1.

In general, target element concentrations in stream sediments within the Bear River watershed were less than the corresponding UCL values. The exception was the selenium concentration of 2.6 mg/kg that was measured in the sample collected at the Georgetown Creek station ST196. This location is downstream of Georgetown Canyon Mine. Table 4-18, *Bear River Watershed 1998 Stream Sediment Data,* summarizes the 1998 stream sample sediment data.

The Conda Mine french drain was the only mine facility in the watershed sampled for sediments. With the exception of manganese and nickel, the target element concentrations were greater than the corresponding UCL values. Table 4-19, *Bear River Watershed 1998 Mine Facility Sediment Data*, summarizes the 1998 sediment data results for the Conda Mine french drain.

TABLE 4-18 BEAR RIVER WATERSHED 1998 STREAM SEDIMENT DATA					
Parameter	**Range (mg/kg)**	**Mean (mg/kg)**	**UCL Values (mg/kg)[1]**	**Number of Samples**	**Number Greater than UCL**
Selenium	0.22 – 2.6	0.96	2.3	4	1
Cadmium	1.8 – 8.1	4.1	8.8	4	0
Manganese	49 – 3800	1050	8861	4	0
Nickel	19 – 40	29	81.8	4	0
Vanadium	16 – 69	40.5	69	4	0
Zinc	20 – 100	47.5	216	4	0

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

TABLE 4-19 BEAR RIVER WATERSHED 1998 MINE FACILITY SEDIMENT DATA					
Parameter	**Range (mg/kg)**	**Mean (mg/kg)**	**UCL Values (mg/kg)[1]**	**Number of Samples**	**Number Greater than UCL**
Selenium	100	na	2.3	1	1
Cadmium	13	na	8.8	1	1
Manganese	6000	na	8861	1	0
Nickel	58	na	81.8	1	0
Vanadium	120	na	69	1	1
Zinc	930	na	216	1	1
Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.					

4.2.1.6 Salt River Watershed Sediments

Sediment samples were collected from 11 Salt River watershed surface water monitoring stations during 1998. Ten of the sites were stream monitoring stations. The only mine facility surface water station sampled was the Smoky Canyon Mine A Pit Pond (MP032). Salt River watershed sediment sampling sites are shown Figure 3-1.

Target element concentrations in stream sediments collected from the Salt River watershed were generally less than the corresponding UCL values. Three stream sediment samples had selenium concentrations greater than the UCL. Two stream samples had vanadium concentrations that exceeded the UCL. Figures 4-5 and 4-6 present 1998 selenium and cadmium sediment data from Salt River watershed stream samples. Table 4-20, *Salt River Watershed 1998 Stream Sediment Data*, summarizes the 1998 stream sample sediment data.

TABLE 4-20 SALT RIVER WATERSHED 1998 STREAM SEDIMENT DATA					
Parameter	**Range (mg/kg)**	**Mean (mg/kg)**	**UCL Values (mg/kg)[1]**	**Number of Samples**	**Number of Exceedances**
Selenium	0.38 – 4.1	1.65	2.3	10	3
Cadmium	3.8 – 8.0	5.3	8.8	10	0
Manganese	1000 – 6500	2540	8861	10	0
Nickel	32 – 64	43.9	81.8	10	0
Vanadium	39 – 84	57.3	69	10	2
Zinc	58 – 190	106	216	10	0
Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.					

The Smoky Canyon Mine A Pit Pond was the only mine facility in the watershed sampled for sediment. With the exception of manganese, target element concentrations in sediment samples were greater than the corresponding UCL values. Table 4-21, Salt *River Watershed 1998 Mine Facility Sediment Data*, summarizes the 1998 sediment data reported for the Smoky Canyon Mine A Pit Pond sample.

TABLE 4-21 SALT RIVER WATERSHED 1998 MINE FACILITY SEDIMENT DATA					
Parameter	Range (mg/kg)	Mean (mg/kg)	Threshold Value (mg/kg)[1]	Number of Samples	Number Greater than UCL
Selenium	28	na	2.3	1	1
Cadmium	43	na	8.8	1	1
Manganese	540	na	8861	1	0
Nickel	290	na	81.8	1	1
Vanadium	730	na	69	1	1
Zinc	1300	na	216	1	1

Notes: 1. The ninety-five percent upper confidence limit on the ninety-fifth percentile of the background data.

na - not applicable

4.3 GROUNDWATER

Twenty groundwater wells were identified in the inventory (MW, 1998b). In May, 18 of the 20 groundwater wells were sampled, while in September 17 of 20 wells were sampled. The Rasmussen Ridge Mine Wash Plant Well #2 (GW010), which did not exist, was included in the inventory as an error. The Smoky Canyon Mine Industrial Supply Well (GW018) was not in use and therefore was not sampled. The Rasmussen Ridge Mine Wash Plant Well #3 (GW011) was not sampled in September because it was non-operational. Groundwater wells are identified in Table 3-2 and the locations are shown on Figure 3-1.

Samples were analyzed for the target elements selenium, cadmium, manganese, nickel, vanadium, and zinc. Field measurements included conductivity, dissolved oxygen, oxygen reduction potential (ORP), pH, temperature and turbidity. Quality control procedures are described in the QA/QC section of this report.

4.3.1 Groundwater Field Data

This section provides a brief summary of groundwater field parameters collected during May and September 1998. Table 4-22, *Groundwater Field Parameter Sample Results*, summarizes the range of field data collected during 1998. Appendix D, Tables D.1 through D.6 presents the 1998 field parameter measurements.

TABLE 4-22 GROUNDWATER FIELD PARAMETER SAMPLE RESULTS		
Parameter	Groundwater Results	
	May	September
Temperature (°C)	4.9 – 16[1]	8.4 – 19[1]
Conductivity (µS/cm)	280 – 970	320 – 810
pH (std. Units)	6.8 – 8.1	7.4 – 8.0
Dissolved Oxygen (mg/l)	2.8 – 8.5	1.2 – 8.8
Turbidity (NTU)	0.23 – 9.0	0.66 – 2.8
Oxygen reduction potential (mV)	-54 – 260	-2 – 230[2]

Notes: 1. Does not include the FMC Office well (GW001). This sample was collected directly from the tap and was hot water (<30°C).
2. Problems with the oxygen reduction potential (ORP) meter were reported and this range of values are qualified as estimated.

Water temperatures in May were typically lower than measured values from the September monitoring event. The water temperatures from the FMC Office well are not characteristic of natural conditions because this water comes from a boiler. Groundwater well conductivity measurements generally showed a slight increase from May to September. However, the maximum reported value of 970 µS/cm was measured in May. This value was measured at the Upper Dry Valley Stock Well #2. The pH values indicated circum-neutral to slightly alkaline conditions and did not change significantly between May and September. The measured pH values ranged from 6.8 to 8.1 units.

The dissolved oxygen measurements exhibited significant variability and ranged from 1.2 mg/l to 8.8 mg/l. This variability may be the result of several wells having high-capacity pumps and samples may have been agitated at the well head. Turbidity results were generally consistent between the May and September sampling events.

4.3.2 Target Elements

The following discussion describes 1998 groundwater sampling results for the six target elements. Validated laboratory results for the 1998 groundwater sampling are presented in Appendix D, Tables D.7 through D.12, for selenium, cadmium, manganese, nickel, vanadium, and zinc, respectively. Table 4-23, *1998 Groundwater Sample Summary Statistics*, presents groundwater sampling summary statistics.

While groundwater zinc concentrations were generally greater than the UTB, none exceeded the MCL. In addition, none of the measurable groundwater selenium concentrations exceeded the MCL. There is no promulgated numeric criterion for vanadium; and manganese and zinc only have secondary drinking water standards. One groundwater well had a measurable nickel concentration that exceeded the MCL in both May and September. In addition, there was one cadmium value greater than the groundwater cadmium MCL.

However, in both cases, these wells were mine-site industrial wells. None of the drinking water wells reported target element concentrations that exceeded MCL values.

TABLE 4-23
1998 GROUNDWATER SAMPLE SUMMARY STATISTICS

Parameter[1]	Number of Samples	Blank UTB [2,3]	Minimum[4]	Mean	Maximum	MCL[5]	Number Greater than MCL
Groundwater – May Monitoring Event							
Selenium	18	0.0015	-0.000018	0.0061	0.033	0.05	0
Cadmium	18	0.0053	-0.0041	0.00039	0.0037	0.005	0
Manganese	18	0.031	-0.00042	0.056	0.30	na	Na
Nickel	18	0.017	0.0073	0.016	0.18	0.1	1
Vanadium	18	0.027	-0.011	0.0011	0.025	na	Na
Zinc	18	0.010	-0.0015	0.23	1.1	5	0
Groundwater – September Monitoring Event							
Selenium	17	0.0013	0.0000064	0.0043	0.027	0.05	0
Cadmium	17	0.0030	-0.00094	0.0013	0.0085	0.005	1
Manganese	17	0.014	0.0026	0.046	0.30	na	Na
Nickel	17	0.021	-0.0017	0.014	0.13	0.1	1
Vanadium	17	0.040	-0.0052	0.0079	0.024	na	Na
Zinc	17	0.015	0.0049	0.22	1.3	5	0

Notes:
1. All units are milligrams per liter (mg/l).
2. Blank UTB values are calculated on laboratory sample blanks.
3. UTB = Upper Tolerance Bound (See subsection 3.4.1 for discussion on UTB's).
4. Negative numbers represent less than detection limit values as calculated after data validation.
5. Maximum Contaminant Level (criteria established by EPA, 1994).

na-not applicable

Figures 4-3, 4-4, 4-5, and 4-6 present 1998 selenium and cadmium concentrations in groundwater samples. Table 4-24, *1998 Groundwater Sample Results*, summarizes the groundwater data with target element concentrations exceeding drinking water criteria.

TABLE 4-24 1998 GROUNDWATER SAMPLE RESULTS				
Station	Parameter	Sample Result		Criteria[1]
		May	September	
GW013	Cadmium		0.0085	0.005
GW020	Nickel	0.18	0.13	0.1
Notes: 1. Source: EPA (1994b). Neither well is used for as a potable water-supply well.				

4.4 SOIL

Soils were sampled from 65 stations in the summer of 1998. Forty-five soil samples were collected from waste rock dumps and five soil samples were collected adjacent to dump seeps. In addition, five soil samples were collected from each of the three background sites: Grizzly Creek, Caldwell Creek and South Fork Sage Creek. Soil samples were analyzed for the target elements selenium, cadmium, manganese, nickel, vanadium, and zinc. The mine facility soil sampling sites are identified in Table 3-2 and the locations are shown on Figure 3-1.

4.4.1 Target Element Concentrations in Soils

Soil samples were collected during July. Validated laboratory results for the 1998 soil sampling are presented Appendix E, Tables E.1 through E.6, for selenium, cadmium, manganese, nickel, vanadium and zinc, respectively.

Table 4-25, *1998 Soil Sample Summary Statistics*, presents summary statistics for soils samples collected from mine facilities and background monitoring stations. There are no promulgated standards for target element soil concentrations.

TABLE 4-25 1998 SOIL SAMPLE SUMMARY STATISTICS						
Parameter[1]	Number of Samples	UTB[2]	Minimum[3]	Mean	Maximum	Number Greater than UTB[4]
Mine Facility Soil Samples						
Selenium	50	18	.69	43	330	22
Cadmium	50	37	4.9	41	110	27
Manganese	50	4400	77	536	5500	1
Nickel	50	1400	380	1891	4000	31
Vanadium	50	180	60	259	640	38
Zinc	50	641	130	947	2100	39
Background Station Soil Samples						
Selenium	15	18	0.61	16	16	0
Cadmium	15	37	4.7	28	28	0
Manganese	15	4400	510	4300	4300	0
Nickel	15	1400	310	1100	1100	0
Vanadium	15	180	43	150	150	0
Zinc	15	641	110	450	450	0

Notes: 1 All units are milligrams per kilogram (mg/kg).
2. UTB = Upper Tolerance Bound (See subsection 3.4.1 for discussion on UTB's).
3. Negative numbers represent less than detection limit values as calculated after data validation.
4. Values were only designated as an exceedance if the value exceeded the UTB.

4.4.1.1 Background Soil Concentrations

Soil samples were collected at three background monitoring stations. Five soil samples were collected at each background site for a total of 15 background samples. The background concentrations were used to determine regional baseline concentrations against which potentially contaminated sites could be measured. A ninety-five percent upper confidence limit (UCL) on the ninety-fifth percentile was calculated using background concentration data. A concentration greater than the UCL value indicates that the sample concentration may be elevated relative to background and may be impacted by phosphate-mining activities. The methodology used to calculate the UCL's is presented in subsection 3.5.4.

The mean background selenium concentration in soil was 3 mg/kg and the mean background cadmium concentration was 11 mg/kg. The average background manganese concentration in soil was 1167 mg/kg and the average background soil nickel concentration was 579 mg/kg. The average background soil vanadium concentration was 72 mg/kg. The average background zinc concentration in soil was 252 mg/kg.

4.4.1.2 Waste Rock and Mine Soil Values

In general, target element concentrations in waste rock dump soils were elevated above background values. The mean selenium concentration in waste rock soils was approximately 14 times greater than the

The mean cadmium and zinc values in waste rock soils were both about 4 times greater then their corresponding background mean values. Vanadium and manganese mean concentrations from the waste rock soil samples were approximately two and three times greater than their corresponding background values. Nickel was the only target element with a waste rock soil mean concentration that was less than the background concentration. Table 4-25 summarizes waste rock soil sample concentrations. Figures 4-1, 4-3 and 4-5 present soil sample selenium concentrations. Cadmium concentrations in project area soil samples are presented in Figure 4-2, 4-4 and 4-6.

4.5 VEGETATION

Vegetation samples were collected at the same 65 locations that were sampled for soils. Forty-five vegetation samples were collected from waste rock dumps and five vegetation samples were collected adjacent to dump seeps. In addition, five vegetation samples were collected from each of the three background sites: Grizzly Creek, Caldwell Creek and South Fork Sage Creek. Vegetation samples were analyzed for the target elements selenium, cadmium, manganese, nickel, vanadium, and zinc. The mine facility vegetation sampling sites are identified in Table 3-2 and the locations are shown on Figure 3-1.

4.5.1 Target Element Concentrations in Vegetation

Vegetation samples were collected during July. Validated laboratory results for the 1998 vegetation sampling are presented Appendix E, Tables E.1 through E.6, for selenium, cadmium, manganese, nickel, vanadium and zinc, respectively.

Table 4-26, *1998 Vegetation Sample Summary Statistics*, presents summary statistics for vegetation samples collected from waste rock dumps, dump seeps and background monitoring stations. There are no promulgated standards for target element vegetation concentrations.

TABLE 4-26 1998 VEGETATION SAMPLE SUMMARY STATISTICS						
Parameter[1]	**Number of Samples**	**Background UTB[2]**	**Minimum[3]**	**Mean[4]**	**Maximum**	**Number > Background UTB[5]**
Mine Facility Vegetation Samples						
Selenium	50	0.80	0.18	16	84	42
Cadmium	50	3.4	0.093	2	8.4	4
Manganese	50	110	11	36	120	1
Nickel	50	2.3	0.92	6	18	39
Vanadium	50	3.6	-1.3	1	9	2
Zinc	50	60	19	70	140	32
Background Station Vegetation Samples						
Selenium	15	0.80	-0.015	0.15	0.78	0
Cadmium	15	3.4	0.1	1	2.1	0
Manganese	15	110	27	51	92	0
Nickel	15	2.3	0.52	1	2	0
Vanadium	15	3.6	-0.89	0.009	1.2	0
Zinc	15	60	19	35	43	0

Notes:
1 All units are milligrams per kilogram (mg/kg).
2. UTB = Upper Tolerance Bound (See subsection 3.3.1 for discussion on UTB's).
3. Negative numbers represent less than detection limit values as calculated after data validation.
4. Mean values were calculated using results that include negative numbers, therefore the means may be negative or zero.
5. Values were only designated as an exceedance if the value exceeded the UTB.

4.5.1.1 Background Vegetation Concentrations

Vegetation samples were collected at the three background monitoring stations. Five vegetation samples were collected at each background site for a total of 15 background samples. The background concentrations were used to determine regional baseline concentrations against which potentially contaminated sites could be measured. A ninety-five percent upper confidence limit (UCL) on the ninety-fifth percentile was calculated using background concentration data. A concentration greater than the UCL value indicates that the sample concentration may be elevated relative to background and may be impacted by phosphate-mining activities. The methodology used to calculate the UCL's is presented in subsection 3.5.4.

Selenium concentrations in background vegetation samples from the background stations ranged from less than the detection limit to 0.78 mg/kg. The mean background vegetation selenium concentration was less than the detection limit. The mean background concentration of cadmium in vegetation was 1 mg/kg. The average background vegetation manganese concentration was 51 mg/kg. The average background nickel concentration in vegetation was 1 mg/kg. The mean background vanadium concentration in vegetation samples was less than the detection limit. The neab zinc concentration in background vegetation samples was 35 mg/kg.

4.5.1.2 Waste Rock and Mine Vegetation Values

In general, target element concentrations in waste rock dump vegetation samples were elevated above background values. Forty-one of 50 vegetation samples had selenium concentrations greater than the UCL. The mean selenium concentration in waste rock vegetation soils was approximately two orders of magnitude greater than the mean background selenium concentration. Ten of 50 vegetation samples had cadmium values that were higher than the background vegetation UCL and the mean cadmium value in waste rock vegetation samples was two times greater then the background mean value. Only three vegetation samples had manganese concentrations greater than the UCL. The mean manganese concentration in waste rock vegetation was less than the mean background vegetation concentration. Nickel and zinc concentrations in waste rock vegetation samples exceeded the UCL in 41 and 34 samples, respectively. The mean concentrations were 6 and

2 time greater, respectively, then the corresponding background vegetation concentrations. Table 4-26 summarizes waste rock vegetation sample concentrations. Vegetation sample results for selenium concentrations are found on Figures 4-1, 4-3 and 4-5. Cadmium concentrations for vegetation samples are presented in Figures 4-2, 4-4 and 4-6.

4.6 CUTTHROAT TROUT RESULTS

Trout fillet tissue was collected at three stream monitoring stations during September 1998. Two of the locations were in the Blackfoot River watershed. These sites were ST026 (Blackfoot River upstream of Wooley Range Ridge Creek) and ST227 (East Mill Creek downstream of North Maybe Mine). The third location, ST228, was on South Fork Sage Creek south of Smoky Canyon Mine. This monitoring site is in the Salt River watershed and was the control or background station for the fish tissue collection effort. The water quality sample collected from the East Mill Creek site was the only water sample collected in September that had a selenium value greater than the cold-water criterion. Three fish were collected at each site. Cutthroat trout was the most common fish sampled; but, one book trout was obtained at East Mill Creek and the three fish from South Fork Sage Creek were brown trout.

The maximum selenium concentration in fillet tissue was 7.9 mg/kg (wet weight). This sample was collected at ST227 in East Mill Creek. The arithmetic mean of the three trout obtained from this station was 6.0 mg/kg (wet weight). (Under an assumption of lognormality and making an adjustment for small sample size bias, a lognormal distribution with an arithmetic mean of 6.5 mg/kg [wet weight] and an arithmetic standard deviation of 3.7 mg/kg [wet weight] is derived and used in the preliminary human health risk assessment (see subsection 5.1.2.2). The other two sites, ST026 and ST228, had arithmetic mean concentrations of 1.2 mg/kg (wet weight) and 1.3 mg/kg 9 wet weight), respectively, and analysis of variance ($\alpha = 0.05$) indicates no difference in trout fillet selenium concentrations between the Blackfoot River and South Fork Sage Creek control. None of the other five targeted trace elements were found to be elevated about control or background levels in trout fillets obtained from East Mill Creek or the Blackfoot River. Figures 4-3, 4-4, 4-5 and 4-6 present maximum selenium and cadmium fish tissue data. Validated laboratory results for the 1998 fish sampling are presented in Appendix D, Table D.7 through D.12.

Section 5

5.0 PRELIMINARY RISK ASSESSMENT

This section summarizes the preliminary human and ecological health risk assessments that were prepared for this project. The preliminary risk assessments were developed using the information collected as part of the 1998 regional investigation. The preliminary risk assessments are presented in in Appendix H.

The draft version of the preliminary risk assessments were given to the Selenium Working Group in June 1999. Comments on the draft version were received from the following Selenium Working Group participants.

- BLM (dated June 25, 1999)
- USFS (dated July 15, 1999; October 26, 1999; and, November 17, 1999)
- IDEQ (dated August 3, 1999)
- Shoshone-Bannock Tribes (dated November, 1999)

Comments, with the exception of the USFS's November 17, 1999 comments and Shoshone-Bannock Tribe's comments have been incorporated into the final version of the preliminary risk assessments. The USFS's November comments and the Shoshone-Bannock Tribe's comments will be incorporated into the 1999-2000 investigation and accompanying risk assessment.

The 1998 SAP (MW, 1998b) presented a risk-based screening process that was used to identify the COPCs. The screening process was focused on ecological risk because it was initially assumed by the Selenium Working Group, during the development of the work plan for the 1998 investigation, that there was only an ecological risk associated with impacts from the phosphate mining activities. The following six constituents were identified as the Selenium Project ecological COPCs.

- cadmium
- manganese
- nickel
- selenium
- vanadium
- zinc

However, concerns were later raised that there potentially were also human health risks attributable to phosphate mining. Consequently, a human health risk assessment was added to the project. The human health COPCs were screened by comparing observed concentrations of the six ecological COPCs in surface water and soil against EPA Region 9 preliminary remediation goal concentrations (PRGs). The comparison between the observed concentrations and EPA's PRGs is presented in Table 5-1, *Comparison of Observed Water and Soil Concentrations to EPA Preliminary Remediation Goals*. EPA uses the RPGs as a guideline in determining when a site is contaminated and may require some form of mitigation. Concentrations greater than the PRGs may indicate that remediation is warranted.

The 1998 data indicate that only two of the targeted trace elements, selenium and cadmium, have maximum observed concentrations in surface water that exceed their respective tap water PRGs. The degree of exceedence for selenium is much greater than that for cadmium. This suggests that selenium could have a higher potential to threaten environmental receptors than does cadmium. As shown in Table 5-1,maximum observed soil concentrations of all targeted trace elements were well below their respective PRG. The data indicates that exposure to soil is not a potential pathway and can be eliminated from further evaluation.

Separate risk assessments were conducted for human and environmental receptors. The preliminary human health risk assessment is summarized in subsection 5.1. The preliminary ecological health risk assessment is summarized in subsection 5.2.

TABLE 5-1
Comparison of Observed Water and Soil Concentrations to EPA Preliminary Remediation Goals

Targeted Trace Element	Maximum Observed Concentration		Preliminary Remediation Goal	
	Surface Water (mg/l)	Soil (mg/kg, dry)	Tap Water (mg/l)	Industrial Soil (mg/kg, dry)
Se	2.0	330	0.18	8,500
Cd	0.030	110	0.018	850
Mn	1.5	5,500	1.7	43,000
Ni	0.48	4,000	0.73	34,000
V	0.18	640	0.26	12,400
Zn	1.5	2,100	11	100,000

5.1 PRELIMINARY HUMAN HEALTH RISK ASSESSMENT

The preliminary human health risk assessment was developed using the following four steps.

- Problem formulation
- Analysis
- Risk characterization
- Risk summary

The four steps of the preliminary assessment are presented in detail in Appendix H. The following subsections summarize the important points of the four phases.

5.1.1 Problem Formulation

The initial phase in the risk assessment process was problem formulation. This potentially iterative phase, which included conceptual modeling, was undertaken to identify substances, receptors, and exposure routes of potential concern. As indicated above, work plans developed to guide the 1998 sampling and analyses efforts did not originally include a human health risk assessment. The Selenium Working Group originally assumed that any potential risk associated with phosphate mining activities in the project area was an ecological risk.

However, concern was raised that it may not be safe to eat trout caught from area steams and rivers that may be impacted by phosphate mining activities. Consequently, the ingestion of trout flesh was identified as a potential exposure pathway. Following the identification of salmonid tissue as a potential risk pathway, the Selenium Working Group concluded that the ingestion of beef or elk that grazed reclaimed water rock dumps could cause another potential human health risk. Consequently, a risk assessment for a beef ingestion exposure scenario was initiated under the assumption that cattle at Henry Mine would provide a conservative surrogate for free- and wide-ranging elk. The Henry Mine cattle were selected because they were pastured on a seleniferous waste rock dump for nine continuous weeks. It was assumed that the cattle would serve as a conservative surrogate for free- and wide-ranging elk.

These two scenarios were evaluated and presented separately in the draft version of preliminary human health assessment. Based on comments received from reviewers the two scenarios were combined for the final version to allow for an overall evaluation. The overall preliminary conceptual model for the human health risk assessment is summarized below.

- *Substance of interest: selenium*

- *Receptor of interest: a randomly selected adult resident of the region who is (1) a recreational fisherman who fishes downstream of phosphate mines and consumes his catch; (2) someone who consumes beef grazed on phosphate mine waste rock dumps; and, (3) is sensitive to selenium*

- *Exposure pathways of interest:background dietary ingestion, multi-vitamin or mineral supplement ingestion, seleniferous fish ingestion, and seleniferous beef ingestion.*

5.1.2 Analysis

The analysis phase of a risk assessment consists of two steps, a toxicity assessment and an exposure assessment. The following equation summarizes the risk model:

$$HQ = \frac{D}{T}$$

Equation 5-1 where:

- HQ is the hazard quotient (unitless) associated with exposure to selenium
- T is the toxicity component of the model, a reference dose (RfD, mg/[kg·d])
- D is the dose resulting from the relevant exposure (mg/[kg·d])

A model was developed for each of the two exposure scenarios, which, in turn, were comprised of two submodels characterizing toxicity and dose. If the dose, D, exceeded the toxicity, T, then the resulting hazard quotient (HQ) is greater than 1.0 which indicates that the potential for toxic effects exists.

5.1.3 Risk Characterization

The risk characterization phase of a risk assessment consists of two steps, risk estimation and risk description. Risk estimation is the integration of the toxicity and exposure sub-models and an analysis of uncertainty.

A HQ in excess of 1.0 indicates that there is the potential for a risk and that there is a possible basis for requiring site remediation. Most risk assessments for systemic toxicants are done within a deterministic framework and a deterministic assessment is generally extremely conservative. Consequently, a HQ in excess of 1.0 is not typically regarded as a hard threshold for remedial action. Selenium is a systemic toxicant.

When using a probabilistic assessment, EPA's (1992a) exposure assessment guidelines suggest that risk managers base remedial action decisions on high-end estimates of risk. These guidelines define a high-end risk estimate to be one that lies within the range of the 90^{th} to 99.9^{th} percentile of the risk estimate. More specifically, the guidelines suggest that the range of reasonable maximum estimates is from the 90^{th} percentile to the 98^{th} percentile, and that any estimate exceeding the 99.9^{th} percentile is to be regarded as a bounding estimate. The guidelines indicate that it is inappropriate to base a site remedy on a bounding estimate. However, a no-action decision can be appropriate in instances where a bounding estimate lies below a level of concern; i.e., bounding estimates have screening utility. More recent guidance (EPA, 1992a) indicates that the 90^{th} percentile can be regarded as reasonable maximum estimate versus the 95^{th} percentile that is usually chosen.

The deterministic estimate represented by $HQ_{Se,site,det}$ is 1.71, which is above the action threshold of 1.0. However, the probabilistic assessment demonstrates that $HQ_{Se,site,det}$ is at the 99.98^{th} percentile. This percentile is more appropriate as a bounding estimate rather than as a basis for making decisions on site remediation (EPA, 1992a). The probabilistic estimate represented by $HQ_{Se,site,0.95}$ is 0.53. This value is significantly less than the action threshold. The semi-stochastic estimate represented by $HQ_{Se,site,semisto}$, is 0.80. This estimate is also well below the action threshold.

None of the other five target trace elements has the same toxicological endpoint as does selenium. The exclusion of the other elements from the model does not compromise the integrity of the analysis in any way because any risk estimates associated with the other trace elements would not be additive with the selenium risk estimate.

5.1.4 Risk Summary

The deterministic estimate of risk represented by $HQ_{Se,site,det}$ is 1.71. This estimate suggests that it may be appropriate to initiate remedial action to avert human exposure to selenium associated with fish and beef ingestion. However, the assessment demonstrates that this estimate is a bounding estimate that lies at the 99.98^{th} percentile of the underlying distribution of valid risk estimates. The 95^{th} percentile of the probabilistic estimate represented by $HQ_{Se,site,0.95}$ is 0.53. This value is significantly less than the human health action threshold of 1.0..

The addition of other trace elements would not affect the risk estimates presented in the preliminary assessment because of the non-additive nature of the constituents. In addition, it is believed that the addition of other selenium exposure pathways would not significantly alter the results of the final version of the preliminary assessment.

The assessment of this preliminary scenario is subject to refinement based upon new data generated by the interim 1999 and 1999-2000 regional investigation activities and upon comments received from Selenium Working Group participants. Therefore, one should be cautious about drawing any conclusions based upon the results of this initial and preliminary effort. The preliminary human health assessment focuses on selenium. Cadmium was not included in the preliminary assessment because the 1998 salmonid fillet cadmium concentrations were not elevated. However, cadmium has not been eliminated as COPC. Additional fish tissue sampling is being conducted as part of the 1999-2000 investigation. In addition, the 1999 – 2000 investigation includes beef and elk skeletal muscle and internal organ tissue sampling and analyses. If elevated levels of cadmium are observed in any of these tissues, then cadmium may be added as an additional constituent of interest in the final assessment.

5.2 PRELIMINARY ECOLOGICAL RISK ASSESSMENT

As indicated above, the Selenium Working Group initially thought that phosphate mining activities only resulted in ecological impacts. The preliminary assessment was intended to evaluate potential ecological impacts associated with phosphate mining on the basis of data collected during the 1998 regional investigation. The results of the preliminary assessment will assist in the identification of potential data gaps in the 1998 regional investigation, and help to focus the 1999-2000 regional investigation on any critical data needs. Consequently, additional data collected as part of the 1999-2000 regional investigation will be used in the development of a refined assessment of potential impacts of phosphate-mining operations on ecological habitats and receptors. Steps similar to those used in the human health risk assessment process are also used in the ecological risk assessment process. The following are the major steps in the screening ecological risk assessment process (EPA, 1998a):

- Problem formulation
- Exposure assessment
- Ecological effects evaluation
- Risk estimation

The exposure assessment includes the development of exposure parameters for use in calculating exposure doses. The ecological effects evaluation includes the establishment of ecotoxicity values for use in evaluating exposures to site COPCs. Finally, the risk estimation step involves a calculation of ecological hazard based on comparison of the exposure doses and ecotoxicity values for each receptor-COPC combination.

5.2.1 Problem Formulation

Problem formulation includes a description of the ecological habitats and biological resources that are present in the investigation area, identification of COPCs, identification of the assessment and measurement endpoints that were selected for evaluation, and identification of the indicator receptors that serve to evaluate the assessment and measurement endpoints.

5.2.2 Ecological Exposure Assessment

The ecological exposure step includes the description of the ecological conceptual site model, and the methods and assumptions that were used in the ecological exposure modeling for the preliminary assessment. The development of the conceptual site model (CSM) serves to identify all potentially exposed receptors and potentially complete exposure pathways. Exposure modeling allows quantification of the potential co-occurrence of receptors and COPCs. Potential exposures are evaluated by estimating COPC exposure point concentrations in abiotic and biotic media, and subsequent uptake by indicator receptors. The results of the exposure assessment are considered in relation to the results of the toxicity assessment to characterize ecological risk.

5.2.3 Ecological Effects Assessment

The potential for ecological effects due to exposures of indicator receptors to COPCs detected in site media was evaluated during this step. The evaluation consisted of comparing calculated exposure doses with toxicity reference values, TRVs, for each COPC-receptor combination. The TRVs used in the evaluation of potential risks to indicator receptors are expressed in terms of mg/(kg·d).

5.2.4 Ecological Risk Characterization

Ecological risk characterization uses the information gathered to determine the potential ecological risks resulting from the presence of COPCs in environmental media. Information regarding the presence and attributes of site receptors as well as the chemistry, toxicology, and distribution of site chemicals was synthesized in an evaluation of the potential for adverse effects to ecological indicator receptors.

The overall goal of this preliminary assessment is to evaluate whether COPC concentrations identified in surface water, sediment, soil, and vegetation potentially impacted by phosphate mining-derived wastes are sufficiently protective of ecological receptors or whether the concentrations are elevated and suggest potential risks to the ecosystem. Attainment of this goal is not directly measurable. To provide an indication of whether the ecosystem is protected, specific assessment endpoints were identified. Measurement endpoints were selected as tools for evaluating the assessment endpoints.

The measurement endpoints evaluated in this preliminary assessment include comparison of modeled exposure doses with toxicity reference values for aquatic/riparian and terrestrial indicator receptors.

The comparison with toxicity reference values yields chemical-specific HQs as follows:

$$HQ = \frac{Dose}{TRV}$$

Equation 5-4 where:

- HQ is the element-specific hazard quotient for a given indicator species, unitless
- Dose is the modeled element-specific exposure dose for a given indicator species, mg/(kg·d)
- TRV is the element-specific toxicity reference value for a given indicator species, mg/(kg·d)

Additionally, to estimate the cumulative effects of COPCs, a hazard index, HI, was calculated for each indicator receptor. This HI was determined by adding the HQs obtained from food chain modeling for all COPCs identified at the site for each indicator receptor. HQ or HI values that exceed 1.0 are generally considered to be indicative of potential biological or ecological effects on representative receptors. These values do not necessarily indicate that a biological or ecological effect will occur, but only that a lower threshold has been exceeded (Menzie et al., 1992). In general, the evaluation of the significance of the HQ and HI values was conducted as follows:

- *HQ or HI less than 1.0* - no adverse effects on representative receptors are anticipated
- *HQ or HI between 1.0 and 10* - there is a limited potential for adverse effects on representative receptors
- *HQ or HI between 10 and 100* - there is potential for adverse effects on representative receptors
- *HQ or HI exceeds 100* - there is significant potential for adverse effects on representative receptors

5.2.5 Risk Estimation

The ecological risk assessment indicates that the common snipe is the aquatic/riparian indicator species that displays the highest potential for adverse effects. All media with the exception of the Blackfoot River surface water has a hazard estimate greater than 10. Muskrats and red-winged blackbirds appear to be susceptible to adverse impacts, especially if they are exposed to stock ponds and concentrations that are similar to those seen in East Mill Creek. In trout, the greatest potential for adverse impacts could be expected in water with concentrations that are similar to East Mill Creek. Mallards and moose do not appear to be adversely impacted by any of the environmental media sampled. Table 5-2, *Summary of Risk Estimation for Aquatic/Riparian Indicator Species*, summarizes the worst-case hazard estimates for the aquatic and riparian indicator species.

TABLE 5-2
Summary of Risk Estimation for Aquatic/Riparian Indicator Species

	Stock Ponds	Tailing Ponds	Blackfoot River	State Land Creek	East Mill Creek
Salmonid	1.2	3.0	1.2	2.9	26
Red-winded blackbird	16	3.4	1.6	3.3	24
Common Snipe	50	18	7.4	16	127
Mallard	0.04	0.03	0.04	0.008	0.1
Muskrat	52	6.8	3.4	7.9	45
Moose	0.03	0.004	0.02	0.004	0.004

The hazard classification system indicates that there is a potential for adverse impacts to sheep, horses, and cattle exposed to waste rock dump soils, vegetation, and water.

Section 6

6.0 CONSIDERATIONS FOR FUTURE DATA-COLLECTION ACTIVITIES

The Selenium Subcommittee is continuing efforts to identify and mitigate releases of selenium and other target elements to the environment in the Resource Area. The data presented in the 1998 Regional Investigation Report will be used to design future investigations and develop best management practices for controlling, reducing and mitigating target element releases. A report describing the best management practices is being prepared under separate cover.

The 1998 data indicates that tailing ponds, stock ponds, and waste rock dump soil and vegetation are adequately characterized from a regional perspective. These media generally had elevated levels of selenium when compared against background.. There are no plans at this time for additional regional characterization activities for these media, with the exception of the Smoky Canyon Mine Tailings Pond #2. This pond appears to support a self-sustaining population of trout. The Selenium Working Group concluded in the spring of 1999 that it would be beneficial to collect additional aquatic biological information from this pond. Future data, or changes in the decision-making process may dictate that additional studies at these types of facilities are warranted. However, it is envisioned that any additional characterization activities for these types of facilities will be on a site-specific basis and the responsibility of the individual mine operator.

The 1998 data also suggests that there is no need to conduct additional groundwater investigations. However, regulatory agencies have expressed concerned about the potential for selenium-related impacts to area municipal water-supplies. In particular, the regulatory agencies want to be assured that the water supplies for the cities of Fort Hall and Soda Springs have not been impacted by phosphate mining activities. Consequently, compliance-monitoring water quality data collected by Soda Springs and Fort Hall will be evaluated as part of the 1999-2000 investigation to demonstrate that the municipal water supplies have not been impacted by phosphate-mining activities.

The Selenium Working Group identified several time-critical tasks that were initiated during May 1999. These tasks include the collection of surface water samples from select Blackfoot River surface water monitoring stations and monthly surface water monitoring at two locations. In addition, avian egg and cutthroat trout investigations were initiated. These work tasks are being carried out in accordance with the *Interim 1999 Field Sampling Plan* (MW, 1999a).

During the review of the 1998 data the Selenium Working Group concluded that the aquatic environment should be investigated. Consequently, a work plan was developed for a 1999-2000 investigation to describe the sampling and analyses of aquatic biota in the study area (MW, 1999b). Media that will be sampled and analyzed as part of the 1999-2000 investigation include benthic macroinvertebrates, plankton, periphyton, submergent macrophytes, riparian vegetation, forage fish and salmonids. Surface water and sediment characterization activities will continue. The aquatic biota data will be used to refine the ecological risk assessment.

Fourteen locations on the upper Blackfoot River and select tributaries and ten Blackfoot Reservoir locations will be sampled as part of the aquatic biota sampling program. The data collected as part of the aquatic biota sampling program will be used to refine the ecological risk assessment. The surface water monitoring program will be a continuation of the outside-in approach. The outside-in approach is a rigorous sample design that will identify the source(s) of contaminates that may require mitigation. The sample designed incorporated the following criteria.

- Every drainage downstream of a mine facility was sampled.

- Sampling on a stream occurred at the point that was furthermost upstream that supported a fishery, but was still downstream of the mine facility.

- If a lower order tributary flowed into the sampled stream upstream of the sampling point, then a sample was also collected on the mainstem upstream of that inflow contribution, and any other tributary inflow that drained a mine facility.

- Numerous stations were established along the upper Blackfoot River to identify COPC loadings from the tributaries that drain the phosphate mine sites.

In addition to the high flow, low flow sampling, monitoring will be conducted to characterize seasonal variability in constituent concentrations. Monthly monitoring is occurring at two surface water monitoring locations. The results of the monthly monitoring may indicate that the runoff hydrograph needs additional characterization.

During the summer of 1999 the Selenium Working Group determined that sampling and analyses of cattle and elk should be conducted. The beef and elk data will be used to refine the human health risk assessment. Consequently, sampling programs for these two media have been implemented. The avian and cutthroat trout studies that were initiated in May 1999 will continue during the spring and early summer of 2000. The aquatic biota, beef, elk, sediment and water sampling that is taking place under the auspices of the 1999-2000 regional investigation are being conducted using the methods and procedures presented in the *1999-2000 SAP* (MW, 1999b).

The Shoshone-Bannock Tribes provided the Selenium Working Group with comments on the preliminary risk assessments at the November 9, 1999 risk assessment workshop. These comments were received very late in the process of finalizing the 1998 Regional Investigation Report. The comments were also substantive and may require some unique sampling and analyses that were not incorporated into the *1999-2000 SAP* (MW, 1999b). The Selenium Working Group will be developing a monitoring program in conjunction with the tribe during spring of 2000 to address the concerns raised in their comments. These data will also be used to refine both the human health and ecological risk assessments.

Section 7

7.0 REFERENCES

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IDAHO MINING ASSOCIATION
SELENIUM SUBCOMMITTEE

Final
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Southeast Idaho
Phosphate Resource Area
Selenium Project

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Prepared by:

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Appendix A

APPENDIX A – PHYSICAL CHARACTERIZATION INFORMATION

TABLE A.1
LIST OF PLANTS POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Common Name	Latin Binomial
American Bistort	*Polygonum bistortoides*
Antelope Bitterbrush	*Purshia tridentata*
Arrowhead	*Sagittaria spp.*
Arrowleaf Balsamroot	*Balsamorhiza sagitatta*
Arrowleaf Groundsel	*Senecio triangularis*
Aster	*Aster spp.*
Baltic Rush	*Juncus balticus*
Beaked Sedge	*Carex rostrata*
Big Mountain Brome	*Bromus carinatus*
Big Sagebrush	*Artemisia tridentata*
Big Whortleberry	*Vaccinium membranaceum*
Black Sagebrush	*Artemisia arbuscula var. nova*
Blue Violet	*Viola spp.*
Blue Wildrye	*Elymus glauca*
Bluebells	*Mertensia sp.*
Bluebunch Wheatgrass	*Agrophyron spicatum*
Bluejoint Reedgrass	*Calamagrostis canadensis*
Bog Birch	*Betula glandulosa*
Booth Willow	*Salix boothii*
Bracted Lousewort	*Pedicularis bracteosa*
Bulrush	*Scirpus sp.*
Butterweed Groundsel	*Senecio serra*
Cache Pensteman	*Penstemon compacgtus*
Canada Thistle	*Cirsium arvense*
Cattail	*Typha spp.*
Cheatgrass	*Bromus tectorum*
Chokecherry	*Prunus virginiana*
Clematis	*Clematis columbianum*
Clover	*Trifolium sp.*
Columbia Monkshod	*Aconitum columbianum*
Common Dandelion	*Taraxacum officinale*
Common Horsetail	*Equisetum arvense*
Common Spikerush	*Eleocharis palustis*
Coontail	*Ceratophyllum spp.*
Co-parsnip	*Heracleum lanatum*
Curlleaf Mountain Mahogany	*Cercocarpus ledifolius*
Curly Dock	*Rumex crispus*
Currant	*Ribes spp.*
Cutleaf Balsam Root	*Balsamorhiza macrophylla*
Dark-throat Shooting-star	*Dodecatheon pulchellum*
Douglas Fir	*Pseudotsuga menziesii*
Douglas' Onion	*Allium douglasii*
Duckweed	*Lemna spp.*
Elephant's Head	*Pedicularis groenlandica*
Elk Sedge	*Carex geyeri*
Engelmann Aster	*Aster engelmanii*
Engelmann Spruce	*Picea engelmanii*
Eriogonum	*Eriogonum spp.*
Fendler's Meadow-rue	*Thalictrum fendleri*
Fleabone Daisy	*Erigeron spp.*
Foothill Sedge	*Carex tumulicola*
Fowl Bluegrass	*Poa palustris*
Fragrant Bedstra	*Galium triflorum*
Geyer's Willow	*Salix geyeriana*
Gland Cinquefoil	*Potentilla fruticosa*
Globemallow	*Sphaeralcea sp.*
Great Basin Wildrye	*Elymus cinereus*
Green Muhly	*Muhlenbergia racemosa*
Green Needlegrass	*Stipa viridula*
Green Spleenwort	*Asplenium viride*
Greene's Mountainash	*Sorbus scopulina*
Grouse Whortleberry	*Vaccinium scopulinum*
Hawkweed	*Hieracium spp.*
Heartleaf Arnica	*Arnica cordifolia*
Hoary Willow	*Salix candida*
Hood's Sedge	*Carex hoodii*
Horsebrush	*Tetradymia spp.*
Horsemint	*Agastache urtricifolia*
Horsetail	*Equisetum spp.*
Idaho Fescue	*Festuca idahoensis*
Idaho sedge	*Carex Parryana Idahoa*
Indian Ricegrass	*Oryzopsis hymenoides*

TABLE A.1 LIST OF PLANTS POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
Kelsey's Phlox	*Phlox kelseyi var kelseyi*
Kentucky Bluegrass	*Poa pratensis*
Leafy Aster	*Aster foliaceus*
Lesser Duckweed	*Lemna minor*
Limber Pine	*Pinus flexilis*
Lodgepole Pine	*Pinus contorta*
Lovage	*Ligusticum sp.*
Lupine	*Lupinus spp.*
Mallow Minebark	*Physocarpus malyaceous*
Mat Muhly	*Muhlenbergia richardsonii*
Meadow Barley	*Hordeum barchyanthum*
Meadow Milkvetch	*Astragalus diversitolius*
Medusa Head	*Elymus caput-medusae*
Mint	*Mentha sp.*
Mosses	
Mountain Big Sagebrush	*Artemisia tridentata*
Mountain Brome	*Bromus carinatus*
Mountain Maple	*Acer glabram*
Mountain Snowberry	*Symphoricarpos oreophilous*
Mountain Sweet-Cicely	*Osmorhiza chilensis*
Mullein	*Verbascum thapus*
Myrtle Pachistima	*Pachistima myrsinites*
Nebraska Sedge	*Carex nebrascensis*
Needle Spikerush	*Eleocharis aciculans*
Nettle	*Urtica diocia*
Northern Muleears	*Wyethia amplexicaulis*
Northwest Cinquefoil	*Potentilla gracilis*
One-Flower Helianthella	*Helianthella uniflora*
Oniongrass	*Melica bulbosa*
Orange Sneezeweed	*Helenium hoopsii*
Orchard-grass	*Dactylis glomerata*
Oregon Grape	*Berberis repens*
Penstemon	*Penstemon spp.*
Pinegrass	*Calamagrostis rubescens*
Plantainleaf Buttercup	*Ranunculus alismaefolius*
Pondweed	*Potamogeton spp.*
Prairie Junegrass	*Koeleria cristata*
Prickly Currant	*Ribies lacustre*
Purple Onion Grass	*Melica spectabilis*
Quaking Aspen	*Populus tremuloides*
Rabbitbrush	*Chrysothamnus viscidiflorus*
Red Glasswort	*Salicornia rubra*
Redosier Dogwood	*Cornus stolonifera*
Richardson's Geranium	*Geranium richardsonii*
Rocky Mountain Juniper	*Juniperus scopulorum*
Rosy Pussy-Toes	*Antennaria microphylla*
Rushes	*Juncus spp.*
Rydberg's Musineon	*Musineon lineare*
Sagewort	*Artemisia scopulorum*
Sandberg Bluegrass	*Poa secunda*
Saskatoon Serviceberry	*Amalanchier alnifolia*
Scarlet Paintbrush	*Castilleja chromosa*
Scouler's Willow	*Salix scouleriana*
Sedge	*Carex spp.*
Sego Lily	*Calochortus nuttali*
Shiny Leaf Spirea	*Spirea betulifolia*
Short-Beaked Sedge	*Carex simulata*
Showey Goldeneye	*Viguiera multiflora*
Silver Sagebrush	*Artemisia cana*
Silverweed	*Potentilla anserina*
Silvery Lupine	*Lupinus argenteus*
Skunk Cabbage	*Veratrum californicum*
Slender Wheatgrass	*Agropyron trachycaulum*
Slick Spot Peppergrass	*Lepidium papilliferum*
Small-Wing Sedge	*Carex microptera*
Smooth Brome	*Bromus inermis*
Snowbrush	*Ceanothus velutinous*
Spike Rush	*Eleocharis spp.*
Starveling Milkvetch	*Astragalus jejunus var jejunus*
Stary Solomon-plume	*Smilacina stellata*
Sticky Geranium	*Geranium viscossisimum*
Strawberry	*Frageria vesca*

TABLE A.1 LIST OF PLANTS POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
Streamside bluebells	*Mertensia ciliata*
Subalpine Fir	*Abies Tasiocarpa*
Sweet Anise	*Osmorhiza occidentalis*
Tapertip Hawksbeard	*Crepis acuminata*
Tarragon Sagebrush	*Artemisia dracunculoides*
Thick-leaf Groundsel	*Senecio crassulus*
Thistle	*Cirsium spp.*
Timothy	*Phleum pratense*
Tufted Cryptantha	*Cryptantha caespitosa*
Tufted Hairgrass	*Deschampsia cespitosa*
Twinberry	*Lonicera involucrata*
Vinta Basin Cryptantha	*Cryptantha breviflora*
Utah Juniper	*Juniperus utahensis*
Ute Ladies Tresses	*Spiranthes diluvialis*
Varying Buckwheat	*Erigonum brevicaule var laxifolium*
Virginia Strawberry	*Frageria virginiana*
Water Sedge	*Carex aquatilis*
Watercress	*Rorippa nasturtium-aquaticum*
Wax Currant	*Ribes cereum*
Western Buttercup	*Ranunculus alismaefolius*
Western Serviceberry	*Amelanchier alnifolia*
Western Thimbleberry	*Rubus parviflora*
Western Valerian	*Valeriana occidentalis*
Western Yarrow	*Achillea millefolium*
Wheatgrass	*Agropyron sp.*
White Phlox	*Phlox sp.*
Willows	*Salix spp.*
Wood's Rose	*Rosa woodsii*
Yanpa	*Carun gairdveri*
Yellow Prairie Violet	*Viola nuttalii*

Sources: 1996 National List of Vascular Plant Species That Occur in Wetlands: 1996 National Summary, U.S. Fish and Wildlife Service.

Pocatello Resource Area, Ecological Site Inventory (FY85-86), Bureau of Land Management.

Idaho Conservation Data Center (1999); List of Vascular Plants (Updated March 1998).

TABLE A.2 LIST OF MAMMALIAN SPECIES POTENTIALLY OCCURRING WITHIN The Study Area	
Common Name	**Latin Binomial**
Badger	*Taxidea taxus*
Beaver	*Castor canadensis*
Big Brown Bat	*Eptesicus fucus*
Black Bear	*Ursus americanus*
Black-Tailed Jack Rabbit	*L. californicus*
Bobcat	*Lynx rufus*
Bushy-Tailed Wood Rat	*Neotoma cinera*
Coyote	*Canis latrans*
Deer Mouse	*Peromyscus maniculatus*
Elk	*Cervus elaphus*
Golden-Mantled Squirrel	*Citellus lateralis*
Gray Wolf	*Canis lupus*
Great Basin Pocket Mouse	*Perognathus parvus*
Hoary Bat	*Lasiurus cinereus*
House Mouse	*Mus musculus*
Idaho Pocket Gopher	*Thomomys idahoensis*
Least Chipmunk	*Etuamias minimus*
Little Brown Myotis	*Myotis lucifugus*
Long-Eared Myotis	*Myotis evotis*
Long-Legged Myotis	*Myotis volans*
Long-Tailed Vole	*Microtus longieaudus*
Long-Tailed Weasel	*Mustela frenata*
Merriam's Shrew	*S. merriami*
Mink	*Mustea vison*
Moose	*Alces alces*
Mountain Cottontail	*Sylvilagus nuttallii*
Mountain Lion	*Felis concolor*
Mountain Vole	*Microtus montanus*
Mule Deer	*Odocoileus hemionus*
Muskrat	*Ondatra zibethica*
North American Wolverine	*Gulo gulo luscus*
Northern Grasshopper Mouse	*Onychomys leucogaster*
Northern Pocket Gopher	*Thomomys talpoides*
Pallid bat	*Antrozous pallidus*
Porcupine	*Erethizone dorsatum*
Pygmy Rabbit	*Brachylagus idahoensis*
Raccoon	*Procyon lotor*
Red Fox	*Vulpes vulpes*
Richardson Ground Squirrel	*Citellus richardsoni*
Rock squirrel	*Spermophilus variegatus*
Short-Tailed Weasel	*Mustela erminea*
Silver-Haired Bat	*Lasionycteris noctivagans*
Snowshoe Hare	*Lepus americanus*
Striped Skunk	*Mephitis mephitis*
Townsend's Big-Eared Bat	*Plecotus townsendii*
Townsend's Ground Squirrel	*Spermophilus townsendii*
Vinta chipmunk	*Tamius umbrinus*
Uinta Ground Squirrel	*Citellus armatus*
Western Harvest Mouse	*Reithrodontomys megalotis*
Western small-footed myotis	*Myotis ciliolabrum*
White-Tailed Deer	*Odocoileus virginianus*
White-Tailed Jack Rabbit	*Lepus townsendii*
Wolverine	*Gulo gulo*
Yellow Pine Chipmunk	*Eutamias amoenus*
Yellow-Bellied Marmot	*Marmota flaviventris*
Yuma myotis	*Myotis yumanenisis*

Sources: Idaho Conservation Data Center (1999); List of Mammals (Updated March 1998).
Riparian Community Type Classification of Eastern Idaho-Western Wyoming by Youngblood, Padgett, and Winward (USFS 1985).
Distribution, Season of Use, and Habitat of the Mammals, Birds, Reptiles, Amphibians and Fishes of Idaho, by Lanny O. Wilson, Bureau of Land Management (1977).

TABLE A.3 LIST OF AVIAN SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
American Avocet	*Recurvirostra americana*
American Bittern	*Botaurus lentiginosus*
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Dipper	*Cinclus mexicanus*
American Goldfinch	*Carduelis tristis*
American Kestrel	*Falco sparverius*
American Redstart	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
American Tree Sparrow	*Spizella arborea*
American Robin	*Pelecanus erythrorhynchos*
American Wigeon	*Anas americana*
Baird's Sandpiper	*Calidris bairdii*
Bald Eagle	*Haliaeetus leucocephalus*
Bank Swallow	*Riparia riparia*
Barn Owl	*Tyto alba*
Barn Swallow	*Hirundo rustica*
Barrow's Goldeneye	*Bucephala islandica*
Belted Kingfisher	*Ceryl alcyon*
Black Tern	*Chlidonias niger*
Black-Backed Woodpecker	*Picoides villosus*
Black-Bellied Plover	*Pluvialis squatarola*
Black-Billed Magpie	*Pica pica*
Black-Capped Chickadee	*Parus atricapillus*
Black-Chinned Hummingbird	*Archilochus alexandri*
Black-Crowned Night-Heron	*Nycticorax nycticorax*
Black-Headed Grosbeak	*Pheucticus melanocephalus*
Black-Necked Stilt	*Himantopus mexicanus*
Black-Throated Gray Warbler	*Dendroica nigrescens*
Blue Grouse	*Dendragapus obscuras*
Blue-Gray Gnatcatcher	*Polioptila caerulea*
Blue-Winged Teal	*Anas discors*
Bohemian Waxwing	*Bambycilla garrula*
Bonaparte's Gull	*Larus philadelphia*
Boreal Owl	*Aegolius funereus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brewer's Sparrow	*Spizella Breweri*
Broad-Tailed Hummingbird	*Selasphorus platycercus*
Brown Creeper	*Certhia familiaris*
Brown-Headed Cowbird	*Molothrus ater*
Bufflehead	*Bucephala albeola*
Burrowing Owl	*Athene cunicularia*
Bushtit	*Psaltriparus minimus*
California Gull	*Larus californicus*
Calliope Hummingbird	*Stellula calliope*
Canada Goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Caspian Tern	*Sterna Caspia*
Cassin's Finch	*Carpodacus cassinnii*
Cassin's Kingbird	*Tyrannus vociferans*
Cattle Egret	*Bubulcus ibis*

TABLE A.3 LIST OF AVIAN SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
Cedar Waxwing	*Bombycilla cedrorum*
Chipping Sparrow	*Spizella passerina*
Cinnamon Teal	*Anas cyanoptera*
Clark's Nutcracker	*Nucifraga columbiana*
Cliff Swallow	*Hirundo pyrrhonota*
Columbian Sharp-Tailed Grouse	*Tympanchus phasianellus columbianus*
Common Crow	*Corrus brachyrhnchos*
Common Goldeneye Duck	*Bucephala clangula*
Common Grackle	*Quiscalus quiscula*
Common Merganser	*Mergus Merganser*
Common Nighthawk	*Chordeiles minor*
Common Poorwill	*Phalaenoptilus nuttallii*
Common Raven	*Corvus coraz*
Common Redpoll	*Carduelis flammea*
Common Snipe	*Gallinago gallinago*
Common Tern	*Sterna hirundo*
Common Yellowthroat	*Geothlypis trichas*
Coopers Hawk	*Accipiter cooperii*
Dark-Eyed Junco	*Junco hyemalis*
Dipper	*Cinclus mexicanus*
Double-Crested Cormorant	*Phalacrocorax auritus*
Downy Woodpecker	*Dendrocopos pubescens*
Dusky Flycatcher	*Empidonax oberholseri*
Eared Grebe	*Podiceps nigricollis*
Eastern Kingbird	*Tyrannus tyrannus*
European Starling	*Sturnus vulgaris*
Evening Grosbeak	*Hesperiphona vespertina*
Ferruginour Hawk	*Buteo regalis*
Flammulated Owl	*Otus flammeolus*
Forster's Tern	*Sterna forsteri*
Fox Sparrow	*Passerella iliaca*
Franklin's Gull	*Larus pipixcan*
Gadwall Duck	*Anas strepera*
Golden Eagle	*Aquila chrysuetos*
Golden-Crowned Kinglet	*Regulus satrapa*
Grasshopper Sparrow	*Ammodramus savannarum*
Gray Catbird	*Dumetella carolinensis*
Gray Flycatcher	*Empidonax wrightii*
Gray Jay	*Perisoreus canadensis*
Gray-Crowned Rosy Finch	*Leucosticte atrata*
Gray-Partridge	*Perdix perdix*
Great Blue Heron	*Ardea herodias*
Great Gray Owl	*Strix nebulosa*
Greater Sandhill Crane	*Grus canadensis*
Greater Scaup	*Aythya marila*
Greater Yellowlegs	*Tringa melanoleuca*
Green Heron	*Butorides striatus*
Green-Tailed Towhee	*Chlorura chlorara*
Green-Winged Teal	*Anas crecca*
Green-Winged Teal Duck	*Anas carolinensis*
Hairy Woodpecker	*Picoides villosus*

TABLE A.3 LIST OF AVIAN SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
Hammond's Flycatcher	*Empidonax hammondii*
Hermit Thrush	*Catharus guttatus*
Herring Gull	*Larus argentatus*
Hooded Merganser	*Lophodytes cucullatus*
Horned Grebe	*Podiceps Auritus*
Horned Lark	*Eremophilia alpestris*
Horned Sparrow	*Passer domesticus*
House Finch	*Carpodacus mexicanus*
House Sparrow	*Passer domesticus*
House Wren	*Troglodytes aedon*
Hungarian Partridge	*Perdix perdix*
Killdeer	*Charadrius vociferus*
Lark Bunting	*Calamospiza melanocorys*
Lark Sparrow	*Chondestes grammacus*
Lazuli Bunting	*Passerina amoena*
Least Sandpiper	*Calidris minutilla*
Lesser Golden-Plover	*Pluvialis dominica*
Lesser Scaup	*Aythya affinis*
Lesser Yellowlegs	*Tringa flavipes*
Lincoln's Sparrow	*Melospiza lincolnii*
Loggerhead Shrike	*Lanius ludovicianus*
Long-Billed Curlew	*Numenius americanus*
Long-Billed Dowitcher	*Limnodromus scolopaceus*
Long-Eared Owl	*Asio otus*
MacGillivray's Warbler	*Oporornis tolmiei*
Mallard Duck	*Anas platyrhynchas*
Marbled Godwit	*Limosa Fedoa*
Marsh Hawk	*Circus cyaneus*
Marsh Wren	*Cistothorus palustris*
Mountain Bluebird	*Sialia currucoides*
Mountain Chickadee	*Parus gambeli*
Mourning Dove	*Zenaida macroura*
Nashville Warbler	*Vermivora ruficapilla*
Northern Flicker	*Colaptes auratus*
Northern Goshawk	*Accipiter gentilis*
Northern Harrier	*Circus cyaneus*
Northern Oriole	*Icterus galbula*
Northern Pintail	*Anas acuta*
Northern Pygmy-Owl	*Glaucidium gnoma*
Northern Rough-Winged Swallow	*Stelgidopteryx ruficollis*
Northern Saw-Whet Owl	*Aegolius acadicus*
Northern Shoveler	*Anas Clypeata*
Northern Waterthrush	*Seiurus noveboracensis*
Olive-Sided Flycatcher	*Nuttallornis borealis*
Orange-Crowned Warbler	*Vermivora celata*
Peregrine Falcon	*Falco peregrinus anatum*
Pied-Billed Grebe	*Podilymbus podiceps*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Carduelis pinus*
Plain Titmouse	*Parus inornatus*
Prairie Falcon	*Falco mexicanus*

TABLE A.3 LIST OF AVIAN SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
Red Crossbill	*Loxia curvirostra*
Red-Breasted Merganser	*Mergus Serrator*
Red-Breasted Nuthatch	*Sitta canadensis*
Red-Eyed Vireo	*Vireo olivaceus*
Redhead Duck	*Aythya americana*
Red-Naped Sapsucker	*Sphyrapicus varius*
Red-Shafted Flicker	*Colaptes cafer*
Red-Tailed Hawk	*Buteo jamaicensis*
Red-Winged Blackbird	*Agelaius phoeniceus*
Ring-Billed Gull	*Larus delawarensis*
Ring-Necked Pheasant	*Phasianus colchicus*
Rock Dove	*Columa livia*
Rock Wren	*Salpinctes obsoletus*
Rough-Legged Hawk	*Buteo lagopus*
Rough-Winged Swallow	*Stelgidopteryx serrupennis*
Ruby-Crowned Kinglet	*Regulus calendula*
Ruddy Duck	*Oxyura jamaicensis*
Ruffed Grouse	*Bonasa umbellus*
Rufous Hummingbird	*Selasphorus rufus*
Rufous-Sided Towhee	*Pipilo erythrophthalmus*
Sage Grouse	*Centrocercus urophasianus*
Sage Sparrow	*Amphispiza belli*
Sage Thrasher	*Oreoscoptes montanus*
Savannah Sparrow	*Passerculus sandwichensis*
Say’s Phoebe	*Sayornis saya*
Sharp-Shinned Hawk	*Accipiter striatus*
Sharp-Tailed Grouse	*Pedioecetes phasianellus*
Short-Billed Dowitcher	*Limnodromus griseus*
Short-Eared Owl	*Asio flammeus*
Snowy Egret	*Egretta Thula*
Solitary Sandpiper	*Tringa solitaria*
Solitary Vireo	*Vireo solitarius*
Song Sparrow	*Melospiza melodia*
Sora	*Porzana carolina*
Sparrow Hawk	*Falco spariverius*
Spotted Sandpiper	*Actitis macularia*
Steller’s Jay	*Cyanocitta stelleri*
Stilt Sandpiper	*Micropalma himantopus*
Swainson’s Hawk	*Buteo swainsoni*
Swainson’s Thrush	*Catharus ustulatus*
Townsend’s Solitare	*Myadestes townsendi*
Townsend’s Warbler	*Dendroica townsendi*
Tree Swallow	*Iridoprocne bicolor*
Trumpeter Swan	*Cygnus buccinator*
Tundra Swan	*Cygnus columbianus*
Turkey Vulture	*Cathartes aura*
Upland Sandpiper	*Bartramia longicauda*
Veery	*Catharus fuscescens*
Vesper Sparrow	*Pooecetes gramineus*
Violet-Green Swallow	*Tachycineta thalassina*
Virginia Rail	*Rallus limicola*

TABLE A.3 LIST OF AVIAN SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
Virginia's Warbler	*Vermivora virginiae*
Warbling Vireo	*Vireo gilvus*
Western Bluebird	*Silalia mexicana*
Western Grebe	*Aechmophorus occidentalis*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
Western Sandpiper	*Calidris mauri*
Western Screech Owl	*Otus kennicottii*
Western Tanager	*Piranga ludoviciana*
Western Wood-Peewee	*Contopus sordidulus*
White-Breasted Nuthatch	*Sitta carolinensis*
White-Crowned Sparrow	*Zonotrichia leucophrys*
White-Faced Ibis	*Plegadis chihi*
White-Winged Crossbill	*Loxia leucoptera*
Whooping Crane	*Grus americana*
Willett	*Catoptrophorus semipalmatus*
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Willow Flycatcher	*Empidonax traillii*
Wilson's Phalarope	*Phalaropus tricolor*
Wilson's Warbler	*Wilsonnia pusilla*
Yellow Warbler	*Dendroica petechia*
Yellow-Breasted Chat	*Ictena virens*
Yellow-Headed Blackbird	*Xanthocephalus xanthocephalus*
Yellow-Rumped Warbler	*Dendroica coronata*

Sources: Idaho Conservation Data Center (1999); List of Birds (Updated August 1997).
Riparian Community Type Classification of Eastern Idaho-Western Wyoming by Youngblood, Padgett, and Winward (USFS 1985).
Distribution, Season of Use, and Habitat of the Mammals, Birds, Reptiles, Amphibians and Fishes of Idaho, by Lanny O. Wilson, Bureau of Land Management (1977).
Ecological Site Inventory for Pocatello Resource Area, Bureau of Land Management (Undated).

TABLE A.4 SELECTED AMPHIBIANS AND REPTILES IN THE STUDY AREA	
Common Name	**Latin Binomial**
Amphibians	
Tiger salamander	Ambystama tigrenum
Western toad	Bufo boreas
Leopard frog	Rana pipiens
Reptiles	
Sagebrush lizard	Sceloporus graciosus
Gopher snake	Pituophies melanoleucus
Western gartersnake	Thamnophis elegans
Racer	Coluber constrictor
Common garter snake	Thamnophis sirtalis

TABLE A.5 LIST OF FISH SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA	
Common Name	**Latin Binomial**
Bear Lake cutthroat trout	*Oncorhynchus clarki pop 3*
Bonneville cutthroat trout	*Oncorhynchus clarki Utah*
Bear Lake Sculpin	*Cottus extensus*
Bear Lake Whitefish	*Prosopium abyssicola*
Bonneville cisco	*Prosopium gemmifer*
Bonneville whitefish	*Prosopium spilonotus*
Brook Trout	*Salvelinus fontinalis*
Brown Trout	*Salmo Trutta*
Common Carp	*Cyprinus carpio*
Cutthroat Trout	*Salmo clarki*
Leatherside Chub	*Gila copei*
Longnose Dace	*Rhinichthys catatactae*
Longnose Sucker	*Catostomus catostomus*
Mountain Sucker	*Catostomus platyrhynchus*
Rainbow Trout	*Lepomis gibbosus*
Redshiner	*Notropis lutrensis*
Snake River Fine-Spotted Cutthroat	*Oncorhynchus clarki ssp2*
Speckled Dace	*Rhinichthys osculus*
Utah Chub	*Gila atraria*
White Sucker	*Catostomus commersoni*
Yellowstone cutthroat trout	*Oncorhynchus clarki Bouvieri*
Source: Idaho Conservation Data Center (1999); List of Fishes (Updated August 1997).	

TABLE A.6 STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT									
Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
				Sept. 1997	May 1998	Sept. 1998	1999-2000	Proximally Upstream of:	Proximally Downstream of:
Portneuf River	Below Bakers Creek	NW ¼, Sec 2, T 5 S, R 38 E	ST001		Yes	Yes			Gay Mine
	Above Bakers Creek	SW ¼, Sec 35, T 4 S, R 38 E	ST002					Gay Mine	
	Below U Creek	SE ¼, Sec 16, T 4 S, R 38 E	ST003						Gay Mine
	Above U Creek	SE ¼, Sec 16, T 4 S, R 38 E	ST004		Yes	Yes		Gay Mine	
Bakers Creek	Below Boundary Creek	SE ¼, Sec 34, T 4 S, R 38 E	ST005						Gay Mine
	Above Boundary Creek	SE ¼, Sec 34, T 4 S, R 38 E	ST006					Gay Mine	
	Below East Limb of Gay Mine	SE ¼, Sec 32, T 4 S, R 38 E	ST007				Yes		Gay Mine
Boundary Creek	Above Bakers Creek	SE ¼, Sec 34, T 4 S, R 38 E	ST008						Gay Mine
	Below East Limb of Gay Mine	NW ¼, Sec 24, T 4 S, R 38 E	ST009						Gay Mine
South Fork Boundary Creek	Below East Limb of Gay Mine	SE ¼, Sec 29, T 4 S, R 38 E	ST010						Gay Mine
U Creek	Above Portneuf River	SW ¼, Sec 16, T 4 S, R 38 E	ST011						Gay Mine
	Below East Limb of Gay Mine	NW ¼, Sec 20, T 4 S, R 38 E	ST012				Yes		Gay Mine
Ross Fork	Below Danielson Creek (1997 #50)	NW ¼, Sec 5, T 5 S, R 37 E	ST013	Yes	Yes	Yes			Gay Mine
	Above Danielson Creek	NW ¼, Sec 5, T 5 S, R 37 E	ST014				Yes	Gay Mine	
	Above South 40 of Gay Mine (1997 #49)	NE ¼, Sec 3, T 5 S, R 37 E	ST015	Yes	Yes	Yes		Gay Mine	
Danielson Creek	Above Ross Fork	NW ¼, Sec 5, T 5 S, R 37 E	ST016				Yes		Gay Mine
Blackfoot River	Below Lincoln Creek	SW ¼, Sec 3, T 3 S, R 36 E	ST017						Gay Mine
	Above Lincoln Creek	NW ¼, Sec 2, T 2 S, R 36 E	ST018					Gay Mine	
	Below Blackfoot Reservoir	NE ¼, Sec 12, T 5 S, R 40 E	ST233				Yes		Blackfoot Reservoir
	Above Blackfoot Reservoir	NE ¼, Sec 16, T 6 S, R 42 E	ST232				Yes	Blackfoot Reservoir	
	Below Woodall Mountain Creek	SE ¼, Sec 16, T 7 S, R 42 E	ST231						Conda Mine
	Below Ballard Creek	SE ¼, Sec 14, T 7 S, R 42 E	ST019		Yes	Yes	Yes		Ballard Mine
	Below State Land Creek	SW ¼, Sec 13, T 7 S, R 42 E	ST020		Yes	Yes	Yes	Ballard Mine	
	Above State Land Creek	NE ¼, Sec 24, T 7 S, R 42 E	ST230				Yes	Ballard Mine	Conda Mine
	Below Trail Creek	NE ¼, Sec 30, T 7 S, R 43 E	ST021				Yes		Conda Mine
	Below Wooley Valley Creek	SW ¼, Sec 33, T 7 S, R 43 E	ST022		Yes	Yes	Yes	Conda Mine	Ballard and Wooley Valley Mines
	Below Dry Valley Creek, FMC's BF1 (1997 #20)	SE ¼, Sec 26, T 7 S, R 43 E	ST023	Yes	Yes	Yes	Yes		Dry Valley Mine
	Above Dry Valley Creek, FMC's BF2 (1997 #19)	SW ¼, Sec 25, T 7 S, R 43 E	ST024	Yes	Yes	Yes	Yes	Dry Valley Mine	
	Below Wooley Range Ridge Creek	NE ¼, Sec 25, T 7 S, R 43 E	ST025						Wooley Valley Mine
	Above Wooley Range Ridge Creek	SW ¼, Sec 19, T 7 S, R 44 E	ST026		Yes	Yes	Yes	Wooley Valley Mine	
	Below Angus Creek	SW ¼, Sec 8, T 7 S, R 44 E	ST027				Yes		Rasmussen Ridge, Enoch Valley, and Wooley Valley Mines
	Diamond Creek Rd.	SW ¼, Sec 9, T 7 S, R 44 E	ST028				Yes	Rasmussen Ridge, Enoch Valley, and Wooley Valley Mines	
	Below Spring Creek	SE ¼, Sec 9, T 7 S, R 44 E	ST229			Yes	Yes		North Maybe Mine
	Above Spring Creek	SE ¼, Sec 9, T 7 S, R 44 E	ST029				Yes	North Maybe Mine	Lanes Creek
Lincoln Creek	Above Blackfoot River	SE ¼, Sec 35, T 2 S, R 36 E	ST030						Gay Mine
	Below Dry Hollow Creek (1997 #52)	NW ¼, Sec 3, T 4 S, R 37 E	ST031	Yes	Yes	Yes	Yes		Gay Mine
	Above Dry Hollow Creek	NE ¼, Sec 3, T 4 S, R 37 E	ST032						Gay Mine
	Above North Limb of Gay Mine (1997 #51)	NW ¼, Sec 12, T 4 S, R 37 E	ST033	Yes	Yes	Yes		Gay Mine	
Dry Hollow Creek	Above Lincoln Creek	NW ¼, Sec 3, T 4 S, R 37 E	ST034						Gay Mine
	Below North Limb Creek	NW ¼, Sec 10, T 4 S, R 37 E	ST035				Yes		Gay Mine
	Below East Fork Dry Hollow Creek	SW ¼, Sec 10, T 4 S, R 37 E	ST036				Yes		Gay Mine
	Above East Fork Dry Hollow Creek	NE ¼, Sec 16, T 4 S, R 37 E	ST037					Gay Mine	
North Limb Creek	Below North Limb of Gay Mine	NE ¼, Sec 10, T 4 S, R 37 E	ST038						Gay Mine
	Above North Limb of Gay Mine	NE ¼, Sec 14, T 4 S, R 37 E	ST039					Gay Mine	
LL Creek	Above Dry Hollow Creek	NW ¼, Sec 10, T 4 S, R 37 E	ST040						Gay Mine
East Fork Dry Hollow Creek	Above Dry Hollow Creek	NE ¼, Sec 16, T 4 S, R 37 E	ST041						Gay Mine
Grizzly Creek	Below Phosphoria Formation outcrop (1997 #64)	NW ¼, Sec 30, T 5 S, R 40 E	ST042	Yes	Yes	Yes	Yes		Western district background
Little Blackfoot River	Above Blackfoot Reservoir	SE ¼, Sec 9, T 6 S, R 42 E	ST234						Henry and Ballard Mines
	Below Long Valley Creek	NE ¼, Sec 15, T 6 S, R 42 E	ST043		Yes	Yes	Yes		Henry Mine
	Immediately below Henry Mine	NE ¼, Sec 14, T 6 S, R 42 E	ST044		Yes	Yes			Henry Mine
	Above Henry Creek (1997 #23)	NE ¼, Sec 14, T 6 S, R 42 E	ST045	Yes				Henry Mine	
	Below Enoch Valley Creek	SE ¼, Sec 12, T 6 S, R 42 E	ST046		Yes	Yes			Henry Mine
	Above Enoch Valley Creek	SE ¼, Sec 12, T 6 S, R 42 E	ST047		Yes	Yes		Henry Mine	

:1227028\Final 1998 Report \Appendices\Table A.5
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TABLE A.6
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station[†]	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
				Sept. 1997	May 1998	Sept. 1998	1999-2000	Proximally Upstream of:	Proximally Downstream of:
Little Blackfoot River (continued)	Below Reese Creek	SW ¼, Sec 5, T 6 S, R 43 E	ST048						Rasmussen Ridge Mine
	Above Reese Creek	SE ¼, Sec 5, T 6 S, R 43 E	ST049		Yes	Yes		Rasmussen Ridge Mine	
Meadow Creek	Above Blackfoot Reservoir	SE ¼, Sec 3, T 6 S, R 42 E	ST235						Central district background
Long Valley Creek	Below Ballard Mine	NW ¼, Sec 1, T 7 S, R 42 E	ST050						Ballard Mine
East Fork Long Valley Creek	Below Henry Mine	NW ¼, Sec 25, T 6 S, R 42 E	ST051						Henry Mine
Henry Creek	Above Little Blackfoot River	NW ¼, Sec 13, T 6 S, R 42 E	ST052						Henry Mine
Enoch Valley Creek	Above Little Blackfoot River	SW ¼, Sec 7, T 6 S, R 42 E	ST053						Henry and Enoch Valley Mines
	Above spring-fed creek	NE ¼, Sec 18, T 6 S, R 43 E	ST054				Yes		Enoch Valley Mine
	Below Strip Mine Creek	NW ¼, Sec 20, T 6 S, R 43 E	ST055						Henry Mine
	Above Strip Mine Creek	NE ¼, Sec 20, T 6 S, R 43 E	ST056						Henry Mine
	Below West Fork of Enoch Valley Creek	SE ¼, Sec 29, T 6 S, R 43 E	ST057						Henry Mine
	Above West Fork Enoch Valley Creek	SE ¼, Sec 29, T 6 S, R 43 E	ST058						Henry Mine
East Fork Enoch Valley Creek	Below Wooley Valley Mine	NW ¼, Sec 33, T 6 S, R 43 E	ST226				Yes	Henry Mine	Wooley Valley Mine
West Rasmussen Ridge Creek #1	Above Enoch Valley Creek	SE ¼, Sec 17, T 6 S, R 43 E	ST059						Enoch Valley Mine
West Rasmussen Ridge Creek #2	Above Enoch Valley Creek	SE ¼, Sec 17, T 6 S, R 43 E	ST060						Enoch Valley Mine
West Rasmussen Ridge Creek #3	Above Enoch Valley Creek	SE ¼, Sec 17, T 6 S, R 43 E	ST061						Enoch Valley Mine
Strip Mine Creek	Above Enoch Valley Creek	NW ¼, Sec 20, T 6 S, R 43 E	ST062						Henry Mine
	Below Henry Mine	SW ¼, Sec 29, T 6 S, R 43 E	ST063						Henry Mine
West Fork Enoch Valley Creek	Below Henry Mine	SE ¼, Sec 29, T 6 S, R 43 E	ST064						Henry Mine
Reese Creek	Above logging activity	NW ¼, Sec 9, T 6 S, R 43 E	ST065						Rasmussen Ridge Mine
Ballard Creek	Above Blackfoot River	NW ¼, Sec 13, T 7 S, R 42 E	ST066						Ballard Mine
	Headwaters	SE ¼, Sec 12, T 7 S, R 42 E	ST067						Ballard Mine
West Fork Ballard Creek	Headwaters	SW ¼, Sec 12, T 7 S, R 42 E	ST068						Ballard Mine
Short Creek	Below Ballard Mine	NE ¼, Sec 13, T 7 S, R 42 E	ST069						Ballard Mine
State Land Creek	Above Blackfoot River	NW ¼, Sec 24, T 7 S, R 42 E	ST070				Yes		Conda Mine
	Below tributaries	NW ¼, Sec 36, T 7 S, R 42 E	ST071		Yes	Yes			Conda Mine
Tributary #1 of State Land Creek	Below Conda Mine	SW ¼, Sec 35, T 7 S, R 42 E	ST072				Yes		Conda Mine
Tributary #2 of State Land Creek	Below Conda Mine	NE ¼, Sec 2, T 8 S, R 42 E	ST073				Yes		Conda Mine
Tributary #3 of State Land Creek	Below Conda Mine	SE ¼, Sec 2, T 8 S, R 42 E	ST074						Conda Mine
Tributary #4 of State Land Creek	Below Conda Mine	NE ¼, Sec 1, T 8 S, R 42 E	ST075						Conda Mine
Trail Creek	Above Blackfoot River	NW ¼, Sec 32, T 7 S, R 43 E	ST076		Yes	Yes			Conda Mine
	Above Pedro Creek	SE ¼, Sec 32, T 7 S, R 43 E	ST077						Conda Mine
	Above Camp G Creek	SW ¼, Sec 4, T 8 S, R 43 E	ST078		Yes	Yes		Conda Mine	
Pedro Creek	Above Trail Creek	SW ¼, Sec 32, T 7 S, R 43 E	ST079						Conda Mine
	Below tributaries	SW ¼, Sec 6, T 8 S, R 43 E	ST080				Yes		Conda Mine
Tributary #1 of Pedro Creek	Below Conda Mine	SW ¼, Sec 1, T 8 S, R 42 E	ST081						Conda Mine
Tributary #2 of Pedro Creek	Below Conda Mine	SE ¼, Sec 1, T 8 S, R 42 E	ST082						Conda Mine
Tributary #3 of Pedro Creek	Below Conda Mine	SE ¼, Sec 1, T 8 S, R 42 E	ST083						Conda Mine
Tributary #4 of Pedro Creek	Below Conda Mine	NW ¼, Sec 12, T 8 S, R 42 E	ST084						Conda Mine
Camp G Creek	Above Trail Creek	NE ¼, Sec 7, T 8 S, R 43 E	ST085						Conda Mine
	Below Conda Mine (1997 #48)	NE ¼, Sec 13, T 8 S, R 42 E	ST086	Yes					Conda Mine
	Above Conda Mine (1997 #47)	SE ¼, Sec 13, T 8 S, R 42 E	ST087	Yes				Conda Mine	
Wooley Valley Creek	Above Blackfoot River	NE ¼, Sec 27, T 7 S, R 43 E	ST088				Yes		Ballard and Wooley Valley Mines
	Below North Fork Wooley Valley Creek	SW ¼, Sec 9, T 7 S, R 43 E	ST089						Ballard Mine
	Above North Fork Wooley Valley Creek	SW ¼, Sec 9, T 7 S, R 43 E	ST090						Ballard Mine
Loadout Creek	Below Wooley Valley Mine	SE ¼, Sec 22, T 7 S, R 43 E	ST091						Wooley Valley Mine
North Fork Wooley Valley Creek	Above Wooley Valley Creek	SE ¼, Sec 8, T 7 S, R 43 E	ST092						Ballard Mine
	Above Ballard Mine	NW ¼, Sec 6, T 7 S, R 43 E	ST093					Ballard Mine	
Spring-fed tributary #1 of North Fork Wooley Valley Creek	Below Ballard Mine	NE ¼, Sec 7, T 7 S, R 43 E	ST094				Yes		Ballard Mine
Spring-fed tributary #2 of North Fork Wooley Valley Creek	Below Ballard Mine	SW ¼, Sec 8, T 7 S, R 43 E	ST095				Yes		Ballard Mine
Tributary of North Fork Wooley Valley Creek	Below Ballard Mine	SW ¼, Sec 8, T 7 S, R 43 E	ST096				Yes		Ballard Mine

TABLE A.6
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
				Sept. 1997	May 1998	Sept. 1998	1999-2000	Proximally Upstream of:	Proximally Downstream of:
Slug Creek	Below Goodheart Creek (1997 #13)	NW ¼, Sec 5, T 9 S, R 44 E	ST097	Yes	Yes	Yes			Champ Mine
	Above Goodheart Creek (1997 #12)	SW ¼, Sec 5, T 9 S, R 44 E	ST098	Yes	Yes	Yes		Champ Mine	
	Below Dry Basin Creek	NW ¼, Sec 16, T 9 S, R 44 E	ST099						Mountain Fuel Mine
	Above Dry Basin Creek	SE ¼, Sec 16, T 9 S, R 44 E	ST100		Yes	Yes		Mountain Fuel Mine	
Caldwell Creek	Below Phosphoria Formation outcrop (1997 #62)	SE ¼, Sec 12, T 8 S, R 43 E	ST101	Yes	Yes	Yes	Yes		Central district background
Goodheart Creek	Slug Creek Rd.	NE ¼, Sec 5, T 9 S, R 44 E	ST102						Champ Mine
	C-B&M-3, Dry Valley Rd. (1997 #11)	SE ¼, Sec 34, T 8 S, R 44 E	ST103	Yes					Champ Mine
	Headwaters	NE ¼, Sec 34, T 8 S, R 44 E	ST104					Champ Mine	
South Fork Goodheart Creek	Headwaters (1997 #10)	NW ¼, Sec 2, T 9 S, R 44 E	ST105	Yes					Champ Mine
Dry Canyon Creek	Dry Basin Rd.	NW ¼, Sec 9, T 9 S, R 44 E	ST106						Mountain Fuel Mine
	Dry Canyon Rd.	SE ¼, Sec 3, T 9 S, R 44 E	ST107						Mountain Fuel Mine
	Below Mountain Fuel Mine	SE ¼, Sec 11, T 9 S, R 44 E	ST108						Mountain Fuel Mine
	Below East Limb Waste Dump	SW ¼, Sec 13, T 9 S, R 44 E	ST109						Mountain Fuel Mine
Dry Canyon Creek	Above Mountain Fuel Mine	NW ¼, Sec 36, T 9 S, R 44 E	ST110					Mountain Fuel Mine	
Dry Basin Creek	Slug Creek Rd.	SE ¼, Sec 16, T 9 S, R 44 E	ST111						Mountain Fuel Mine
Shop Creek	Below Wooley Valley Mine	NE ¼, Sec 26, T 7 S, R 43 E	ST112						Wooley Valley Mine
Dry Valley Creek	Above Blackfoot River, FMC's DV2 (1997 #18)	SE ¼, Sec 25, T 7 S, R 43 E	ST113	Yes	Yes	Yes	Yes		Dry Valley Mine
	Below Maybe Creek, FMC's DV3 (1997 #17)	NW ¼, Sec 5, T 8 S, R 44 E	ST114	Yes			Yes	Dry Valley Mine	
	Above Maybe Creek, FMC's DV5	NE ¼, Sec 8, T 8 S, R 44 E	ST115				Yes	Dry Valley Mine	
	Above mining activity, FMC's DV6 (1997 #16)	NW ¼, Sec 16, T 8 S, R 44 E	ST116	Yes				Dry Valley Mine	
	Above Dry Valley Mine, FMC's DV7 (1997 #15)	SW ¼, Sec 22, T 8 S, R 44 E	ST117	Yes				Dry Valley Mine	
Chicken Creek	Above Dry Valley Creek, FMC's CC1 (1997 #72)	SW ¼, Sec 31, T 7 S, R 44 E	ST118	Yes					Dry Valley Mine
	Above Dry Valley Mine	NW ¼, Sec 6, T 8 S, R 44 E	ST119					Dry Valley Mine	
Maybe Creek	Above Dry Valley Mine, FMC's MB1 (1997 #14)	NE ¼, Sec 9, T 8 S, R 44 E	ST120	Yes				Dry Valley Mine	
Big Draw Creek	Above old channel of Maybe Creek	SW ¼, Sec 4, T 8 S, R 44 E	ST121						North Maybe Mine
	Headwaters (1997 #5)	NE ¼, Sec 4, T 8 S, R 44 E	ST122	Yes					North Maybe Mine
Overburden Creek	Above Blackfoot River	NE ¼, Sec 25, T 7 S, R 43 E	ST123				Yes		Wooley Valley Mine
Wooley Range Ridge Creek	Above Blackfoot River	SE ¼, Sec 24, T 7 S, R 43 E	ST124				Yes		Wooley Valley Mine
West Mill Creek	Above Blackfoot River	SE ¼, Sec 18, T 7 S, R 44 E	ST125				Yes		Wooley Valley Mine
Angus Creek	Above Blackfoot River	SE ¼, Sec 8, T 7 S, R 44 E	ST126						Rasmussen Ridge, Enoch Valley, and Wooley Valley Mines
	Below No Name Creek	SW ¼, Sec 36, T 6 S, R 43 E	ST127				Yes		Rasmussen Ridge and Enoch Valley Mines
	Above No Name Creek	SE ¼, Sec 35, T 6 S, R 43 E	ST132		Yes	Yes		Rasmussen Ridge Mine	
	Above Rasmussen Creek	SE ¼, Sec 35, T 6 S, R 43 E	ST128					Rasmussen Ridge and Enoch Valley Mines	
	R-B&M-10, below Wooley Valley Mine	SW ¼, Sec 34, T 6 S, R 43 E	ST129		Yes	Yes	Yes		Wooley Valley Mine
	R-B&M-12, below Upper Angus Creek Res.	SW ¼, Sec 11, T 7 S, R 43 E	ST130				Yes		Wooley Valley Mine
Rasmussen Creek	Above Angus Creek	SE ¼, Sec 35, T 6 S, R 43 E	ST131		Yes	Yes	Yes		Rasmussen Ridge and Enoch Valley Mines
	M-B&M-1, below Enoch Valley Mine	SE ¼, Sec 27, T 6 S, R 43 E	ST133				Yes		Enoch Valley Mine
	Below West Pond Creek	NW ¼, Sec 27, T 6 S, R 43 E	ST134						Enoch Valley Mine
	Above West Pond Creek	NW ¼, Sec 27, T 6 S, R 43 E	ST135					Enoch Valley Mine	
	Headwaters near Shop Pond	SE ¼, Sec 21, T 6 S, R 43 E	ST136						Enoch Valley Mine
No Name Creek	R-B-2, above Angus Creek	NE ¼, Sec 35, T 6 S, R 43 E	ST137		Yes	Yes	Yes		Rasmussen Ridge Mine
	R-B&M-3, below Rasmussen Ridge Mine haul road	NE ¼, Sec 26, T 6 S, R 43 E	ST138						Rasmussen Ridge Mine
	Above Rasmussen Ridge Mine	SW ¼, Sec 23, T 6 S, R 43 E	ST139					Rasmussen Ridge Mine	
West Fork No Name Creek	Below proposed North Pit of Rasmussen Ridge Mine	SW ¼, Sec 23, T 6 S, R 43 E	ST140						Rasmussen Ridge Mine
East Fork No Name Creek	Below proposed North Pit of Rasmussen Ridge Mine	SW ¼, Sec 23, T 6 S, R 43 E	ST141						Rasmussen Ridge Mine
	Above proposed North Pit of Rasmussen Ridge Mine	NW ¼, Sec 15, T 6 S, R 43 E	ST142					Rasmussen Ridge Mine	
East Fork Rasmussen Creek	Above Rasmussen Creek	SW ¼, Sec 26, T 6 S, R 43 E	ST143				Yes		Enoch Valley Mine
West Pond Creek	Headwaters, below West Pond	NW ¼, Sec 27, T 6 S, R 43 E	ST144						Enoch Valley Mine
Spring Creek	C-B-1, below north fork of East Mill Creek (1997 #3)	SW ¼, Sec 10, T 7 S, R 44 E	ST145	Yes			Yes		North Maybe Mine
	Above north fork of East Mill Creek	NW ¼, Sec 15, T 7 S, R 44 E	ST146					North Maybe Mine	
	C-B-2, below south fork of East Mill Creek	NE ¼, Sec 15, T 7 S, R 44 E	ST147						North Maybe Mine
	Above south fork of East Mill Creek (1997 #2)	SE ¼, Sec 15, T 7 S, R 44 E	ST148	Yes			Yes	North Maybe Mine	

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TABLE A.6
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
								Proximally Upstream of:	Proximally Downstream of:
East Mill Creek	Above Spring Creek, on north fork	NW ¼, Sec 15, T 7 S, R 44 E	ST149		Yes	Yes			North Maybe Mine
	Above Spring Creek, on south fork	SE ¼, Sec 15, T 7 S, R 44 E	ST150		Yes	Yes			North Maybe Mine
	Fish sampling station, below North Maybe Mine	NE ¼, Sec 21, T 7 S, R 44 E	ST227			Yes	Yes		North Maybe Mine
	C-B&M-1, below North Maybe Mine (1997 #1)	NE ¼, Sec 21, T 7 S, R 44 E	ST151	Yes					North Maybe Mine
Diamond Creek	Below Kendall Creek	SW ¼, Sec 14, T 7 S, R 44 E	ST152		Yes	Yes			North Maybe Mine
	Above Kendall Creek	NE ¼, Sec 36, T 7 S, R 44 E	ST153		Yes	Yes			North Maybe Mine
Kendall Creek	Diamond Creek Rd.	SE ¼, Sec 26, T 7 S, R 44 E	ST154				Yes		North Maybe Mine
Stuart Creek	Above Diamond Creek	SW ¼, Sec 29, T 8 S, R 45 E	ST236				Yes		Central district background
Timber Creek	Above Diamond Creek	NE ¼, Sec 28, T 8 S, R 45 E	ST237				Yes		Central district background
Lanes Creek	Below 6500-Feet Creek	NE ¼, Sec 9, T 7 S, R 44 E	ST155		Yes	Yes	Yes		Lanes Creek Mine
	Below Sheep Creek	NW ¼, Sec 3, T 7 S, R 44 E	ST156		Yes	Yes	Yes	Lanes Creek Mine	Rasmussen Ridge Mine
	Above Sheep Creek	SE ¼, Sec 33, T 6 S, R 44 E	ST157				Yes	Rasmussen Ridge Mine	
6500-Feet Creek	Above Lanes Creek	NE ¼, Sec 4, T 7 S, R 44 E	ST158				Yes		Lanes Creek Mine
	Above South Fork 6500-Feet Creek	NE ¼, Sec 4, T 7 S, R 44 E	ST159						Lanes Creek Mine
South Fork 6500-Feet Creek	Above 6500-Feet Creek	NE ¼, Sec 4, T 7 S, R 44 E	ST160						Lanes Creek Mine
Sheep Creek	Above Lanes Creek	SW ¼, Sec 33, T 6 S, R 44 E	ST161		Yes	Yes	Yes		Rasmussen Ridge Mine
	R-B&M-7, below West Fork Sheep Creek	SE ¼, Sec 30, T 6 S, R 44 E	ST162		Yes	Yes			Rasmussen Ridge Mine
	R-B-4, above West Fork Sheep Creek	SE ¼, Sec 30, T 6 S, R 44 E	ST163		Yes	Yes		Rasmussen Ridge Mine	
	R-B&M-4, near Rasmussen Ridge Mine office	NW ¼, Sec 25, T 6 S, R 43 E	ST164						Rasmussen Ridge Mine
South Fork Sheep Creek	Below Lanes Creek Mine	NE ¼, Sec 32, T 6 S, R 44 E	ST165				Yes		Lanes Creek Mine
	Above Lanes Creek Mine	SW ¼, Sec 32, T 6 S, R 44 E	ST166					Lanes Creek Mine	
West Fork Sheep Creek	R-B-1	SE ¼, Sec 25, T 6 S, R 43 E	ST167						Rasmussen Ridge Mine
Stump Creek	Below Tygee Creek	SE ¼, Sec 27, T 7 S, R 46 E	ST168						Smoky Canyon Mine
	Above Tygee Creek	SW ¼, Sec 27, T 7 S, R 46 E	ST169					Smoky Canyon Mine	
Tygee Creek	Below Smoky Creek	NW ¼, Sec 10, T 8 S, R 46 E	ST170				Yes		Smoky Canyon Mine
	S-B&M-3, below Roberts Creek	NW ¼, Sec 15, T 8 S, R 46 E	ST171						Smoky Canyon Mine
	S-B&M-7, above Smoky Canyon Mine	NW ¼, Sec 27, T 8 S, R 46 E	ST172					Smoky Canyon Mine	
Smoky Creek	Below Smoky Canyon Mine at FS station	NW ¼, Sec 16, T 8 S, R 46 E	ST173		Yes	Yes			Smoky Canyon Mine
	S-B&M-4, above activity at Smoky Canyon Mine	SE ¼, Sec 24, T 8 S, R 45 E	ST174		Yes	Yes		Smoky Canyon Mine	
Roberts Creek	Below tailings ponds	SE ¼, Sec 16, T 8 S, R 46 E	ST175						Smoky Canyon Mine
	S-B&M-5, above tailing ponds	SE ¼, Sec 20, T 8 S, R 46 E	ST176		Yes	Yes			Smoky Canyon Mine
Crow Creek	Below Sage Creek	NW ¼, Sec 21, T 9 S, R 46 E	ST177						Smoky Canyon Mine
	Above Sage Creek	SW ¼, Sec 21, T 9 S, R 46 E	ST178					Smoky Canyon Mine	
	Below Deer Creek	NE ¼, Sec 1, T 10 S, R 45 E	ST179						Georgetown Canyon Mine
	Above Deer Creek	NE ¼, Sec 1, T 10 S, R 45 E	ST180					Georgetown Canyon Mine	
Sage Creek	Above Crow Creek	SW ¼, Sec 21, T 9 S, R 46 E	ST181						Smoky Canyon Mine
	Below North Fork Sage Creek	NE ¼, Sec 17, T 9 S, R 46 E	ST182				Yes		Smoky Canyon Mine
	S-B&M-11, immediately below Smoky Canyon Mine	NE ¼, Sec 7, T 9 S, R 46 E	ST183		Yes	Yes	Yes		Smoky Canyon Mine
	S-B&M-10, above Smoky Canyon Mine	NE ¼, Sec 12, T 9 S, R 45 E	ST184		Yes	Yes		Smoky Canyon Mine	
South Fork Sage Creek	Below Smoky Canyon Mine	SE ¼, Sec 18, T 9 S, R 46 E	ST228			Yes	Yes		Smoky Canyon Mine
	Above Smoky Canyon Mine, below Phosphoria Formation outcrop (1997 #60)	SE ¼, Sec 13, T 9 S, R 45 E	ST185	Yes	Yes	Yes	Yes		Eastern district background
Hoopes Creek	Below S-B&M-12	NE ¼, Sec 18, T 9 S, R 46 E	ST186						Smoky Canyon Mine
North Fork Sage Creek	Below Pole Creek (1997 #68)	NE ¼, Sec 8, T 9 S, R 46 E	ST187	Yes	Yes	Yes	Yes		Smoky Canyon Mine
	Above Pole Creek (1997 #67)	SE ¼, Sec 5, T 9 S, R 46 E	ST188	Yes	Yes	Yes		Smoky Canyon Mine	
Pole Creek	S-B&M-9, below Pole Canyon Dump at Smoky Canyon Mine (1997 #66)	SE ¼, Sec 31, T 8 S, R 46 E	ST189	Yes					Smoky Canyon Mine
	S-B&M-8, above Pole Canyon Dump at Smoky Canyon Mine (1997 #65)	SE ¼, Sec 36, T 8 S, R 45 E	ST190	Yes				Smoky Canyon Mine	
Deer Creek	Below South Fork Deer Creek	SW ¼, Sec 34, T 9 S, R 45 E	ST191						Georgetown Canyon Mine
	Above South Fork Deer Creek	SE ¼, Sec 33, T 9 S, R 45 E	ST192					Georgetown Canyon Mine	
South Fork Deer Creek	Below Georgetown Canyon Mine	NW ¼, Sec 5, T 10 S, R 45 E	ST193			Yes			Georgetown Canyon Mine
Bear River	Below Georgetown Creek	NW ¼, Sec 14, T 11 S, R 43 E	ST194				Yes		Georgetown Canyon Mine
	Above Georgetown Creek	NE ¼, Sec 14, T 11 S, R 43 E	ST195				Yes	Georgetown Canyon Mine	

TABLE A.6
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
								Proximally Upstream of:	Proximally Downstream of:
Georgetown Creek	Below irrigation diversion dam	SE ¼, Sec 5, T 11 S, R 44 E	ST196		Yes	Yes			Georgetown Canyon Mine
	Below Central Farmers plant	NW ¼, Sec 25, T 10 S, R 44 E	ST197				Yes		Georgetown Canyon Mine
	Above Central Farmers plant	SW ¼, Sec 24, T 10 S, R 44 E	ST198					Georgetown Canyon Mine	
	Below sediment retention ponds	NE ¼, Sec 24, T 10 S, R 44 E	ST199				Yes		Georgetown Canyon Mine
	Above Georgetown Canyon Mine	SE ¼, Sec 6, T 10 S, R 45 E	ST200		Yes	Yes		Georgetown Canyon Mine	
Right Hand Fork	Below Georgetown Canyon Mine	NE ¼, Sec 10, T 11 S, R 44 E	ST201		Yes	Yes			Georgetown Canyon Mine
	Above Georgetown Canyon Mine	NE ¼, Sec 12, T 11 S, R 44 E	ST202		Yes	Yes		Georgetown Canyon Mine	
Church Hollow Creek	Below tailings pond	SW ¼, Sec 35, T 10 S, R 44 E	ST203						Georgetown Canyon Mine
	Above tailings pond	SW ¼, Sec 35, T 10 S, R 44 E	ST204					Georgetown Canyon Mine	
West-flowing tributary of Georgetown Creek #9	Georgetown Canyon Rd.	SW ¼, Sec 25, T 10 S, R 44 E	ST205						Georgetown Canyon Mine
Phosphoria Gulch	Above thickening pond	NW ¼, Sec 25, T 10 S, R 44 E	ST206						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #8	Georgetown Canyon Rd.	SE ¼, Sec 24, T 10 S, R 44 E	ST207						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #7	Georgetown Canyon Rd.	NE ¼, Sec 24, T 10 S, R 44 E	ST208						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #6	Georgetown Canyon Rd.	SE ¼, Sec 13, T 10 S, R 44 E	ST209						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #5	Georgetown Canyon Rd.	SE ¼, Sec 13, T 10 S, R 44 E	ST210						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #4	Georgetown Canyon Rd.	NE ¼, Sec 13, T 10 S, R 44 E	ST211						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #3	Georgetown Canyon Rd.	SE ¼, Sec 12, T 10 S, R 44 E	ST212						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #2	Georgetown Canyon Rd.	SW ¼, Sec 7, T 10 S, R 45 E	ST213						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #1	Georgetown Canyon Rd.	NW ¼, Sec 7, T 10 S, R 45 E	ST214						Georgetown Canyon Mine
Trail Canyon Creek	Below Conda Mine	SE ¼, Sec 27, T 8 S, R 42 E	ST215						Conda Mine
	Above Conda Mine	NW ¼, Sec 30, T 8 S, R 43 E	ST216					Conda Mine	
Margarette Creek	Above Trail Canyon Creek	NE ¼, Sec 25, T 8 S, R 42 E	ST217						Conda Mine
Formation Creek	Headwaters, at City of Soda Springs water intake	SW ¼, Sec 27, T 8 S, R 42 E	ST218		Yes	Yes			Conda Mine
Ledger Creek	City of Soda Springs water intake	SE ¼, Sec 5, T 9 S, R 42 E	ST219						Conda Mine
Woodall Creek	Below wetland	NE ¼, Sec 4, T 8 S, R 42 E	ST220						Conda Mine
Northwest Woodall Mountain Creek #1	Below Conda Mine	SE ¼, Sec 34, T 7 S, R 42 E	ST221						Conda Mine
Northwest Woodall Mountain Creek #2	Below Conda Mine	NW ¼, Sec 3, T 8 S, R 42 E	ST222						Conda Mine
Northwest Woodall Mountain Creek #3	Below Conda Mine	NW ¼, Sec 3, T 8 S, R 42 E	ST223						Conda Mine
Southwest Woodall Mountain Creek #1	Below Conda Mine	NW ¼, Sec 10, T 8 S, R 42 E	ST224						Conda Mine
Southwest Woodall Mountain Creek #2	Below Conda Mine	SE ¼, Sec 10, T 8 S, R 42 E	ST225						Conda Mine

Notes: †Station identification for those sampled in September 1997 is provided parenthetically.

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TABLE A.6
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
				Sept. 1997	May 1998	Sept. 1998	1999-2000	Proximally Upstream of:	Proximally Downstream of:
Portneuf River	Below Bakers Creek	NW ¼, Sec 2, T 5 S, R 38 E	ST001		Yes	Yes			Gay Mine
	Above Bakers Creek	SW ¼, Sec 35, T 4 S, R 38 E	ST002					Gay Mine	
	Below U Creek	SE ¼, Sec 16, T 4 S, R 38 E	ST003						Gay Mine
	Above U Creek	SE ¼, Sec 16, T 4 S, R 38 E	ST004		Yes	Yes		Gay Mine	
Bakers Creek	Below Boundary Creek	SE ¼, Sec 34, T 4 S, R 38 E	ST005						Gay Mine
	Above Boundary Creek	SE ¼, Sec 34, T 4 S, R 38 E	ST006					Gay Mine	
	Below East Limb of Gay Mine	SE ¼, Sec 32, T 4 S, R 38 E	ST007				Yes		Gay Mine
Boundary Creek	Above Bakers Creek	SE ¼, Sec 34, T 4 S, R 38 E	ST008						Gay Mine
	Below East Limb of Gay Mine	NW ¼, Sec 24, T 4 S, R 38 E	ST009						Gay Mine
South Fork Boundary Creek	Below East Limb of Gay Mine	SE ¼, Sec 29, T 4 S, R 38 E	ST010						Gay Mine
U Creek	Above Portneuf River	SW ¼, Sec 16, T 4 S, R 38 E	ST011						Gay Mine
	Below East Limb of Gay Mine	NW ¼, Sec 20, T 4 S, R 38 E	ST012				Yes		Gay Mine
Ross Fork	Below Danielson Creek (1997 #50)	NW ¼, Sec 5, T 5 S, R 37 E	ST013	Yes	Yes	Yes			Gay Mine
	Above Danielson Creek	NW ¼, Sec 5, T 5 S, R 37 E	ST014				Yes	Gay Mine	
	Above South 40 of Gay Mine (1997 #49)	NE ¼, Sec 3, T 5 S, R 37 E	ST015	Yes	Yes	Yes		Gay Mine	
Danielson Creek	Above Ross Fork	NW ¼, Sec 5, T 5 S, R 37 E	ST016				Yes		Gay Mine
Blackfoot River	Below Lincoln Creek	SW ¼, Sec 3, T 3 S, R 36 E	ST017						Gay Mine
	Above Lincoln Creek	NW ¼, Sec 2, T 2 S, R 36 E	ST018					Gay Mine	
	Below Blackfoot Reservoir	NE ¼, Sec 12, T 5 S, R 40 E	ST233				Yes		Blackfoot Reservoir
	Above Blackfoot Reservoir	NE ¼, Sec 16, T 6 S, R 42 E	ST232				Yes	Blackfoot Reservoir	
	Below Woodall Mountain Creek	SE ¼, Sec 16, T 7 S, R 42 E	ST231						Conda Mine
	Below Ballard Creek	SE ¼, Sec 14, T 7 S, R 42 E	ST019		Yes	Yes	Yes		Ballard Mine
	Below State Land Creek	SW ¼, Sec 13, T 7 S, R 42 E	ST020		Yes	Yes	Yes	Ballard Mine	
	Above State Land Creek	NE ¼, Sec 24, T 7 S, R 42 E	ST230				Yes	Ballard Mine	Conda Mine
	Below Trail Creek	NE ¼, Sec 30, T 7 S, R 43 E	ST021				Yes		Conda Mine
	Below Wooley Valley Creek	SW ¼, Sec 33, T 7 S, R 43 E	ST022		Yes	Yes	Yes	Conda Mine	Ballard and Wooley Valley Mines
	Below Dry Valley Creek, FMC's BF1 (1997 #20)	SE ¼, Sec 26, T 7 S, R 43 E	ST023	Yes	Yes	Yes	Yes		Dry Valley Mine
	Above Dry Valley Creek, FMC's BF2 (1997 #19)	SW ¼, Sec 25, T 7 S, R 43 E	ST024	Yes	Yes	Yes	Yes	Dry Valley Mine	
	Below Wooley Range Ridge Creek	NE ¼, Sec 25, T 7 S, R 43 E	ST025						Wooley Valley Mine
	Above Wooley Range Ridge Creek	SW ¼, Sec 19, T 7 S, R 44 E	ST026		Yes	Yes	Yes	Wooley Valley Mine	
	Below Angus Creek	SW ¼, Sec 8, T 7 S, R 44 E	ST027				Yes		Rasmussen Ridge, Enoch Valley, and Wooley Valley Mines
	Diamond Creek Rd.	SW ¼, Sec 9, T 7 S, R 44 E	ST028				Yes	Rasmussen Ridge, Enoch Valley, and Wooley Valley Mines	
	Below Spring Creek	SE ¼, Sec 9, T 7 S, R 44 E	ST229			Yes	Yes		North Maybe Mine
	Above Spring Creek	SE ¼, Sec 9, T 7 S, R 44 E	ST029				Yes	North Maybe Mine	Lanes Creek
Lincoln Creek	Above Blackfoot River	SE ¼, Sec 35, T 2 S, R 36 E	ST030						Gay Mine
	Below Dry Hollow Creek (1997 #52)	NW ¼, Sec 3, T 4 S, R 37 E	ST031	Yes	Yes	Yes	Yes		Gay Mine
	Above Dry Hollow Creek	NE ¼, Sec 3, T 4 S, R 37 E	ST032						Gay Mine
	Above North Limb of Gay Mine (1997 #51)	NW ¼, Sec 12, T 4 S, R 37 E	ST033	Yes	Yes	Yes		Gay Mine	
Dry Hollow Creek	Above Lincoln Creek	NW ¼, Sec 3, T 4 S, R 37 E	ST034						Gay Mine
	Below North Limb Creek	NW ¼, Sec 10, T 4 S, R 37 E	ST035				Yes		Gay Mine
	Below East Fork Dry Hollow Creek	SW ¼, Sec 10, T 4 S, R 37 E	ST036				Yes		Gay Mine
	Above East Fork Dry Hollow Creek	NE ¼, Sec 16, T 4 S, R 37 E	ST037					Gay Mine	
North Limb Creek	Below North Limb of Gay Mine	NE ¼, Sec 10, T 4 S, R 37 E	ST038						Gay Mine
	Above North Limb of Gay Mine	NE ¼, Sec 14, T 4 S, R 37 E	ST039					Gay Mine	
LL Creek	Above Dry Hollow Creek	NW ¼, Sec 10, T 4 S, R 37 E	ST040						Gay Mine
East Fork Dry Hollow Creek	Above Dry Hollow Creek	NE ¼, Sec 16, T 4 S, R 37 E	ST041						Gay Mine
Grizzly Creek	Below Phosphoria Formation outcrop (1997 #64)	NW ¼, Sec 30, T 5 S, R 40 E	ST042	Yes	Yes	Yes	Yes		Western district background
Little Blackfoot River	Above Blackfoot Reservoir	SE ¼, Sec 9, T 6 S, R 42 E	ST234						Henry and Ballard Mines
	Below Long Valley Creek	NE ¼, Sec 15, T 6 S, R 42 E	ST043		Yes	Yes	Yes		Henry Mine
	Immediately below Henry Mine	NE ¼, Sec 14, T 6 S, R 42 E	ST044		Yes	Yes			Henry Mine
	Above Henry Creek (1997 #23)	NE ¼, Sec 14, T 6 S, R 42 E	ST045	Yes				Henry Mine	
	Below Enoch Valley Creek	SE ¼, Sec 12, T 6 S, R 42 E	ST046		Yes	Yes			Henry Mine
	Above Enoch Valley Creek	SE ¼, Sec 12, T 6 S, R 42 E	ST047		Yes	Yes		Henry Mine	

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TABLE A.6
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station[†]	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
				Sept. 1997	May 1998	Sept. 1998	1999-2000	Proximally Upstream of:	Proximally Downstream of:
Little Blackfoot River (continued)	Below Reese Creek	SW ¼, Sec 5, T 6 S, R 43 E	ST048						Rasmussen Ridge Mine
	Above Reese Creek	SE ¼, Sec 5, T 6 S, R 43 E	ST049		Yes	Yes		Rasmussen Ridge Mine	
Meadow Creek	Above Blackfoot Reservoir	SE ¼, Sec 3, T 6 S, R 42 E	ST235						Central district background
Long Valley Creek	Below Ballard Mine	NW ¼, Sec 1, T 7 S, R 42 E	ST050						Ballard Mine
East Fork Long Valley Creek	Below Henry Mine	NW ¼, Sec 25, T 6 S, R 42 E	ST051						Henry Mine
Henry Creek	Above Little Blackfoot River	NW ¼, Sec 13, T 6 S, R 42 E	ST052						Henry Mine
Enoch Valley Creek	Above Little Blackfoot River	SW ¼, Sec 7, T 6 S, R 42 E	ST053						Henry and Enoch Valley Mines
	Above spring-fed creek	NE ¼, Sec 18, T 6 S, R 43 E	ST054				Yes		Enoch Valley Mine
	Below Strip Mine Creek	NW ¼, Sec 20, T 6 S, R 43 E	ST055						Henry Mine
	Above Strip Mine Creek	NE ¼, Sec 20, T 6 S, R 43 E	ST056						Henry Mine
	Below West Fork of Enoch Valley Creek	SE ¼, Sec 29, T 6 S, R 43 E	ST057						Henry Mine
	Above West Fork Enoch Valley Creek	SE ¼, Sec 29, T 6 S, R 43 E	ST058						Henry Mine
East Fork Enoch Valley Creek	Below Wooley Valley Mine	NW ¼, Sec 33, T 6 S, R 43 E	ST226				Yes	Henry Mine	Wooley Valley Mine
West Rasmussen Ridge Creek #1	Above Enoch Valley Creek	SE ¼, Sec 17, T 6 S, R 43 E	ST059						Enoch Valley Mine
West Rasmussen Ridge Creek #2	Above Enoch Valley Creek	SE ¼, Sec 17, T 6 S, R 43 E	ST060						Enoch Valley Mine
West Rasmussen Ridge Creek #3	Above Enoch Valley Creek	SE ¼, Sec 17, T 6 S, R 43 E	ST061						Enoch Valley Mine
Strip Mine Creek	Above Enoch Valley Creek	NW ¼, Sec 20, T 6 S, R 43 E	ST062						Henry Mine
	Below Henry Mine	SW ¼, Sec 29, T 6 S, R 43 E	ST063						Henry Mine
West Fork Enoch Valley Creek	Below Henry Mine	SE ¼, Sec 29, T 6 S, R 43 E	ST064						Henry Mine
Reese Creek	Above logging activity	NW ¼, Sec 9, T 6 S, R 43 E	ST065						Rasmussen Ridge Mine
Ballard Creek	Above Blackfoot River	NW ¼, Sec 13, T 7 S, R 42 E	ST066						Ballard Mine
	Headwaters	SE ¼, Sec 12, T 7 S, R 42 E	ST067						Ballard Mine
West Fork Ballard Creek	Headwaters	SW ¼, Sec 12, T 7 S, R 42 E	ST068						Ballard Mine
Short Creek	Below Ballard Mine	NE ¼, Sec 13, T 7 S, R 42 E	ST069						Ballard Mine
State Land Creek	Above Blackfoot River	NW ¼, Sec 24, T 7 S, R 42 E	ST070				Yes		Conda Mine
	Below tributaries	NW ¼, Sec 36, T 7 S, R 42 E	ST071		Yes	Yes			Conda Mine
Tributary #1 of State Land Creek	Below Conda Mine	SW ¼, Sec 35, T 7 S, R 42 E	ST072				Yes		Conda Mine
Tributary #2 of State Land Creek	Below Conda Mine	NE ¼, Sec 2, T 8 S, R 42 E	ST073				Yes		Conda Mine
Tributary #3 of State Land Creek	Below Conda Mine	SE ¼, Sec 2, T 8 S, R 42 E	ST074						Conda Mine
Tributary #4 of State Land Creek	Below Conda Mine	NE ¼, Sec 1, T 8 S, R 42 E	ST075						Conda Mine
Trail Creek	Above Blackfoot River	NW ¼, Sec 32, T 7 S, R 43 E	ST076		Yes	Yes			Conda Mine
	Above Pedro Creek	SE ¼, Sec 32, T 7 S, R 43 E	ST077						Conda Mine
	Above Camp G Creek	SW ¼, Sec 4, T 8 S, R 43 E	ST078		Yes	Yes		Conda Mine	
Pedro Creek	Above Trail Creek	SW ¼, Sec 32, T 7 S, R 43 E	ST079						Conda Mine
	Below tributaries	SW ¼, Sec 6, T 8 S, R 43 E	ST080				Yes		Conda Mine
Tributary #1 of Pedro Creek	Below Conda Mine	SW ¼, Sec 1, T 8 S, R 42 E	ST081						Conda Mine
Tributary #2 of Pedro Creek	Below Conda Mine	SE ¼, Sec 1, T 8 S, R 42 E	ST082						Conda Mine
Tributary #3 of Pedro Creek	Below Conda Mine	SE ¼, Sec 1, T 8 S, R 42 E	ST083						Conda Mine
Tributary #4 of Pedro Creek	Below Conda Mine	NW ¼, Sec 12, T 8 S, R 42 E	ST084						Conda Mine
Camp G Creek	Above Trail Creek	NE ¼, Sec 7, T 8 S, R 43 E	ST085						Conda Mine
	Below Conda Mine (1997 #48)	NE ¼, Sec 13, T 8 S, R 42 E	ST086	Yes					Conda Mine
	Above Conda Mine (1997 #47)	SE ¼, Sec 13, T 8 S, R 42 E	ST087	Yes				Conda Mine	
Wooley Valley Creek	Above Blackfoot River	NE ¼, Sec 27, T 7 S, R 43 E	ST088				Yes		Ballard and Wooley Valley Mines
	Below North Fork Wooley Valley Creek	SW ¼, Sec 9, T 7 S, R 43 E	ST089						Ballard Mine
	Above North Fork Wooley Valley Creek	SW ¼, Sec 9, T 7 S, R 43 E	ST090						Ballard Mine
Loadout Creek	Below Wooley Valley Mine	SE ¼, Sec 22, T 7 S, R 43 E	ST091						Wooley Valley Mine
North Fork Wooley Valley Creek	Above Wooley Valley Creek	SE ¼, Sec 8, T 7 S, R 43 E	ST092						Ballard Mine
	Above Ballard Mine	NW ¼, Sec 6, T 7 S, R 43 E	ST093					Ballard Mine	
Spring-fed tributary #1 of North Fork Wooley Valley Creek	Below Ballard Mine	NE ¼, Sec 7, T 7 S, R 43 E	ST094				Yes		Ballard Mine
Spring-fed tributary #2 of North Fork Wooley Valley Creek	Below Ballard Mine	SW ¼, Sec 8, T 7 S, R 43 E	ST095				Yes		Ballard Mine
Tributary of North Fork Wooley Valley Creek	Below Ballard Mine	SW ¼, Sec 8, T 7 S, R 43 E	ST096				Yes		Ballard Mine

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TABLE A.6
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project: Sept. 1997	May 1998	Sept. 1998	1999-2000	Mine(s) Monitored: Proximally Upstream of:	Proximally Downstream of:
Slug Creek	Below Goodheart Creek (1997 #13)	NW ¼, Sec 5, T 9 S, R 44 E	ST097	Yes	Yes	Yes			Champ Mine
	Above Goodheart Creek (1997 #12)	SW ¼, Sec 5, T 9 S, R 44 E	ST098	Yes	Yes	Yes		Champ Mine	
	Below Dry Basin Creek	NW ¼, Sec 16, T 9 S, R 44 E	ST099						Mountain Fuel Mine
	Above Dry Basin Creek	SE ¼, Sec 16, T 9 S, R 44 E	ST100		Yes	Yes		Mountain Fuel Mine	
Caldwell Creek	Below Phosphoria Formation outcrop (1997 #62)	SE ¼, Sec 12, T 8 S, R 43 E	ST101	Yes	Yes	Yes	Yes		Central district background
Goodheart Creek	Slug Creek Rd.	NE ¼, Sec 5, T 9 S, R 44 E	ST102						Champ Mine
	C-B&M-3, Dry Valley Rd. (1997 #11)	SE ¼, Sec 34, T 8 S, R 44 E	ST103	Yes					Champ Mine
	Headwaters	NE ¼, Sec 34, T 8 S, R 44 E	ST104					Champ Mine	
South Fork Goodheart Creek	Headwaters (1997 #10)	NW ¼, Sec 2, T 9 S, R 44 E	ST105	Yes					Champ Mine
Dry Canyon Creek	Dry Basin Rd.	NW ¼, Sec 9, T 9 S, R 44 E	ST106						Mountain Fuel Mine
	Dry Canyon Rd.	SE ¼, Sec 3, T 9 S, R 44 E	ST107						Mountain Fuel Mine
	Below Mountain Fuel Mine	SE ¼, Sec 11, T 9 S, R 44 E	ST108						Mountain Fuel Mine
	Below East Limb Waste Dump	SW ¼, Sec 13, T 9 S, R 44 E	ST109						Mountain Fuel Mine
Dry Canyon Creek	Above Mountain Fuel Mine	NW ¼, Sec 36, T 9 S, R 44 E	ST110					Mountain Fuel Mine	
Dry Basin Creek	Slug Creek Rd.	SE ¼, Sec 16, T 9 S, R 44 E	ST111						Mountain Fuel Mine
Shop Creek	Below Wooley Valley Mine	NE ¼, Sec 26, T 7 S, R 43 E	ST112						Wooley Valley Mine
Dry Valley Creek	Above Blackfoot River, FMC's DV2 (1997 #18)	SE ¼, Sec 25, T 7 S, R 43 E	ST113	Yes	Yes	Yes	Yes		Dry Valley Mine
	Below Maybe Creek, FMC's DV3 (1997 #17)	NW ¼, Sec 5, T 8 S, R 44 E	ST114	Yes			Yes	Dry Valley Mine	
	Above Maybe Creek, FMC's DV5	NE ¼, Sec 8, T 8 S, R 44 E	ST115				Yes	Dry Valley Mine	
	Above mining activity, FMC's DV6 (1997 #16)	NW ¼, Sec 16, T 8 S, R 44 E	ST116	Yes				Dry Valley Mine	
	Above Dry Valley Mine, FMC's DV7 (1997 #15)	SW ¼, Sec 22, T 8 S, R 44 E	ST117	Yes				Dry Valley Mine	
Chicken Creek	Above Dry Valley Creek, FMC's CC1 (1997 #72)	SW ¼, Sec 31, T 7 S, R 44 E	ST118	Yes					Dry Valley Mine
	Above Dry Valley Mine	NW ¼, Sec 6, T 8 S, R 44 E	ST119					Dry Valley Mine	
Maybe Creek	Above Dry Valley Mine, FMC's MB1 (1997 #14)	NE ¼, Sec 9, T 8 S, R 44 E	ST120	Yes				Dry Valley Mine	
Big Draw Creek	Above old channel of Maybe Creek	SW ¼, Sec 4, T 8 S, R 44 E	ST121						North Maybe Mine
	Headwaters (1997 #5)	NE ¼, Sec 4, T 8 S, R 44 E	ST122	Yes					North Maybe Mine
Overburden Creek	Above Blackfoot River	NE ¼, Sec 25, T 7 S, R 43 E	ST123				Yes		Wooley Valley Mine
Wooley Range Ridge Creek	Above Blackfoot River	SE ¼, Sec 24, T 7 S, R 43 E	ST124				Yes		Wooley Valley Mine
West Mill Creek	Above Blackfoot River	SE ¼, Sec 18, T 7 S, R 44 E	ST125				Yes		Wooley Valley Mine
Angus Creek	Above Blackfoot River	SE ¼, Sec 8, T 7 S, R 44 E	ST126						Rasmussen Ridge, Enoch Valley, and Wooley Valley Mines
	Below No Name Creek	SW ¼, Sec 36, T 6 S, R 43 E	ST127				Yes		Rasmussen Ridge and Enoch Valley Mines
	Above No Name Creek	SE ¼, Sec 35, T 6 S, R 43 E	ST132		Yes	Yes		Rasmussen Ridge Mine	
	Above Rasmussen Creek	SE ¼, Sec 35, T 6 S, R 43 E	ST128					Rasmussen Ridge and Enoch Valley Mines	
	R-B&M-10, below Wooley Valley Mine	SW ¼, Sec 34, T 6 S, R 43 E	ST129		Yes	Yes	Yes		Wooley Valley Mine
	R-B&M-12, below Upper Angus Creek Res.	SW ¼, Sec 11, T 7 S, R 43 E	ST130				Yes		Wooley Valley Mine
Rasmussen Creek	Above Angus Creek	SE ¼, Sec 35, T 6 S, R 43 E	ST131		Yes	Yes	Yes		Rasmussen Ridge and Enoch Valley Mines
	M-B&M-1, below Enoch Valley Mine	SE ¼, Sec 27, T 6 S, R 43 E	ST133				Yes		Enoch Valley Mine
	Below West Pond Creek	NW ¼, Sec 27, T 6 S, R 43 E	ST134						Enoch Valley Mine
	Above West Pond Creek	NW ¼, Sec 27, T 6 S, R 43 E	ST135					Enoch Valley Mine	
	Headwaters near Shop Pond	SE ¼, Sec 21, T 6 S, R 43 E	ST136						Enoch Valley Mine
No Name Creek	R-B-2, above Angus Creek	NE ¼, Sec 35, T 6 S, R 43 E	ST137		Yes	Yes	Yes		Rasmussen Ridge Mine
	R-B&M-3, below Rasmussen Ridge Mine haul road	NE ¼, Sec 26, T 6 S, R 43 E	ST138						Rasmussen Ridge Mine
	Above Rasmussen Ridge Mine	SW ¼, Sec 23, T 6 S, R 43 E	ST139					Rasmussen Ridge Mine	
West Fork No Name Creek	Below proposed North Pit of Rasmussen Ridge Mine	SW ¼, Sec 23, T 6 S, R 43 E	ST140						Rasmussen Ridge Mine
East Fork No Name Creek	Below proposed North Pit of Rasmussen Ridge Mine	SW ¼, Sec 23, T 6 S, R 43 E	ST141						Rasmussen Ridge Mine
	Above proposed North Pit of Rasmussen Ridge Mine	NW ¼, Sec 15, T 6 S, R 43 E	ST142					Rasmussen Ridge Mine	
East Fork Rasmussen Creek	Above Rasmussen Creek	SW ¼, Sec 26, T 6 S, R 43 E	ST143				Yes		Enoch Valley Mine
West Pond Creek	Headwaters, below West Pond	NW ¼, Sec 27, T 6 S, R 43 E	ST144						Enoch Valley Mine
Spring Creek	C-B-1, below north fork of East Mill Creek (1997 #3)	SW ¼, Sec 10, T 7 S, R 44 E	ST145	Yes			Yes		North Maybe Mine
	Above north fork of East Mill Creek	NW ¼, Sec 15, T 7 S, R 44 E	ST146					North Maybe Mine	
	C-B-2, below south fork of East Mill Creek	NE ¼, Sec 15, T 7 S, R 44 E	ST147						North Maybe Mine
	Above south fork of East Mill Creek (1997 #2)	SE ¼, Sec 15, T 7 S, R 44 E	ST148	Yes			Yes	North Maybe Mine	

TABLE A.5
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project	Mine(s) Monitored: Proximally Upstream of:	Proximally Downstream of:

East Mill Creek	Above Spring Creek, on north fork	NW ¼, Sec 15, T 7 S, R 44 E	ST149		Yes	Yes			North Maybe Mine
	Above Spring Creek, on south fork	SE ¼, Sec 15, T 7 S, R 44 E	ST150		Yes	Yes			North Maybe Mine
	Fish sampling station, below North Maybe Mine	NE ¼, Sec 21, T 7 S, R 44 E	ST227			Yes	Yes		North Maybe Mine
	C-B&M-1, below North Maybe Mine (1997 #1)	NE ¼, Sec 21, T 7 S, R 44 E	ST151	Yes					North Maybe Mine
Diamond Creek	Below Kendall Creek	SW ¼, Sec 14, T 7 S, R 44 E	ST152		Yes	Yes			North Maybe Mine
	Above Kendall Creek	NE ¼, Sec 36, T 7 S, R 44 E	ST153		Yes	Yes			North Maybe Mine
Kendall Creek	Diamond Creek Rd.	SE ¼, Sec 26, T 7 S, R 44 E	ST154				Yes		North Maybe Mine
Stuart Creek	Above Diamond Creek	SW ¼, Sec 29, T 8 S, R 45 E	ST236				Yes		Central district background
Timber Creek	Above Diamond Creek	NE ¼, Sec 28, T 8 S, R 45 E	ST237				Yes		Central district background
Lanes Creek	Below 6500-Feet Creek	NE ¼, Sec 9, T 7 S, R 44 E	ST155		Yes	Yes	Yes		Lanes Creek Mine
	Below Sheep Creek	NW ¼, Sec 3, T 7 S, R 44 E	ST156		Yes	Yes	Yes	Lanes Creek Mine	Rasmussen Ridge Mine
	Above Sheep Creek	SE ¼, Sec 33, T 6 S, R 44 E	ST157				Yes	Rasmussen Ridge Mine	
6500-Feet Creek	Above Lanes Creek	NE ¼, Sec 4, T 7 S, R 44 E	ST158				Yes		Lanes Creek Mine
	Above South Fork 6500-Feet Creek	NE ¼, Sec 4, T 7 S, R 44 E	ST159						Lanes Creek Mine
South Fork 6500-Feet Creek	Above 6500-Feet Creek	NE ¼, Sec 4, T 7 S, R 44 E	ST160						Lanes Creek Mine
Sheep Creek	Above Lanes Creek	SW ¼, Sec 33, T 6 S, R 44 E	ST161		Yes	Yes	Yes		Rasmussen Ridge Mine
	R-B&M-7, below West Fork Sheep Creek	SE ¼, Sec 30, T 6 S, R 44 E	ST162		Yes	Yes			Rasmussen Ridge Mine
	R-B-4, above West Fork Sheep Creek	SE ¼, Sec 30, T 6 S, R 44 E	ST163		Yes	Yes		Rasmussen Ridge Mine	
	R-B&M-4, near Rasmussen Ridge Mine office	NW ¼, Sec 25, T 6 S, R 43 E	ST164						Rasmussen Ridge Mine
South Fork Sheep Creek	Below Lanes Creek Mine	NE ¼, Sec 32, T 6 S, R 44 E	ST165				Yes		Lanes Creek Mine
	Above Lanes Creek Mine	SW ¼, Sec 32, T 6 S, R 44 E	ST166					Lanes Creek Mine	
West Fork Sheep Creek	R-B-1	SE ¼, Sec 25, T 6 S, R 43 E	ST167						Rasmussen Ridge Mine
Stump Creek	Below Tygee Creek	SE ¼, Sec 27, T 7 S, R 46 E	ST168						Smoky Canyon Mine
	Above Tygee Creek	SW ¼, Sec 27, T 7 S, R 46 E	ST169					Smoky Canyon Mine	
Tygee Creek	Below Smoky Creek	NW ¼, Sec 10, T 8 S, R 46 E	ST170				Yes		Smoky Canyon Mine
	S-B&M-3, below Roberts Creek	NW ¼, Sec 15, T 8 S, R 46 E	ST171						Smoky Canyon Mine
	S-B&M-7, above Smoky Canyon Mine	NW ¼, Sec 27, T 8 S, R 46 E	ST172					Smoky Canyon Mine	
Smoky Creek	Below Smoky Canyon Mine at FS station	NW ¼, Sec 16, T 8 S, R 46 E	ST173		Yes	Yes			Smoky Canyon Mine
	S-B&M-4, above activity at Smoky Canyon Mine	SE ¼, Sec 24, T 8 S, R 45 E	ST174		Yes	Yes		Smoky Canyon Mine	
Roberts Creek	Below tailings ponds	SE ¼, Sec 16, T 8 S, R 46 E	ST175						Smoky Canyon Mine
	S-B&M-5, above tailing ponds	SE ¼, Sec 20, T 8 S, R 46 E	ST176		Yes	Yes			Smoky Canyon Mine
Crow Creek	Below Sage Creek	NW ¼, Sec 21, T 9 S, R 46 E	ST177						Smoky Canyon Mine
	Above Sage Creek	SW ¼, Sec 21, T 9 S, R 46 E	ST178					Smoky Canyon Mine	
	Below Deer Creek	NE ¼, Sec 1, T 10 S, R 45 E	ST179						Georgetown Canyon Mine
	Above Deer Creek	NE ¼, Sec 1, T 10 S, R 45 E	ST180					Georgetown Canyon Mine	
Sage Creek	Above Crow Creek	SW ¼, Sec 21, T 9 S, R 46 E	ST181						Smoky Canyon Mine
	Below North Fork Sage Creek	NE ¼, Sec 17, T 9 S, R 46 E	ST182				Yes		Smoky Canyon Mine
	S-B&M-11, immediately below Smoky Canyon Mine	NE ¼, Sec 7, T 9 S, R 46 E	ST183		Yes	Yes	Yes		Smoky Canyon Mine
	S-B&M-10, above Smoky Canyon Mine	NE ¼, Sec 12, T 9 S, R 45 E	ST184		Yes	Yes		Smoky Canyon Mine	
South Fork Sage Creek	Below Smoky Canyon Mine	SE ¼, Sec 18, T 9 S, R 46 E	ST228			Yes	Yes		Smoky Canyon Mine
	Above Smoky Canyon Mine, below Phosphoria Formation outcrop (1997 #60)	SE ¼, Sec 13, T 9 S, R 45 E	ST185	Yes	Yes	Yes	Yes		Eastern district background
Hoopes Creek	Below S-B&M-12	NE ¼, Sec 18, T 9 S, R 46 E	ST186						Smoky Canyon Mine
North Fork Sage Creek	Below Pole Creek (1997 #68)	NE ¼, Sec 8, T 9 S, R 46 E	ST187	Yes	Yes	Yes	Yes		Smoky Canyon Mine
	Above Pole Creek (1997 #67)	SE ¼, Sec 5, T 9 S, R 46 E	ST188	Yes	Yes	Yes		Smoky Canyon Mine	
Pole Creek	S-B&M-9, below Pole Canyon Dump at Smoky Canyon Mine (1997 #66)	SE ¼, Sec 31, T 8 S, R 46 E	ST189	Yes					Smoky Canyon Mine
	S-B&M-8, above Pole Canyon Dump at Smoky Canyon Mine (1997 #65)	SE ¼, Sec 36, T 8 S, R 45 E	ST190	Yes				Smoky Canyon Mine	
Deer Creek	Below South Fork Deer Creek	SW ¼, Sec 34, T 9 S, R 45 E	ST191						Georgetown Canyon Mine
	Above South Fork Deer Creek	SE ¼, Sec 33, T 9 S, R 45 E	ST192					Georgetown Canyon Mine	
South Fork Deer Creek	Below Georgetown Canyon Mine	NW ¼, Sec 5, T 10 S, R 45 E	ST193			Yes			Georgetown Canyon Mine
Bear River	Below Georgetown Creek	NW ¼, Sec 14, T 11 S, R 43 E	ST194				Yes		Georgetown Canyon Mine
	Above Georgetown Creek	NE ¼, Sec 14, T 11 S, R 43 E	ST195				Yes	Georgetown Canyon Mine	

TABLE A.5
STREAM INVENTORY FOR THE SOUTHEAST IDAHO SELENIUM PROJECT

Stream	Sampling Station†	Location	Station Number	Station Sampled as Part of the Selenium Project				Mine(s) Monitored	
								Proximally Upstream of:	Proximally Downstream of:
Georgetown Creek	Below irrigation diversion dam	SE ¼, Sec 5, T 11 S, R 44 E	ST196		Yes	Yes			Georgetown Canyon Mine
	Below Central Farmers plant	NW ¼, Sec 25, T 10 S, R 44 E	ST197				Yes		Georgetown Canyon Mine
	Above Central Farmers plant	SW ¼, Sec 24, T 10 S, R 44 E	ST198					Georgetown Canyon Mine	
	Below sediment retention ponds	NE ¼, Sec 24, T 10 S, R 44 E	ST199				Yes		Georgetown Canyon Mine
	Above Georgetown Canyon Mine	SE ¼, Sec 6, T 10 S, R 45 E	ST200		Yes	Yes		Georgetown Canyon Mine	
Right Hand Fork	Below Georgetown Canyon Mine	NE ¼, Sec 10, T 11 S, R 44 E	ST201		Yes	Yes			Georgetown Canyon Mine
	Above Georgetown Canyon Mine	NE ¼, Sec 12, T 11 S, R 44 E	ST202		Yes	Yes		Georgetown Canyon Mine	
Church Hollow Creek	Below tailings pond	SW ¼, Sec 35, T 10 S, R 44 E	ST203						Georgetown Canyon Mine
	Above tailings pond	SW ¼, Sec 35, T 10 S, R 44 E	ST204					Georgetown Canyon Mine	
West-flowing tributary of Georgetown Creek #9	Georgetown Canyon Rd.	SW ¼, Sec 25, T 10 S, R 44 E	ST205						Georgetown Canyon Mine
Phosphoria Gulch	Above thickening pond	NW ¼, Sec 25, T 10 S, R 44 E	ST206						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #8	Georgetown Canyon Rd.	SE ¼, Sec 24, T 10 S, R 44 E	ST207						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #7	Georgetown Canyon Rd.	NE ¼, Sec 24, T 10 S, R 44 E	ST208						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #6	Georgetown Canyon Rd.	SE ¼, Sec 13, T 10 S, R 44 E	ST209						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #5	Georgetown Canyon Rd.	SE ¼, Sec 13, T 10 S, R 44 E	ST210						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #4	Georgetown Canyon Rd.	NE ¼, Sec 13, T 10 S, R 44 E	ST211						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #3	Georgetown Canyon Rd.	SE ¼, Sec 12, T 10 S, R 44 E	ST212						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #2	Georgetown Canyon Rd.	SW ¼, Sec 7, T 10 S, R 45 E	ST213						Georgetown Canyon Mine
West-flowing tributary of Georgetown Creek #1	Georgetown Canyon Rd.	NW ¼, Sec 7, T 10 S, R 45 E	ST214						Georgetown Canyon Mine
Trail Canyon Creek	Below Conda Mine	SE ¼, Sec 27, T 8 S, R 42 E	ST215						Conda Mine
	Above Conda Mine	NW ¼, Sec 30, T 8 S, R 43 E	ST216					Conda Mine	
Margarette Creek	Above Trail Canyon Creek	NE ¼, Sec 25, T 8 S, R 42 E	ST217						Conda Mine
Formation Creek	Headwaters, at City of Soda Springs water intake	SW ¼, Sec 27, T 8 S, R 42 E	ST218		Yes	Yes			Conda Mine
Ledger Creek	City of Soda Springs water intake	SE ¼, Sec 5, T 9 S, R 42 E	ST219						Conda Mine
Woodall Creek	Below wetland	NE ¼, Sec 4, T 8 S, R 42 E	ST220						Conda Mine
Northwest Woodall Mountain Creek #1	Below Conda Mine	SE ¼, Sec 34, T 7 S, R 42 E	ST221						Conda Mine
Northwest Woodall Mountain Creek #2	Below Conda Mine	NW ¼, Sec 3, T 8 S, R 42 E	ST222						Conda Mine
Northwest Woodall Mountain Creek #3	Below Conda Mine	NW ¼, Sec 3, T 8 S, R 42 E	ST223						Conda Mine
Southwest Woodall Mountain Creek #1	Below Conda Mine	NW ¼, Sec 10, T 8 S, R 42 E	ST224						Conda Mine
Southwest Woodall Mountain Creek #2	Below Conda Mine	SE ¼, Sec 10, T 8 S, R 42 E	ST225						Conda Mine

Notes: †Station identification for those sampled in September 1997 is provided parenthetically.

Appendix B

APPENDIX B – SCREENING FOR CONSTITUENTS OF PONTENTIAL CONCERN (FROM 1998 SAMPLING AND ANALYSIS PLAN)

Preliminary, Ecological Risk-Based Screening

B.1 Introduction

This appendix presents the methods used in screening analytes detected in surface water samples collected by FMC and the USFS from monitoring stations on Maybe Creek and Dry Valley Creek, respectively, to identify constituents of potential concern (COPCs). The methods may be broadly categorized as: (1) development of surface water screening criteria; and, (2) COPC screening. Separate screening criteria were identified for aquatic receptors, avian and mammalian and mammalian terrestrial receptors.

Aquatic screening criteria were based on freshwater aquatic toxicity benchmarks published by the EPA and other sources. Riparian and terrestrial screening criteria were developed based on indicator species that are representative of riparian and terrestrial receptors potentially exposed to project surface waters. Potentially exposed riparian receptors include waterfowl, represented by the mallard, and mammals that utilize aquatic habitats, represented by the muskrat. Potentially exposed terrestrial receptors include livestock. Concentrations of constituents detected in surface water samples are screened against the identified or developed surface water criteria, and the resultant COPCs for the site are identified.

B.2 Development of Surface Water Screening Criteria

The development of surface water screening criteria for aquatic receptors and riparian/terrestrial receptors is presented in the following subsections. Aquatic and riparian/terrestrial screening criteria are described separately, because of differences in the availability of existing surface water benchmarks for these receptors.

B.2.1 Aquatic Screening Criteria

Several types of freshwater aquatic toxicity benchmarks have been developed for the potential toxic trace element constituents included in the FMC and USFS monitoring data (Table B.1). These freshwater aquatic toxicity benchmarks include national ambient water quality criteria (NAWQCs) and lowest chronic values (LVCs) promulgated by EPA (1986), United States Department of Energy (DOE) surface water preliminary remediation goals (PRGs) as referenced by Efdroymson et al. (1996), Tier II secondary chronic values (EPA, 1986) and 20th percentile effective concentrations for aquatic populations (EC_{20}s) as presented in Suter and Mabrey (1994). The NAWQCs have generally been used as aquatic screening benchmarks.

Both acute and chronic NAWQCs are available for most of the trace elements of interest. However, only chronic NAWQCs are considered as potential screening criteria given that organisms are more sensitive to chronic exposures. Freshwater chronic NAWQC are generally calculated by EPA as half the final acute value (FAV), which is equivalent to the fifty percentile of the distribution of 48- to 96-hour LC_{50} or median effective concentration (EC_{50}) values, divided by a final acute-chronic rato (FACR). Therefore, freshwater chronic NAWQCs represent lower bound estimates of the range of anticipated chronic effects in freshwater aquatic organisms. Selenium is a notable exception to this procedure. The chronic selenium NAWQC is empirically derived and the acute NAWQC is calculated from the chronic value.

The LCVs are based on the same aquatic toxicity data set used by EPA to calculate freshwater chronic NAWQC. The LCV represents the lowest freshwater chronic toxicity value reported for a chemical, or a chronic estimate based on n acute value.

Table B.1
Development of Surface Water Screening Criteria for Aquatic Receptors

Analyte	National Ambient Water Quality Criteria[a] (mg/l)	Lowest Chronic Value [b] (mg/l)	DOE Surface Water PRG [c] (mg/l)	Tier II Secondary Chronic Value[d] (mg/l)	Aquatic Population EC_{20}[e] (mg/l)	Aquatic Screening Criterion[f] (mg/l)
Aluminum	NA	0.46	0.087	NA	NA	0.46[b]
Antimony	0.03	0.61	0.03	0.104	0.079	0.03[a]
Arsenic III	0.04	0.914	0.19	NA	10995	0.04[a]
Arsenic	0.048	0.048	0.0031	0.0081	0.185	0.048[a]
Barium	NA	5.8	0.004	0.0038	NA	5.8[b]
Cadmium	0.0011	0.00015	0.0011	NA	0.0043	0.0011[a]
Chromium	0.21	<0.044	0.21	NA	0.126	0.21[a]
Copper	0.012	0.00023	0.012	NA	0.0086	0.012[a]
Lead	0.0032	0.0123	0.0032	NA	0.071	0.0032[a]
Manganese	NA	<1.1	0.12	0.0803	0.112	0.12[c]
Molybdenum	NA	0.88	0.37	0.239	NA	0.88[a]
Nickel	0.16	<0.0005	0.16	NA	0.215	0.16[a]
Selenium	0.005	0.0883	0.00039	NA	0.0128-0.1859[g]	0.0128-0.1859[g]
Uranium	NA	0.142	0.0026	0.0019	0.027	0.142[b]
Vanadium	NA	0.08	0.02	0.0191	0.032	0.08[b]
Zinc	0.11	0.03	0.11	NA	0.08	0.11[a]

[a]National Ambient Water Quality Criteria (EPA, 1986).
[b]Lowest Chronic Value (EPA, 1986).
[c]DOE Surface Water Preliminary Remediation Goal (Efroymson et al., 1996).
[d]Tier II freshwater aquatic Secondary Chronic Value (EPA, 1986).
[e]Source: Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota, 1994 Revision (Suter and Mabrey, 1994).
[f]The aquatic screening criterion used in the identification of constituents of potential concern (COPCs) for surface water receptors. Refer to text for selection criteria.
[g]The range of Criterion Maximum Concentration (CMCs) for selenium compounds depending upon form present (e.g. selenite, selenate). Source: Proposed Selenium Criterion Maximum Concentration for the Water Quality Guidance for the Great Lakes System; Proposed Rule, 40 CFR Part 132 (EPA, 1996).

The DOE surface water PRGs were developed by the Oak Ridge National Laboratory (ORNL), and are based on either aquatic toxicity criteria (i.e., NQWQC or SCVs) or lowest-observed-adverse-effect-levels (LOAELs) in piscivorous wildlife. The lower of the three types of values is selected as the surface water PRG.

Tier II aquatic toxicity values (EPA, 1986) include secondary acute values (SAVs) and secondary chronic values (SCVs). The SAV is derived by taking the lowest genus mean acute value and dividing it by a Final Acute Value Factor (FAVF). The SCV is calculated from the SAV, based on division of the SAV by a secondary acute-chronic ration (SACR). Based on their method of estimation, Tier II values represent very conservative potential aquatic toxicity benchmarks. The SAV, as a result of the method used in its derivation, may be an order of magnitude lower than the lowest acute toxicity value reported. The SAV is generally reduce by another order of magnitude in deriving the SCV. For example, the SCV derived for arsenic is more than 100 times lower than the lowest acute toxicity value reported for arsenic, and is nearly 2,400 times lower than the mean acute toxicity value reported.

Aquatic population EC_{20} values developed by Suter and Mabrey (1994) are modeled estimates of the concentration of a chemical that would cause a reduction in largemouth bass populations. Data for all available life stages are considered, and the data are modified based on acute-to-chronic extrapolations, where appropriate, and sensitivity differences between the test species and bass (i.e, taxonomic differences). Aquatic population EC_{20} values represent continuous concentrations that would cause a 20 percent reduction in the recruitment abundance of largemouth bass.

For purposes of developing a set of aquatic screening criteria for the analytical results from Maybe Creek and Dry Valley Creek drainage data, a hierarchy of benchmarks is established. First, freshwater chronic NAWQC were selected as the primary source of aquatic screening criteria. If a freshwater chronic NAWQC was not available for a chemical, then EPA LCVs were reviewed; followed by DOE surface water PRGs, Tier II SCVs, and aquatic population EC_{20} values. The one exception to this rule is the criterion for selenium, which represents the range of selenium criterion maximum concentrations (CMCs) developed for the Great Lakes System (EPA, 1996). This criterion was selected because it takes into consideration the form of selenium present (i.e., selenite or selenate). The aquatic screening criteria for the identification of COPCs for Maybe Creek and Dry Valley Creek monitoring stations are presented in Table B.1.

B.2.2 Riparian/Terrestrial Screening Critieria

Screening criteria are not readily available for non-aquatic ecological receptors. The ecological receptors most likely to receive exposures to site-derived contaminants in surface waters include riparian receptors (e.g., waterfowl and aquatic mammals) and terrestrial receptors (e.g., livestock). It is not possible to screen COPCs for all riparian and terrestrial species potentially exposed to the trace elements of interest. Therefore, indicator receptors were identified for use in the development of riparian/terrestrial screening criteria. Potentially exposed waterfowl are represented by the mallard, aquatic mammals are represented by the muskrat.

Screening criteria for the mallard and muskrat are developed based on methods described in *Toxicological Benchmarks for Wildlife* (Opresko et al., 1994). This reference contains toxicity benchmarks for mammals and avians expressed in terms of milligrams of chemical per kilograms of body weight per day [mg/(kg·d)]. Toxicity benchmarks are based on experimentally-derived, no-observed-adverse effects-levels (NOAELs) or LOAELs. In cases where a NOAEL for a specific chemical is not available but an experimentally-derived LOAEL is available, Opresko et al, (1994) reduced the LOAEL by an uncertainity factor of 10 to arrive at a NOAEL. Emphasis is placed on using toxicological studies in which reproductive and developmental endpoints were considered.

Reported benchmarks (i.e., NOAELs) for avian and mammalian test species are presented in Tables B.2 and B.3 respectively. Experimental NOAELs are allometrically converted for each indicator species (i.e., mallard or muskrat) based on body weight scaling using the following equation:

$$NOAEL_w = NOAEL_t x(\frac{BW_t}{BW_w})^{1/3}$$

where:

$NOAEL_w$	= NOAEL dose for the wildlife species [mg/(kg·d)]
$NOAEL_t$	= NOAEL does for the test species [mg/(kg·d)]
BW_t	= Body weight for the test species (kg)
BW_w	= Body weight for the wildlife species (kg)

Estimated water consumption rates for indicator receptors were used to convert toxicity benchmarks (i.e., NOAELs) from doses expressed in terms of mg/(kg·d) to surface water concentrations expressed in terms of milligrams per liter (mg/l). The water consumption rate expressed in terms of liter per day (l/d) for the mallard is estimated based on Equation 3-15 in EPA's *Wildlife Exposure Factors Handbook* (EPA, 1993) as follows:

$$W = 0.099x(BW)^{0.67}$$

where:

W	= Water consumption rate for birds (l/d)
BW	= Body weight of indicator species (kg)

The water consumption rate for the muskrat is estimated based on Equation 3-17 in EPA's *Wildlife Exposure Factors Handbook* (EPA, 1993) as follows:

$$W = 0.099x(BW)^{0.90}$$

where:

W	= Water consumption rate for birds (l/d)
BW	= Body weight of indicator species (kg)

The NOAEL-equivalent surface water benchmarks for each indicator species were calculated based on Equation 19 in *Toxicological Benchmarks for Wildlife* (Opresko et al., 1994), as follows:

$$C_w = \frac{(NOAEL_w x BW_w)}{W}$$

where:

C_w	= Concentration in surface water (mg/l)
$NOAEL_w$	= NOAEL dose for the wildlife species [mg/(kg·d)]
BW_w	= Body weight for the wildlife species (kg)
W	= Water consumption rate for the wildlife species (l/d)

NOAEL-equivalent surface water concentrations for the mallard duck and muskrat were divided fby a factor of 10 to account for potential exposure pathways in addition to surface water consumption. Calculated surface water benchmarks for the mallard duck and muskrat are presented in Table B.2 and B.3, respectively.

Surface water benchmarks for livestock are taken directly from EPA's proposed safe upper concentration limits in drinking water for livestock (EPA, 1973). These surface water criteria are expressed in terms of milligrams per liter (mg/l) and require no conversion or safety factors. Surface water benchmarks for livestock are summarized in Table B.4.

An overall riparian/terrestrial screening criterion was selected as the lower of the surface water benchmarks for the mallard, muskrat and livestock (Table B.4). In this way, the riparian/terrestrial screening criterion is anticipated to be protective of all potentially exposed riparian and terrestrial receptors.

Table B.2 Development of Surface Water Benchmarks for Riparian Receptors - Mallard						
COPC	**Test Species NOAEL**[a] (mg/l)	**Test Species** [b]	**Test Species Body Weight** [c] (kg)	**Estimated Mallard NOAEL**[d] [(mg/kg·d)]	**Water Consumption Rate - W**[e] (L/d)	**Surface Water Benchmark $C_{w(mallard)}$**[f] (mg/l)
Aluminum	111.4	ringed dove	0.155	49	0.088	100
Antimony	NA	NA	NA	NA	NA	NA
Arsenic III	5.135	mallard	1	4.2	0.088	8.7
Arsenic V	NA	NA	NA	NA	NA	NA
Barium	20.86	chick	0.121	8.5	0.088	18
Cadmium	1.450	mallard	1.153	1.2	0.088	2.6
Chromium	1	black duck	1.25	0.88	0.088	1.8
Copper	33.21	chicken	0.534	22	0.088	46
Lead	3.85	kestrel	0.13	1.6	0.088	3.3
Manganese	NA	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA	NA
Nickel	77.4	Mallard duckling	0.782	59	0.088	120
Selenium	0.5	mallard	1	0.41	0.088	0.85
Uranium	16	black duck	1.25	14	0.088	29
Vanadium	11.38	mallard	1.17	10	0.088	20
Zinc	3	mallard	1	2.5	0.088	5.1

[a]NOAELs obtained from Opresko et al. (1994).
[b]The test species in which the NOAEL was derived.
[c]Average body weight of the test species per Opresko et al. (1994).
[d]The NOAEL for the mallard was estimated based on the equation: $NOAEL_{mallard} = NOAEL_{test\ species} \times (Body\ Weight_{test\ species}/Body\ Weight_{mallard})^{0.33}$; per Opresko et al.(1994).
[e]Water consumption rate (W) is estimated based on the equation: $W = 0.059\ (Body\ Weight)^{0.67}$ for all birds per EPA (1993).
[f]Surface water benchmark calculated according to the equation: $C_{w(mallard)} = (NOAEL_{mallard} * Body\ Weight_{mallard})/W_{mallard}$ (Opresko et al.(1994); this value is then divided by an uncertainty factor of 10 to account for exposure pathways other than surface water ingestion.
NA – not available.
NOAEL – no observable adverse effect level.

Table B.3 Development of Surface Water Benchmarks for Riparian Receptors - Muskrat						
COPC	**Test Species NOAEL**[a] (mg/l)	**Test Species** [b]	**Test Species Body Weight** [c] (kg)	**Estimated Muskrat NOAEL**[d] [(mg/kg·d)]	**Water Consumption Rate - W**[e] (L/d)	**Surface Water Benchmark $C_{w(muskrat)}$**[f] (mg/l)
Aluminum	1.93	mouse	0.030	0.53	0.15	0.55
Antimony	0.125	mouse	0.030	0.034	0.15	0.036
Arsenic III	0.126	mouse	0.030	0.034	0.15	0.036
Arsenic V	NA	NA	NA	NA	NA	NA
Barium	5.06	rat	0.35	3.1	0.15	3.3
Cadmium	0.191	mouse	0.030	0.052	0.15	0.055
Chromium	2,737	rat	0.35	1.700	0.15	1,800
Copper	11.71	mink	1.0	10	0.15	11
Lead	8	rat	0.35	4.9	0.15	5.2
Manganese	88	rat	0.35	54	0.15	57
Molybdenum	NA	NA	NA	NA	NA	NA
Nickel	40	rat	0.35	24	0.15	26
Selenium	0.075	mouse	0.030	0.020	0.15	0.022
Uranium	3.07	rat	0.35	1.9	0.15	2.0
Vanadium	0.21	rat	0.35	0.13	0.15	0.14
Zinc	160	rat	0.35	98	0.15	100

[a]NOAELs obtained from Opresko et al. (1994).
[b]The test species in which the NOAEL was derived.
[c]Average body weight of the test species per Opresko et al. (1994).
[d]The NOAEL for the muskrat was estimated based on the equation: $NOAEL_{muskrat} = NOAEL_{test\ species} \times (Body\ Weight_{test\ species}/Body\ Weight_{muskrat})^{0.33}$; per Opresko et al.(1994).
[e]Water consumption rate (W) is estimated based on the equation: $W = 0.099\ (Body\ Weight)^{0.9}$ for all birds per EPA (1993).
[f]Surface water benchmark calculated according to the equation: $C_{w(muskrat)} = (NOAEL_{muskrat} * Body\ Weight_{muskrat})/W_{muskrat}$ (Opresko et al.(1994); this value is then divided by an uncertainty factor of 10 to account for exposure pathways other than surface water ingestion.
NA – not available.
NOAEL – no observable adverse effect level.

Table B.4 Selection of Surface Water Screening Criteria for Riparian and Terrestrial Receptors				
Analyte	**Mallard[a]**	**Musdrat[b]**	**Livestock[c]**	**Riparian/Terrestrial Screening Criterion[d] (mg/l)**
Aluminum	100	**0.55**	5	0.55[f]
Antimony	NA	**0.036**	NA	0.036[f]
Arsenic III	8.7	**0.036**	0.2	0.036[f]
Arsenic V	NA	NA	NA	NA
Barium	18	**3.3**	NA	3.3[f]
Cadmium	2.6	0.055	**0.05**	0.05[c]
Chromium	1.8	1,800	**1**	1[c]
Copper	46	11	**0.5**	0.05[c]
Lead	3.3	5.2	**0.1**	0.1[c]
Manganese	NA	**57**	NA	57[f]
Molybdenum	NA	NA	NA	NA
Nickel	120	26	**1[e]**	1[c]
Selenium	0.85	**0.022**	0.05	0.022[f]
Uranium	29	**2.0**	NA	2.0
Vanadium	20	0.14	**0.1**	0.1[c]
Zinc	**5.1**	100	25	5.1[g]

[a]Calculated based on methods described in Opresko et al. (1994); refer to Table 2.
[b]Calculated based on methods described in Opresko et al. (1994); refer to Table 3.
[c]Safe Upper Concentration Limit in Drinking Water for Livestock (EPA, 1973).
[d]The selected screening criterion is the lower of the surface water benchmark values for the mallard, muskrat, or livestock.
[e]Recommended concentration limit for livestock (National Academy of Sciences, 1974).
[f]Based on protection of the muskrat.
[g]Based on protection of the mallard.
NA – not available.

B.3 Screening for Constituents of Potential Concern (COPCs)

Potentially toxic trace elements detected in surface water samples collected from Maybe Creek and Dry Valley Creek stations were screened for purpose of COPC identification by comparison of maximum observed concentrations to the aquatic and riparian/terrestrial screening critieria described in Sections B.2.1 and B.2.2, respectively. If the maximum detected surface water concentration for a given analyte exceeds the lower of the available aquatic or riparian/terrestrial screening criteria, it is identified as a COPC. If only one screening criterion is available, it was used to determine whether or not an analyte is a COPC. Riparian/terrestrial screening criteria could not be developed for pentavalent arsenic, molybdenum, and uranium. The analytes that exceeded one or both screening criteria (Table B.5) for the project are:

- aluminum
- cadmium
- manganses
- nickel
- selenium
- vanadium
- zinc

Although the maximum concentration of aluminum detected in surface water samples collected from the Dry Valley Creek site exceeded screening criteria, the unique physical/chemical characteristics of this inorganic analyte suggest that the screening criteria for aluminum are overly protective. First, the aquatic screening criterion for aluminum (0.460 mg/l) is based on the lowest chronic value (LCV) for aluminum chloride in green algae (*Selenastrum capricornutum*). Chronic toxicity values for aquatic invertebrates and fish exposed in the laboratory to highly soluble forms (i.e., aluminum chloride and sodium aluminate) are generally in the range of 1.0 – 2.3 mg/l (EPA, 1988). Such inorganic forms, including the simple hydroxides, are apparently the most toxic forms of aluminum (EPA, 1986).

However, in fresh water at neutral pH (6.5 – 9.0), aluminum readily forms soluble and insoluble polymers with hydroxide ions, and forms strong complexes with fulvic and humic acids. In experiments conducted on the water flea (*Daphnia magna*) exposed to aluminum in river water, no toxic effects were observed at concentrations as high as 1,000 mg/l (Bringmann and Kuhn, 1958; as cited in EPA, 1988). In laboratory experiments conducted on this species, toxicity is observed at approximately 1.0 mg/l. It was suggested that toxicity may have been reduced by naturally occurring ligands in the river water. Surface water samples collected at the Dry Valley Creek site were analyzed for total aluminum, and the form and toxicity of aluminum in these samples would be most similar to that associated with the experiments of Bringmann and Kahn using river water. Based on the above, the aquatic screening criterion for aluminum is most likely over-protective by at least two orders of magnitude. Therefore, current levels of aluminum present in surface water at the Dry Creek site most likely do not pose an unacceptable risk for aquatic receptors.

Similar reasoning suggests that the riparian/terrestrial screening criterion for aluminum is over-protective. The toxicity benchmark values for riparian and terrestrial receptors (Table B.2) and B.3) were based on experiments conducted with aluminum sulfate and aluminum chloride, respectively (Opresko et al., 1994). However, the chemical equilibrium in 'natural' waters would be shifted towards the less soluble forms of aluminum such as polymeric hydroxides and inorganic complexes (EPA, 1986). Again, aluminum measurements in surface water samples collected from the Dry Valley Creek site represent soluble and insoluble complexes of aluminum, in addition to aluminum adsorbed to suspended sediment particles. Many of the forms of aluminum likely to be present would not be absorbed by the gastrointestinal tract of riparian or terrestrial receptors. Based on the above, the current levels of aluminum present in surface water at the Dry Valley Creek site do not pose an unacceptable risk for riparian or terrestrial receptors.

In conclusion, the analytes identified as COPECs for the Dry Valley Creek site are cadmium, manganese, nickel, selenium, vanadium, and zinc.

Table B.5

Screening for Chemicals of Potential Ecological Concern (COPECs) in Surface Water

Analyte	Maximum Observed Surface Water Concentration[a] (mg/l)	Aquatic Screening Criterion [b] (mg/l)	Riparian/Terrestrial Screening Criterion[c] (mg/l)	COPC?[d] (mg/l)
Aluminum	5	0.46	0.55	Yes
Antimony	0.0075	0.03	0.036	No
Arsenic III	0.0018	0.04	0.036	No
Arsenic V	0.0018	0.048	NA	No
Barium	0.1	5.8	3.3	No
Cadmium	0.023	0.0011	0.05	Yes
Chromium	0.045	0.21	1	No
Copper	0.0083	0.012	0.5	No
Lead	0.0031	0.0032	0.1	No
Manganese	0.21	0.12	57	Yes
Molybdenum	0.39	0.88	NA	No
Nickel	0.4	0.16	1	Yes
Selenium	0.43	0.0128-0.1859	0.022	Yes
Uranium	<0.00155	0.142	2	No
Vanadium	0.19	0.08	0.1	Yes
Zinc	1.7	0.11	5.1	Yes

[a]Maximum concentration observed in surface water samples collected by FMC at Dry Valley Mine or FS at South Maybe Mine.
[b]Refer to Table 1.
[c]Refer to Table 2.
[d]An analyte is identified as a constituent of potential concern (COPC) if the maximum detected surface water concentration exceeds either criterion

B.4 References

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Appendix C

APPENDIX C – DATA VALIDATION CALCULATIONS

TABLE C.1 SUMMARY AND DEFINITION OF DATA VALIDATION	
Process Summary	**Definitions**
General Equation for a Straight Line: $y = mx + b$	y: dependent variable m: slope x: independent variable b: intercept
Step 1 Lab-QA Correction: $x_{LA} = (x_L - b_L)/m_L$	x_L: concentration reported by the laboratory b_L: mean laboratory blank concentration m_L: laboratory standards regression slope (forced through 0, 0) x_{LA}: laboratory-quality-assurance-corrected concentration
Step 2 Field-QA Correction: $x_{FLA} = (x_{LA} - b_F)/m_F$	xLA: laboratory-quality-assurance-corrected concentration bF: mean laboratory-quality-assurance-corrected equipment blank concentration mF: mean laboratory-quality-assurance-corrected matrix spike recovery xFLA: field-and-laboratory-quality-assurance-corrected concentration
Overall Correction Equation: $x_{FLA} = (((x_L - b_L)/m_L)-b_F)/m_F$	

TABLE C.2 DATA VALIDATION FOR MAY 1998 WATER SAMPLING				
Analyte	**m_L**	**b_L**	**m_F**	**b_F**
Se	1.008	-0.0006601	1.086	-0.000008936
Cd	0.9709	0.001240	0.9442	-0.001354
Zn	1.003	-0.0001360	0.9238	-0.002771
Ni	0.9221	-0.0004200	0.9970	-0.001372
Mn	1.036	-0.01028	0.8782	0.01011
V	0.9345	0.002560	1.013	0.01260
Ca	0.9664	0.003080	1.000 [1]	2.424
Mg	0.8167	-0.01612	1.000 [1]	0.4519
K	0.9610	-0.07444	1.000 [1]	0.5553
Na	0.9953	-0.08354	1.000 [1]	0.8098
Fe	0.9655	-0.02798	1.000 [1]	-0.002237
Alk	1.005	0.9030	1.000 [1]	0.06667
SO_4	1.012	0.007474	1.018	-0.007384
Cl	0.9674	0.05338	0.9927	-0.08026

[1]No matrix spikes; therefore, a default value of 1.000 is used.

TABLE C.3
DATA VALIDATION FOR SEPTEMBER 1998 WATER SAMPLING

Analyte	m_L	b_L	m_F	b_F
Se	1.023	-0.0003817	1.020	0.00004399
Cd	0.9748	-0.002725	0.9191	0.002431
Mn	0.9919	-0.002600	0.9878	0.0005545
Ni	1.036	0.002600	0.8628	-0.004098
V	0.9867	-0.0021	0.9019	-0.0006250
Zn	1.011	-0.004925	0.8981	0.001849
Ca	1.000	-0.001750	1.000 [1]	0.2302
Fe	0.9893	-0.009350	1.000 [1]	-0.0002359
K	0.9823	0.002600	1.000 [1]	0.02140
Mg	0.9486	-0.01883	1.000 [1]	0.01768
Na	1.002	0.001250	1.000 [1]	0.1085
Alk	1.042	1.439	1.000 [1]	0 [2]
Cl	1.026	0.1221	1.000 [1]	0 [2]
SO_4	1.099	0.01129	1.000 [1]	0 [2]

[1]No matrix spikes; therefore, a default value of 1.000 is used.
[2]No equipment blanks; therefore, a default value of 0 is used.

TABLE C.4
DATA VALIDATION FOR 1998 SEDIMENT SAMPLING

Analyte	m_L	b_L	m_F	b_F
Se	1.030	-0.08963	1.131	0.0757
Cd	0.9266	0.7010	0.9458	-0.8364
Mn	0.9697	-2.0880	0.9289	2.232
Ni	0.9544	1.684	0.9317	-2.078
V	0.9255	2.985	0.9346	-3.882
Zn	0.9621	-4.131	0.9476	4.440
Ca	1.091	207.1	1.000 [1]	-152.2
Fe	0.8802	-25.15	1.113	29.37
K	0.9610	57.00	0.8429	-44.39
Mg	0.9272	-0.03288	1.380	6.984
Na	0.9553	51.87	1.028	-39.75
$SO_{4\text{-}S}$	0.8690	4.635	1.0850	0 [2]
Org. Matter	1.009	0 [3]	1000 [2]	0 [2]

[1]No matrix spikes; therefore, a default value of 1.000 is used.
[2]No equipment blanks; therefore, a default value of 0 is used.
[3]No laboratory blanks; therefore, a default value of 0 is used.

TABLE C.5 DATA VALIDATION FOR 1998 FISH SAMPLING				
Analyte	**m_L**	**b_L**	**m_F**	**b_F**
Se	1.048	-0.01050	1.056	0.01334
Cd	1.049	0.01300	0.9916	-0.01462
Mn	0.9707	-0.004000	0.9105	0.08035
Ni	0.9197	0.03000	0.9564	0.05292
V	0.8660	-0.06100	0.9610	0.1416
Zn	0.9533	-0.07400	1.057	0.1297

TABLE C.6
DATA VALIDATION FOR 1998 SOIL SAMPLING

Analyte	m_L	b_L	m_F	b_F
Se	1.003	0.01582	1.086	0.005157
Cd	0.987	0.4382	0.8421	-0.2909
Zn	0.9907	-1.647	3.192	0.9113
Ni	0.9905	1.531	0.8531	-0.8471
Mn	0.9979	-5.924	0.9181	6.729
V	0.9728	2.600	-1.952	0.9731
Ca	0.9520	162.4	1.000 [1]	-43.50
Mg	0.9714	-8.531	1.006	21.50
K	0.9867	55.57	1.380	-33.98
Na	1.002	57.69	0.9659	-35.47
Fe	0.9613	-18.35	1.000 [1]	19.25
SO_4	0.9224	17.92	1.016	0 [2]
Org. Matter	0.9834	0.05636	1.000 [1]	0 [2]
Available P	0.8907	3.280	1.141	0 [2]
CEC	1.226	-6.925	1.000 [1]	0 [2]
NH_4	1.054	0.3335	0.9053	0 [2]
NO_3	1.012	-1.411	0.8990	0 [2]

[1] No matrix spikes; therefore, a default value of 1.000 is used.
[2] No equipment

TABLE C.7
DATA VALIDATION FOR 1998 VEGETATION SAMPLING

Analyte	m_L	b_L	m_F	b_F
Se	1.043	0.0001102	1.101	0.01741
Cd	0.9347	0.1042	1.077	-0.05152
Fe	0.9471	-0.1673	0.7709	-0.7057
Zn	0.9434	0.1734	1.040	0.3119
Ni	1.128	0.0140	0.9036	0.2250
Mn	0.9648	0.1489	1.001	-0.1058
V	1.045	-0.1095	0.8780	0.4251
SO_4	0.9348	275.0	1.029	0 [1]

[1]No equipment blanks; therefore a default value of 0 is used.

TABLE C.8
UTB'S FOR BLANK RESULTS FOR MAY 1998 WATER DATA

Analyte	**Lab Blanks [1]**				**Equipment Blanks [2]**				**F-Test (1-sided; a = 0.05)**			**t-Test (2-sided; a = 0.05)**				**UTB (a = 0.05; p = 0.95, n = n_{pooled}+1)**		**Notes**
	n	ν	$\bar{x}$	s	n	ν	$\bar{x}$	s	F	p	s_{pooled}	ν_{pooled}	t	p	$\bar{x}_{pooled}$	g'	UTB	
Se	22	21	0	0.0006790	10	9	0	0.0006728	0.98	0.48	0.0006771	30	0.000	1.00	0	2.209	0.0015	
Cd	5	4	0	0.0006498	10	9	0	0.001825	7.89	**0.03**						2.911	0.0053	Only equipment blanks used.
Mn	5	4	0	0.02154	10	9	0	0.001707	0.01	1.00	0.01203	13	0.000	1.00	0	2.614	0.031	
Ni	5	4	0	0.006763	10	9	0	0.006567	0.94	0.57	0.006628	13	0.000	1.00	0	2.614	0.017	
V	5	4	0	0.01297	10	9	0	0.009138	0.50	0.82	0.01047	13	0.000	1.00	0	2.614	0.027	
Zn	5	4	0	0.002850	10	9	0	0.004190	2.16	0.24	0.003828	13	0.000	1.00	0	2.614	0.010	
Ca	5	4	0	0.009370	10	9	0	3.487	138,492.01	**0.00**						2.911	10	Only equipment blanks used.
Fe	5	4	0	0.029980	10	9	0	0.03361	1.26	0.44	0.03254	13	0.000	1.00	0	2.614	0.085	
K	5	4	0	0.08200	10	9	0	1.201	214.52	**0.00**						2.911	3.5	Only equipment blanks used.
Mg	5	4	0	0.01576	10	9	0	0.6983	1,963.23	**0.00**						2.911	2.0	Only equipment blanks used.
Na	5	4	0	0.02858	10	9	0	1.111	1,511.14	**0.00**						2.911	3.2	Only equipment blanks used.
Alk	10	9	0	0.3363	2	1	0	0	0.00	1.00	0.319042	10	0.000	1.00	0	2.815	0.90	
Cl	16	15	0	0.05961	2	1	0	0	0.00	1.00	0.05772	16	0.000	1.00	0	2.486	0.14	
SO_4	16	15	0	0.02517	2	1	0	0	0.00	1.00	0.02437	16	0.000	1.00	0	2.486	0.061	

[1]Laboratory-adjusted results.
[2]Laboratory-and-field-adjusted results.

TABLE C.9
UTB'S FOR BLANK RESULTS FOR SEPTEMBER 1998 WATER DATA

Analyte	Lab Blanks [1]				Equipment Blanks [2]				F-Test (1-sided; a = 0.05)			t-Test (2-sided; a = 0.05)				UTB (a = 0.05; p = 0.95, n = n_{pooled}+1)		Notes
	n	ν	$\bar{x}$	s	n	ν	$\bar{x}$	s	F	p	s_{pooled}	ν_{pooled}	t	p	$\bar{x}_{pooled}$	g'	UTB	
Se	19	18	0	0.0005440	9	8	0	0.0006964	1.64	0.18	0.0005950	26	0.000	1.00	0	2.263	0.0013	
Cd	4	3	0	0.004897	9	8	0	0.001107	0.05	1.00	0.002726	11	0.000	1.00	0	2.736	0.0030	
Mn	4	3	0	0.003466	9	8	0	0.005538	2.55	0.24	0.0051	11	0.000	1.00	0	2.736	0.014	
Ni	4	3	0	0.005500	9	8	0	0.008268	2.26	0.27	0.0076	11	0.000	1.00	0	2.736	0.021	
V	4	3	0	0.006898	9	8	0	0.01670	5.86	0.09	0.0147	11	0.000	1.00	0	2.736	0.040	
Zn	4	3	0	0.006627	9	8	0	0.004966	0.56	0.77	0.0055	11	0.000	1.00	0	2.736	0.015	
Ca	4	3	0	0.01625	9	8	0	0.2807	298.39	**0.00**						3.032	0.851	Only equipment blanks used.
Fe	4	3	0	0.02196	9	8	0	0.02497	1.29	0.46	0.0242	11	0.000	1.00	0	2.736	0.066	
K	4	3	0	0.1555	9	8	0	0.2437	2.46	0.25	0.2231	11	0.000	1.00	0	2.736	0.610	
Mg	4	3	0	0.01053	9	8	0	0.006389	0.37	0.89	0.0077	11	0.000	1.00	0	2.736	0.021	
Na	4	3	0	0.06670	9	8	0	0.2120	10.10	**0.04**						2.736	0.580	Only equipment blanks used.
Alk	8	7	0	0.5334												3.188	1.700	Only lab blanks used.
Cl	13	12	0	0.2063												2.670	0.551	Only lab blanks used.
SO_4	14	13	0	0.03841												2.614	0.100	Only lab blanks used.

[1] Laboratory-adjusted results.
[2] Laboratory-and-field-adjusted results.

TABLE C.10
UTB'S FOR BLANK RESULTS FOR 1998 SEDIMENT SAMPLING

Analyte	Lab Blanks [1]				Equipment Blanks [2]				F-Test (1-sided; a = 0.05)			t-Test (2-sided; a = 0.05)				UTB (a = 0.05; p = 0.95, n = n_{pooled}+1)		Notes
	n	ν	$\bar{x}$	s	n	ν	$\bar{x}$	s	F	p	s_{pooled}	ν_{pooled}	t	p	$\bar{x}_{pooled}$	g'	UTB	
Se	12	11	0	0.1134	7	6	0	0.0100	0.01	1.00	0.09141	17	0.000	1.00	0	2.453	0.22	
Cd	13	12	0	0.3201	8	7	0	0.1275	0.16	0.99	0.26590	19	0.000	1.00	0	2.396	0.31	
Mn	13	12	0	2.491	8	7	0	0.5591	0.05	1.00	2.0085	19	0.000	1.00	0	2.396	4.8	
Ni	13	12	0	1.042	8	7	0	0.7419	0.51	0.81	0.9426	19	0.000	1.00	0	2.396	2.3	
V	13	12	0	1.048	8	7	0	1.51	2.08	0.13	1.2384	19	0.000	1.00	0	2.396	3.0	
Zn	13	12	0	4.203	8	7	0	0.9901	0.06	1.00	3.3938	19	0.000	1.00	0	2.396	8.1	
Ca	13	12	0	36.98	8	7	0	39.41	1.14	0.40	3.3938	19	0.000	1.00	0	2.396	5100	
Fe	13	12	0	7.023	8	7	0	3.188	0.21	0.98	5.9072	19	0.000	1.00	0	2.396	14	
K	13	12	0	41.30	8	7	0	25.52	0.38	0.90	36.2935	19	0.000	1.00	0	2.396	87	
Mg	13	12	0	7.150	8	7	0	6.200	6.200	**0.00**						3.187	20	Only equipment blanks used.
Na	13	12	0	13.13	8	7	0	15.78	1.44	0.27	14.1641	19	0.000	1.00	0	2.396	34	
SO_4	16	15	0	1.033												2.523	2.6	Only lab blanks used.
Org. C																	0.0	No lab blanks or equipment blanks

[1]Laboratory-adjusted results.
[2]Laboratory-and-field-adjusted results.

TABLE C.11
UTB'S FOR BLANK RESULTS FOR 1998 FISH SAMPLING

Analyte	Lab Blanks [1]				Equipment Blanks [2]				F-Test (1-sided; a = 0.05)			t-Test (2-sided; a = 0.05)				UTB (a = 0.05; p = 0.95, n = n_{pooled}+1)		Notes
	n	ν	$\bar{x}$	s	n	ν	$\bar{x}$	s	F	p	s_{pooled}	ν_{pooled}	t	p	$\bar{x}_{pooled}$	g'	UTB	
Se	3	2	0	0.01267												7.656	0.097	Only used lab blanks.
Cd	1	0	0		3	2	0	0.008178			0.008178	2			0	7.656	0.063	
Mn	1	0	0		3	2	0	0.1254			0.1254	2			0	7.656	0.96	
Ni	1	0	0		3	2	0	0.005834			0.005834	2			0	7.656	0.045	
V	1	0	0		3	2	0	0.03502			0.03502	2			0	7.656	0.27	
Zn	1	0	0		3	2	0	0.01810			0.01810	2			0	7.656	0.14	

[1]Laboratory-adjusted results.
[2]Laboratory-and-field-adjusted results.

TABLE C.12
UTB'S FOR BLANK RESULTS FOR 1998 SOIL SAMPLING

Analyte	Lab Blanks [1]				Equipment Blanks [2]				F-Test (1-sided; a = 0.05)			t-Test (2-sided; a = 0.05)				UTB (a = 0.05; p = 0.95, n = n_{pooled}+1)		Notes
	n	ν	$\bar{x}$	s	n	ν	$\bar{x}$	s	F	p	s_{pooled}	ν_{pooled}	t	p	$\bar{x}_{pooled}$	g'	UTB	
Se	16	15	0	0.08437	7	6	0	0.02841	0.11	0.99	0.07290	21	0.000	1.00	0	2.350	0.17	
Cd	14	13	0	0.2697	7	6	0	0.1718	0.41	0.86	0.2431	19	0.000	1.00	0	2.396	0.58	
Mn	13	12	0	3.184	7	6	0	1.232	0.15	0.99	2.696	18	0.000	1.00	0	2.423	6.5	
Ni	13	12	0	0.6617	7	6	0	0.6744	1.04	0.45	0.6660	18	0.000	1.00	0	2.423	1.6	
V	13	12	0	0.9261	7	6	0	0.3393	0.13	0.99	0.7811	18	0.000	1.00	0	2.423	1.9	
Zn	13	12	0	2.880	7	6	0	2.703	0.88	0.54	2.822	18	0.000	1.00	0	2.423	6.8	
Ca	15	14	0	55.54	7	6	0	205.9	13.74	**0.00**						2.371	132	Used Lab Blanks only
Fe	13	12	0	8.131	7	6	0	2.012	0.06	1.00	6.740	18	0.000	1.00	0	2.423	16	
K	13	12	0	53.92	7	6	0	18.44	0.12	0.99	45.29	18	0.000	1.00	0	2.423	110	
Mg	13	12	0	15.02	7	6	0	21.36	2.02	0.14	17.39	18	0.000	1.00	0	2.423	42	
Na	13	12	0	21.85	7	6	0	32.00	2.14	0.12	25.68	18	0.000	1.00	0	2.423	62	
SO_4-S	13	12	0	3.637												2.670	9.7	Used Lab Blanks only
Org. Matter	11	10	0	0.03295												2.815	0.093	Used Lab Blanks only
P-$NaHCO_3$	10	9	0	0.8509												2.911	2.5	Used Lab Blanks only
CEC	11	10	0	1.569												2.815	4.4	Used Lab Blanks only

[1]Laboratory-adjusted results.

TABLE C.13 UTB'S FOR BLANK RESULTS FOR 1998 VEGETATION SAMPLING																	
Analyte	**Lab Blanks [1]**				**Equipment Blanks [2]**				**F-Test (1-sided; a = 0.05)**			**t-Test (2-sided; a = 0.05)**				**UTB (a = 0.05; p = 0.95, n = n_{pooled}+1)**		**Notes**
	n	ν	$\bar{x}$	s	n	ν	$\bar{x}$	s	F	p	s_{pooled}	ν_{pooled}	t	p	$\bar{x}\ \bar{x}_{pooled}$	g'	UTB	
Se	18	17	0	0.03834	7	6	0	0.03696	0.93	0.50	0.03798	23	0.000	1.00	0	2.309	0.088	
Cd	4	3	0	0.08601	7	6	0	0.05095	0.35	0.87	0.06478	9	0.000	1.00	0	2.911	0.19	
Fe	4	3	0	2.245	7	6	0	0.4105	0.03	1.00	1.339	9	0.000	1.00	0	2.911	3.9	
Mn	4	3	0	0.1298	7	6	0	0.08195	0.40	0.84	0.1005	9	0.000	1.00	0	2.911	0.29	
Ni	4	3	0	0.3596	7	6	0	0.1910	0.28	0.91	0.2597	9	0.000	1.00	0	2.911	0.76	
SO_4	6	5	0	80.42												3.708	300	Used Lab Blanks Only
V	4	3	0	0.3215	7	6	0	0.1666	0.27	0.92	0.2301	9	0.000	1.00	0	2.911	0.67	
Zn	4	3	0	0.2721	7	6	0	0.8515	9.79	**0.04**						2.911	2.5	Used Equipment Blanks Only

[1]Laboratory-adjusted results.
[2]Laboratory-and-field-adjusted results.

TABLE C.14 UI-UC COMPARISONS FOR MAY 1998 WATER DATA								
Analyte	**Station**	**UI Results**						**UC-Davis Results**
		n	$\bar{x}$	**s**	$t_{((1-0.05)0.1/2;n-1)}$	**LPB**	**UPB**	
Se	ST044	5	0.0004049	0.0001323	5.567	-0.00040	0.0012	-0.00018
	GW001	4	0.0009485	0.0001081	7.402	0.000054	0.0018	0.00014
	GW011	5	0.0003036	0.0002997	5.567	-0.0015	0.0021	0.0012
	ST048	5	-0.0007201	0.0001369	5.567	-0.0016	0.00011	-0.000070
	ST049	5	-0.0005789	0.00083038	5.567	-0.0056	0.0045	-0.0016
	ST101	5	0.00006378	0.0004105	5.567	-0.0024	0.0026	-0.00059
	ST201	5	0.00007470	0.00011911	5.567	-0.00065	0.00080	0.00019
	ST022	5	0.006002	0.00022546	5.567	0.0046	0.0074	0.0057
	ST001	5	0.0005001	0.00027561	5.567	-0.0012	0.0022	0.00035
	SP024	5	0.1264	0.008603	5.567	0.074	0.18	0.16
Cd	ST044	5	0.002101	0.001445	5.567	-0.0067	0.011	**-0.013**
	GW001	4	0.001118	0.001246	7.402	-0.0092	0.011	**-0.018**
	GW011	5	-0.002554	0.00055752	5.567	-0.0060	0.00085	**0.0070**
	ST048	5	-0.002420	0.00060977	5.567	-0.0061	0.0013	-0.0047
	ST049	5	-0.001648	0.001354	5.567	-0.0099	0.0066	0.0031
	ST101	5	-0.004573	0.0005150	5.567	-0.0077	-0.0014	**-0.019**
	ST201	5	-0.001483	0.001238	5.567	-0.0090	0.0061	0.0014
	ST022	5	-0.002163	0.00023712	5.567	-0.0036	-0.00072	**-0.00022**
	ST001	5	-0.001092	0.00057068	5.567	-0.0046	0.0024	**0.0053**
	SP024	5	0.002740	0.001485	5.567	-0.0063	0.012	**-0.022**
Mn	ST044	5	0.03512	0.00032733	5.567	0.033	0.037	**0.022**
	GW001	4	0.01255	0.00069326	7.402	0.0068	0.018	**-0.0050**
	GW011	5	0.01465	0.00039209	5.567	0.012	0.017	**-0.00084**
	ST048	5	0.04379	0.01975	5.567	-0.077	0.16	0.034
	ST049	5	0.06114	0.009883	5.567	0.0009	0.12	0.058
	ST101	5	0.08793	0.04891	5.567	-0.21	0.39	0.10
	ST201	5	0.009961	0.00069806	5.567	0.0057	0.014	**-0.0040**
	ST022	5	0.06400	0.007547	5.567	0.018	0.11	0.059
	ST001	5	0.05160	0.01260	5.567	-0.025	0.13	0.044
	SP024	5	0.02660	0.005470	5.567	-0.0068	0.060	0.017
Ni	ST044	5	0.004273	0.003849	5.567	-0.019	0.028	0.0017
	GW001	4	-0.007746	0.003899	7.402	-0.040	0.025	0.0060
	GW011	5	-0.001713	0.002985	5.567	-0.020	0.016	0.0021
	ST048	5	-0.0008025	0.003987	5.567	-0.025	0.024	0.0027
	ST049	5	-0.004013	0.001688	5.567	-0.014	0.0063	0.0027
	ST101	5	0.002277	0.002332	5.567	-0.012	0.016	0.0065
	ST201	5	0.004967	0.009104	5.567	-0.051	0.060	0.0070
	ST022	5	-0.003644	0.002279	5.567	-0.018	0.010	**0.011**
	ST001	5	0.007700	0.006805	5.567	-0.034	0.049	0.0094
	SP024	5	0.01930	0.004509	5.567	-0.0082	0.047	0.024
V	ST044	5	0.03135	0.005245	5.567	-0.00063	0.063	**-0.0043**
	GW001	4	0.008871	0.006466	7.402	-0.045	0.062	0.0013
	GW011	5	0.01032	0.003038	5.567	-0.0082	0.029	0.0058
	ST048	5	0.01044	0.006191	5.567	-0.027	0.048	0.00030
	ST049	5	0.01077	0.003715	5.567	-0.012	0.033	0.00030
	ST101	5	0.01419	0.001721	5.567	0.0037	0.025	**0.0018**
	ST201	5	0.007202	0.006966	5.567	-0.035	0.050	0.0043
	ST022	5	0.01066	0.003734	5.567	-0.012	0.033	0.0018
	ST001	5	0.01952	0.01481	5.567	-0.071	0.11	0.0033
	SP024	5	0.04541	0.003816	5.567	0.022	0.069	0.042

TABLE C.15
UI-UC COMPARISONS FOR SEPTEMBER 1998 WATER DATA

Analyte	Station	UI Results						UC-Davis Results
		n	$\bar{x}$	s	$t_{((1-0.05)}0.1_{/2;n-1)}$	LPB	UPB	
Se	GW001	3	0.001461	0.0003013	13.949	-0.0034	0.0063	0.000039
	GW009	3	0.001194	0.0001606	13.949	-0.0014	0.0038	0.000039
	SP024	3	0.04101	0.003587	13.949	-0.017	0.099	0.041
	ST022	3	0.002364	0.00004408	13.949	0.0017	0.0031	**0.0013**
	ST023	3	0.003254	0.00009495	13.949	0.0017	0.0048	0.0017
	ST044	3	0.001075	0.00005140	13.949	0.00025	0.0019	**-0.000013**
	ST048	3	0.0002838	0.0001906	13.949	-0.0028	0.0034	0.000039
	ST049	3	0.0004058	0.00016434	13.949	-0.0022	0.0031	-0.00022
	ST101	3	0.002112	0.0009412	13.949	-0.013	0.017	-0.00027
	ST201	3	-0.0001381	0.00016594	13.949	-0.0028	0.0025	-0.00027
Cd	GW001	3	0.002898	0.0006407	13.949	-0.0074	0.013	**0.12**
	GW009	4	0.003911	0.001663	7.402	-0.0099	0.018	**0.091**
	SP024	3	0.003616	0.0003078	13.949	-0.0013	0.0086	**0.12**
	ST022	3	0.005223	0.00025818	13.949	0.0011	0.0094	**0.10**
	ST023	3	0.001735	0.0004626	13.949	-0.0057	0.0092	**0.12**
	ST044	3	0.001564	0.001600	13.949	-0.024	0.027	**0.10**
	ST048	3	0.002932	0.00091949	13.949	-0.012	0.018	**0.12**
	ST049	3	0.002761	0.001766	13.949	-0.026	0.031	**0.12**
	ST101	3	0.003155	0.00018494	13.949	0.00018	0.0061	**0.11**
	ST201	3	0.002351	0.001299	13.949	-0.019	0.023	**0.10**
Mn	GW001	4	0.003075	0.0001931	7.402	0.0015	0.0047	**0.060**
	GW009	4	0.004512	0.0005231	7.402	0.0002	0.0088	**0.056**
	SP024	4	0.1084	0.003620	7.402	0.078	0.138	**0.18**
	ST022	4	0.01263	0.0004611	7.402	0.0088	0.02	**0.081**
	ST023	4	0.005343	0.0004197	7.402	0.002	0.01	**0.072**
	ST044	4	0.007965	0.002153	7.402	-0.010	0.026	**0.068**
	ST048	4	0.03191	0.006919	7.402	-0.025	0.09	**0.10**
	ST049	4	0.08187	0.01932	7.402	-0.078	0.24	0.16
	ST101	4	0.07778	0.04697	7.402	-0.31	0.47	0.21
	ST201	4	0.002571	0.0001931	7.402	0.0010	0.0042	**0.061**
Ni	GW001	4	-0.001569	0.002172	7.402	-0.020	0.016	**0.11**
	GW009	4	-0.003186	0.002937	7.402	-0.027	0.021	**0.11**
	SP024	4	0.01897	0.002172	7.402	0.0010	0.037	**0.13**
	ST022	4	0.005443	0.001717	7.402	-0.009	0.020	**0.11**
	ST023	4	0.008255	0.001688	7.402	-0.006	0.022	**0.11**
	ST044	4	0.0003500	0.003406	7.402	-0.028	0.029	**0.11**
	ST048	4	0.001303	0.001921	7.402	-0.015	0.017	**0.098**
	ST049	4	-0.002414	0.004345	7.402	-0.038	0.0335	**0.10**
	ST101	4	0.005600	0.005366	7.402	-0.039	0.050	**0.12**
	ST201	4	-0.00002400	0.001035	7.402	-0.009	0.009	**0.10**
V	GW001	4	0.004789	0.005232	7.402	-0.039	0.048	**0.083**
	GW009	4	-0.002660	0.003367	7.402	-0.031	0.025	**0.084**
	SP024	4	0.08422	0.007606	7.402	0.0213	0.147	**0.17**
	ST022	4	0.02161	0.02416	7.402	-0.178	0.222	0.088
	ST023	4	0.01873	0.001693	7.402	0.005	0.033	**0.084**
	ST044	4	0.005169	0.003476	7.402	-0.024	0.034	**0.094**
	ST048	4	0.004789	0.003527	7.402	-0.024	0.034	**0.081**
	ST049	4	0.0004814	0.002931	7.402	-0.024	0.025	**0.077**
	ST101	4	0.01333	0.002931	7.402	-0.0109	0.038	**0.092**
	ST201	4	0.01269	0.001479	7.402	0.000	0.025	**0.088**

TABLE C.16 UI-UC COMPARISONS FOR 1998 SEDIMENT SAMPLING DATA								
Analyte	**Station**	**UI Results**						**UC-Davis Results**
		n	$\bar{x}$	**s**	$t_{((1-0.05)0.1/2;n-1)}$	**LPB**	**UPB**	
Se	ST023	3	1.479	0.1483	13.95	-0.91	3.9	1.0
	ST101	3	1.142	0.2789	13.95	-3.4	5.6	0.79
	ST048	3	0.8605	0.2473	13.95	-3.1	4.8	0.58
	ST049	3	0.9446	0.3623	13.95	-4.9	6.8	0.57
	SP24	3	78.08	5.932	13.95	-17	170	79
	ST044	3	1.932	0.5137	13.95	-6.3	10	1.7
	ST022	3	0.6275	0.1405	13.95	-1.6	2.9	1.8
	ST201	3	0.3265	0.1898	13.95	-2.7	3.4	0.42
Cd	ST023	4	2.023	0.3223	7.40	-0.64	4.7	2.3
	ST101	4	5.598	3.391	7.40	-22	34	6.1
	ST048	4	2.994	0.5668	7.40	-1.7	7.7	4.3
	ST049	4	3.560	0.5845	7.40	-1.3	8.4	6.1
	SP24	4	33.24	0.6231	7.40	28	38	36
	ST044	4	6.960	1.381	7.40	-4.5	18	9.8
	ST022	4	2.265	1.381	7.40	-9.2	14	3.5
	ST201	4	1.564	0.1079	7.40	0.67	2.5	2.5
Mn	ST023	4	302.0	25.78	7.40	89	520	310
	ST101	4	1369	114.3	7.40	420	2300	1300
	ST048	4	740.3	75.01	7.40	120	1400	660
	ST049	4	1846	367.0	7.40	-1200	4900	1500
	SP24	4	394.8	12.98	7.40	290	500	410
	ST044	4	429.6	58.24	7.40	-52	910	330
	ST022	4	459.3	241.8	7.40	-1500	2500	350
	ST201	4	155.1	18.83	7.40	-0.74	310	170
Ni	ST023	4	31.50	11.30	7.40	-62	130	18
	ST101	4	49.18	8.397	7.40	-20	120	41
	ST048	4	62.15	10.51	7.40	-25	150	43
	ST049	4	38.05	13.98	7.40	-78	150	37
	SP24	4	299.5	5.239	7.40	260	340	290
	ST044	4	41.85	23.25	7.40	-150	230	53
	ST022	4	16.57	3.258	7.40	-10	44	17
	ST201	4	34.91	4.278	7.40	-0.49	70	24
V	ST023	4	24.06	2.045	7.40	7.1	41	12
	ST101	4	40.26	1.845	7.40	25	56	**24**
	ST048	4	32.16	3.459	7.40	3.5	61	19
	ST049	4	48.91	5.943	7.40	-0.27	98	31
	SP24	4	404.7	10.34	7.40	320	490	**230**
	ST044	4	84.97	21.46	7.40	-93	260	63
	ST022	4	25.81	2.732	7.40	3.2	48	12
	ST201	4	25.68	1.845	7.40	10	41	15
Zn	ST023	4	33.92	3.232	7.40	7.2	61	32
	ST101	4	126.4	5.197	7.40	83	170	100
	ST048	4	80.17	6.519	7.40	26	130	70
	ST049	4	85.11	17.61	7.40	-61	230	71
	SP24	4	1339	14.95	7.40	1200	1500	1300
	ST044	4	122.5	25.24	7.40	-86	330	93
	ST022	4	44.57	4.976	7.40	3.4	86	51
	ST201	4	23.26	10.13	7.40	-61	110	36

[1] Shaded areas indicate UC-Davis values outside of UI prediction intervals

TABLE C.17
UI-UC COMPARISONS FOR 1998 SOIL SAMPLING DATA

Analyte	Station	UI Results						UC-Davis Results
		n	$\bar{x}$	s	$t_{((1-0.05)} 0.1_{/2;n-1)}$	LPB	UPB	
Se	WD074	4	8.830	0.8929	7.402	1.4	16	10
	WD080	4	83.46	52.57	7.402	-350	520	67
	BB001	4	4.046	0.3935	7.402	0.79	7.3	4
	WD075	4	29.89	8.803	7.402	-43	100	23
	BB003	4	1.137	0.1260	7.402	0.094	2.2	1.4
	WD031	4	19.42	5.668	7.402	-27	66	23
	WD034	4	36.37	30.97	7.402	-220	290	18
Cd	WD074	4	31.72	1.275	7.402	21	42	39
	WD080	4	34.25	3.912	7.402	1.9	67	56
	BB001	4	7.609	0.9228	7.402	-0.028	15	11
	WD075	4	34.00	3.308	7.402	6.6	61	38
	BB003	4	5.900	0.1724	7.402	4.5	7.3	**7.6**
	WD031	4	54.51	5.928	7.402	5.4	100	64
	WD034	4	34.00	20.02	7.402	-130	200	48
Fe	WD074	4	12,580	2,663	7.402	-9,500	35,000	17,000
	WD080	4	13,180	4,706	7.402	-26,000	52,000	14,000
	BB001	4	9,251	2,126	7.402	-8,300	27,000	17,000
	WD075	4	9,841	7,812	7.402	-55,000	74,000	18,000
	BB003	4	11,350	2,399	7.402	-8,500	31,000	14,000
	WD031	4	13,800	996.0	7.402	5,600	22,000	13,000
	WD034	4	16,920	1,309	7.402	6,100	28,000	18,000
Mn	WD074	4	354.2	27.60	7.402	130	580	330
	WD080	4	281.5	20.86	7.402	110	450	**43**
	BB001	4	767.5	53.03	7.402	330	1,200	**52**
	WD075	4	296.5	101.2	7.402	-540	1,100	42
	BB003	4	1634	95.94	7.402	840	2,400	**52**
	WD031	4	127.4	37.13	7.402	-180	440	49
	WD034	4	329.1	155.8	7.402	-960	1,600	54
Ni	WD074	4	144.9	10.10	7.402	61	230	160
	WD080	4	213.0	87.00	7.402	-510	930	290
	BB001	4	47.42	2.403	7.402	28	67	50
	WD075	4	113.4	74.33	7.402	-500	730	330
	BB003	4	66.73	2.896	7.402	43	91	77
	WD031	4	182.7	34.36	7.402	-100	470	190
	WD034	4	112.8	22.48	7.402	-73	300	220
V	WD074	4	272.3	27.03	7.402	49	500	270
	WD080	4	303.1	93.98	7.402	-480	1,100	450
	BB001	4	55.66	25.31	7.402	-150	270	43
	WD075	4	143.3	65.68	7.402	-400	690	260
	BB003	4	57.72	2.570	7.402	36	79	**34**
	WD031	4	621.8	99.09	7.402	-200	1,400	430
	WD034	4	303.1	168.40	7.402	-1,100	1,700	460
Zn	WD074	4	690.6	26.55	7.402	470	910	720
	WD080	4	1,202	144.3	7.402	7.8	2,400	1,300
	BB001	4	254.0	24.73	7.402	49	460	250
	WD075	4	1364	100.9	7.402	530	2,200	1,400
	BB003	4	299.4	10.09	7.402	220	380	310
	WD031	4	1,019	145.9	7.402	-190	2,200	940
	WD034	4	501	122.4	7.402	-510	1,500	810

[1] Shaded areas indicate UC-Davis values outside of UI prediction intervals

TABLE C.18
UI-UC COMPARISONS FOR MAY 1998 VEGETATION DATA

Analyte	Station	UI Results						UC-Davis Results
		n	$\bar{x}$	s	$t_{((1-0.05)0.1/2;n-1)}$	LPB	UPB	
Se	WD074	4	6.114	4.181	7.402	-28	41	3.6
	WD080	4	44.12	15.43	7.402	-84	172	11
	BB001	4	0.2277	0.0593	7.402	-0.26	0.72	0.25
	WD075	4	8.392	5.220	7.402	-35	52	24
	BB003	4	0.02613	0.02865	7.402	-0.21	0.26	0.20
	WD031	4	3.477	0.8592	7.402	-3.6	11	5.5
	WD034	4	26.61	21.78	7.402	-154	207	22
Cd	WD074	4	3.446	2.036	7.402	-13	20	1.3
	WD080	4	1.178	0.8282	7.402	-5.7	8.0	1.0
	BB001	4	0.9704	0.8178	7.402	-5.8	7.7	1.0
	WD075	4	2.135	0.4663	7.402	-1.7	6.0	1.9
	BB003	4	0.6668	0.9808	7.402	-7.5	8.8	0.0039
	WD031	4	2.269	0.4814	7.402	-1.7	6.3	**8.1**
	WD034	4	2.483	0.9177	7.402	-5.1	10	3.6
Fe	WD074	4	83.06	23.49	7.402	-110	280	130
	WD080	4	40.96	6.147	7.402	-9.9	92	37
	BB001	4	37.00	10.58	7.402	-51	130	68
	WD075	4	88.86	42.07	7.402	-260	440	83
	BB003	4	48.61	6.34	7.402	-3.9	100	73
	WD031	4	48.48	8.012	7.402	-18	120	67
	WD034	4	81.47	27.51	7.402	-150	310	64
Mn	WD074	4	47.27	26.08	7.402	-170	260	49
	WD080	4	24.20	8.568	7.402	-47	95	28
	BB001	4	62.56	27.38	7.402	-160	290	54
	WD075	4	32.67	15.73	7.402	-98	160	35
	BB003	4	73.96	34.36	7.402	-210	360	36
	WD031	4	23.94	1.770	7.402	9	39	32
	WD034	4	46.23	10.24	7.402	-39	130	33
Ni	WD074	4	3.203	1.150	7.402	-6.3	13	3.3
	WD080	4	5.227	4.009	7.402	-28	38	6.8
	BB001	4	1.394	0.3300	7.402	-1.3	4.1	2.4
	WD075	4	9.862	2.218	7.402	-8.5	28	18
	BB003	4	1.451	0.4721	7.402	-2.5	5.4	1.2
	WD031	4	2.959	2.218	7.402	-15	21	2.5
	WD034	4	3.535	1.423	7.402	-8.2	15	5.3
V	WD074	4	0.8341	0.4370	7.402	-2.8	4.5	1.9
	WD080	4	0.2803	0.1803	7.402	-1.2	1.8	0.47
	BB001	4	0.1443	0.04639	7.402	-0.24	0.53	0.45
	WD075	4	1.326	0.9439	7.402	-6.5	9.1	1.4
	BB003	4	0.06166	0.1992	7.402	-1.6	1.7	0.61
	WD031	4	1.116	0.2919	7.402	-1.3	3.5	1.0
	WD034	4	1.064	0.2773	7.402	-1.2	3.4	1.0
Zn	WD074	4	60.24	23.21	7.402	-130	250	54
	WD080	4	74.04	52.76	7.402	-360	510	77
	BB001	4	37.71	5.894	7.402	-11	86	47
	WD075	4	111.5	18.52	7.402	-42	270	100
	BB003	4	50.00	7.709	7.402	-14	110	28
	WD031	4	96.28	22.52	7.402	-90	280	92
	WD034	4	74.81	6.998	7.402	17	130	54

[1] Shaded areas indicate UC-Davis values outside of UI prediction intervals

TABLE C.15
UI-UC COMPARISONS FOR SEPTEMBER 1998 WATER DATA
(CONTINUED)

Analyte	Station	UI Results						UC-Davis Results
		n	$\bar{x}$	s	$t_{((1-0.05)0.1/2;n-1)}$	LPB	UPB	
Zn	GW001	4	0.00[illegible]255	0.0004037	7.402	0.0029	0.010	**-0.0003**
	GW009	4	0.01711	0.001704	7.402	0.00	0.03	**-0.0014**
	SP024	4	0.04361	0.006247	7.402	-0.008	0.10	0.048
	ST022	4	0.006391	0.0003901	7.402	0.0032	0.010	**-0.0019**
	ST023	4	-0.002126	0.0004936	7.402	-0.0062	0.002	-0.0044
	ST044	4	0.004759	0.002190	7.402	-0.0134	0.0229	-0.0003
	ST048	4	0.005019	0.001660	7.402	-0.009	0.019	-0.0039
	ST049	4	0.007664	0.0006917	7.402	0.002	0.0134	**-0.0024**
	ST101	4	-0.003251	0.001721	7.402	-0.017	0.011	-0.0029
	ST201	4	0.002893	0.0006409	7.402	-0.002	0.008	**-0.0024**

[1] Shaded areas indicate UC-Davis values outside of UI prediction intervals

TABLE C.14
UI-UC COMPARISONS FOR MAY 1998 WATER DATA
(CONTINUED)

Analyte	Station	UI Results						UC-Davis Results
		n	$\bar{x}$	s	$t_{((1-0.05)0.1/2;n-1)}$	LPB	UPB	
Zn	ST044	5	-0.0003430	0.0005524	5.567	-0.0037	0.0030	**-0.024**
	GW001	4	0.002715	0.001501	7.402	-0.0097	0.015	**0.045**
	GW011	5	0.008112	0.01712	5.567	-0.10	0.11	-0.014
	ST048	5	-0.004700	0.002846	5.567	-0.022	0.013	-0.016
	ST049	5	-0.005607	0.001214	5.567	-0.013	0.0018	**-0.014**
	ST101	5	-0.004590	0.005089	5.567	-0.036	0.026	-0.024
	ST201	5	-0.006654	0.002684	5.567	-0.023	0.010	-0.015
	ST022	5	-0.0000837	0.001716	5.567	-0.011	0.010	**-0.011**
	ST001	5	0.001172	0.0009809	5.567	-0.0048	0.0072	**-0.014**
	SP024	5	0.05196	0.01605	5.567	-0.046	0.15	0.019
Ca	ST044	5	68.31	0.2691	5.567	67	70	**75**
	GW001	4	60.17	2.150	7.402	42	78	63
	GW011	5	50.19	0.4387	5.567	48	53	49
	ST048	5	50.66	2.803	5.567	34	68	51
	ST049	5	43.40	0.4027	5.567	41	46	**47**
	ST101	5	73.84	0.8667	5.567	69	79	73
	ST201	5	87.67	1.391	5.567	79	96	91
	ST022	5	60.31	1.246	5.567	53	68	64
	ST001	5	103.1	4.212	5.567	77	130	110
	SP024	5	62.42	0.4159	5.567	60	65	64
Mg	ST044	5	20.11	0.2111	5.567	19	21	20
	GW001	4	12.06	0.2859	7.402	9.7	14	11
	GW011	5	24.81	0.2469	5.567	23	26	**19**
	ST048	5	10.92	0.7518	5.567	6.3	16	9.1
	ST049	5	9.963	0.09993	5.567	9.4	11	**8.8**
	ST101	5	14.60	0.1376	5.567	14	15	**13**
	ST201	5	26.60	1.061	5.567	20	33	23
	ST022	5	13.17	0.2283	5.567	12	15	**11**
	ST001	5	32.23	1.214	5.567	25	40	29
	SP024	5	36.41	0.2639	5.567	35	38	**35**

[1]Shaded areas indicate UC-Davis values outside of UI prediction intervals

Appendix D

APPENDIX D – VALIDATED WATER, SEDIMENT AND FISH DATA

TABLE D.1 DISSOLVED OXYGEN RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Calibrated Instrument Readings [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg	Fish (Sept.), mg/kg
Wells					
PW001	FMC Office Well	5.2	2.9	not applicable	not applicable
PW002	Huntzeker Well	6.8	1.2	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	4.3	2.9	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	8.4	7.2	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	5.8	4.6	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	2.8	3.1	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	3.4	4.2	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	5.3	4.8	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	4.7	sample not reported	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	6.2	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	6.0	sample not reported	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	4.5	sample not reported	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	sample not reported	7.4	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	4.7	7.3	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	4.8	4.3	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	8.5	8.8	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	3.5	4.0	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	3.6	4.1	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	7.8	7.6	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	9.1	4.9	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	8.6	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	5.6	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	sample not reported	9.2	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	9.1	3.0	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	7.4	4.2	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	11	10	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	9.5	11.0	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	11	9.1	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	9.9	6.8	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	8.2	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	9.1	7.9	not applicable	not applicable
SP025	Gay Mine W Pit Pond	12	8.1	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	9.2	8.6	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	9.0	9.2	not applicable	not applicable

TABLE D.1 DISSOLVED OXYGEN RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Calibrated Instrument Readings [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg	Fish (Sept.), mg/kg
Streams					
ST001	Portneuf River, below Bakers Creek	8.4	9.2	not applicable	not applicable
ST004	Portneuf River, above U Creek	9.8	9.3	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	10	8.5	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	8.5	8.7	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	9.2	8.4	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	9.1	11	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	8.1	8.5	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	9.6	9.5	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	9.2	10	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	8.8	8.8	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	9.4	7.9	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	9.4	6.2	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	9.3	9.0	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	9.4	6.5	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	8.4	9.9	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	9.3	8.2	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	9.2	7.8	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	11	5.6	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	9.0	7.9	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	8.9	7.1	not applicable	not applicable
ST071	State Land Creek, below tributaries	8.9	8.4	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	7.4	8.6	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	9.7	8.9	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	9.2	10	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	8.9	9.7	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	9.6	8.1	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	9.4	8.5	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	8.6	9.8	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	10	12	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	7.7	10	not applicable	not applicable
ST132	Angus Creek, above No Name Creek[2]	8.3	10	not applicable	not applicable
ST137	No Name, above Angus Creek[2]	10	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	9.1	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	9.4	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	8.5	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	9.9	8.3	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	10	8.5	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	7.6	8.6	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	11	9.5	not applicable	not applicable

TABLE D.1
DISSOLVED OXYGEN RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg	Fish (Sept.), mg/kg
Streams, Continued					
ST161	Sheep Creek, above Lanes Creek	7.1	10	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	10	8.3	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	10	8.2	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	8.6	7.7	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	9.9	8.8	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	8.6	7.8	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	10	8.8	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	9.8	8.7	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	9.9	7.6	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	7.7	8.5	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	8.4	6.7	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	8.6	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	9.0	8.9	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	9.9	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	8.5	8.6	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	9.1	8.8	not applicable	not applicable
ST218	Formation Creek, headwaters	2.8	8.2	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	6.7	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	9.6	10	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	11	9.5	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	8.8	10	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	8.6	7.8	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	8.9	8.6	not applicable	not applicable

[1]Instruments Calibrated in the Field
[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D.2 OXYGEN REDUCING POTENTIAL (ORP) RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		**Calibrated Instrument Readings [1]**			
		Water (May), mV	**Water (Sept.), mV**	**Sediment (Sept.), mV**	**Fish (Sept.), mV**
Wells					
PW001	FMC Office Well	240	200	not applicable	not applicable
PW002	Huntzeker Well	110	110	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	230	130	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	240	150	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	240	160	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	-54	sample nor reported	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	73	sample not reported	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	79	140	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	230	sample not reported	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	260	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	78	sample not reported	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	180	sample not reported	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	sample not reported	sample not reported	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	120	sample not reported	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	260	180	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	210	200	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	40	-2	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	32	230	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	260	190	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	310	sample not reported	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	250	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	300	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	sample not reported	250	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	210	-34	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	210	280	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	230	sample not reported	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	180	54	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	230	120	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	230	210	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	210	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	240	150	not applicable	not applicable
SP025	Gay Mine W Pit Pond	190	sample not reported	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	190	sample not reported	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	210	sample not reported	not applicable	not applicable

TABLE D.2 OXYGEN REDUCING POTENTIAL (ORP) RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		**Calibrated Instrument Readings [1]**			
		Water (May), mV	**Water (Sept.), mV**	**Sediment (Sept.), mV**	**Fish (Sept.), mV**
Streams					
ST001	Portneuf River, below Bakers Creek	190	sample not reported	not applicable	not applicable
ST004	Portneuf River, above U Creek	170	sample not reported	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	190	sample not reported	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	210	sample not reported	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	270	150	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	280	sample not reported	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	270	170	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	230	140	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	260	130	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	280	140	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	310	150	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	190	sample not reported	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	200	sample not reported	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	220	100	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	190	180	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	210	72	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	31	160	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	140	160	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	280	210	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	240	160	not applicable	not applicable
ST071	State Land Creek, below tributaries	310	120	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	20	170	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	210	220	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	210	-44	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	200	-77	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	200	-51	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	210	140	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	250	140	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	270	180	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	190	130	not applicable	not applicable
ST132	Angus Creek, above No Name Creek[2]	140	160	not applicable	not applicable
ST137	No Name, above Angus Creek[2]	75	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	300	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	280	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	180	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	320	150	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	260	230	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	220	92	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	230	110	not applicable	not applicable

TABLE D.2
OXYGEN REDUCING POTENTIAL (ORP) RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]			
		Water (May), mV	**Water (Sept.), mV**	**Sediment (Sept.), mV**	**Fish (Sept.), mV**
Streams, Continued					
ST161	Sheep Creek, above Lanes Creek	240	140	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	180	110	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	170	130	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	230	190	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	210	150	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	240	170	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	100	180	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	240	140	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	290	150	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	150	210	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	220	170	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	sample not reported	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	230	sample not reported	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	220	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	220	sample not reported	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	210	sample not reported	not applicable	not applicable
ST218	Formation Creek, headwaters	310	sample not reported	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	190	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	250	sample not reported	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	230	sample not reported	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	270	sample not reported	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	190	190	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	200	190	not applicable	not applicable

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[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D.3 pH RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Calibrated Instrument Readings [1]		Field-and-Lab-QA-Adjusted Concentration [1]	
		Water (May), std. units	Water (Sept.), std. units	Sediment (Sept.), std. units	Fish (Sept.), std. units
Wells					
PW001	FMC Office Well	7.7	7.4	not applicable	not applicable
PW002	Huntzeker Well	7.5	7.6	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	7.1	7.3	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	7.1	7.4	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	7.7	10	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	7.9	7.8	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	8.1	7.8	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	7.7	pH not reported	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	7.9		not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	8.0	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	7.8		not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	7.4		not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	sample not reported	7.6	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	7.7	7.5	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	6.8	7.6	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	7.7	7.8	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	7.5	8.0	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	7.0	7.5	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	7.3	6.7	7.3	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	7.6	7.6	7.2	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	6.9	station was dry	7.2	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	6.9	station was dry	7.2	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	sample not reported	7.2	7.2	not applicable
French Drains					
FD001	Conda Mine French Drain	7.6	7.7	7.7	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	7.6	7.2	7.2	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	7.2	9.1	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	8.1	11	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	9.1	9.6	7.3	not applicable
MP032	Smoky Canyon Mine A Pit Pond	8.5	8.6	7.5	not applicable
SP011	Ballard Mine Upper Elk Pond	9.1	station was dry	7.6	not applicable
SP024	Enoch Valley Mine North Pond	9.4	8.9	7.5	not applicable
SP025	Gay Mine W Pit Pond	8.4	8.6	7.6	not applicable
SP026	Gay Mine Z Pit Pond	8.8	10	7.2	not applicable
SP027	Gay Mine JD Pit Pond	8.6	8.4	7.7	not applicable

TABLE D.3
pH RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]		Field-and-Lab-QA-Adjusted Concentration [1]	
		Water (May), std. units	Water (Sept.), std. units	Sediment (Sept.), std. units	Fish (Sept.), std. units
Streams					
ST001	Portneuf River, below Bakers Creek	8.4	8.5	7.7	not applicable
ST004	Portneuf River, above U Creek	8.6	8.6	7.6	not applicable
ST013	Ross Fork, below Danielson Creek	8.5	8.4	6.2	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	8.4	8.4	7.7	not applicable
ST019	Blackfoot River, below Ballard Creek	8.1	7.8	7.7	not applicable
ST020	Blackfoot River, below State Land Creek	8.0	8.6	8.0	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	8.6	8.4	7.6	not applicable
ST023	Blackfoot River, below Dry Valley Creek	8.2	7.8	7.9	not applicable
ST024	Blackfoot River, above Dry Valley Creek	8.3	7.7	7.9	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	8.9	8.5	7.9	not applicable
ST229	Blackfoot River, below Spring Creek	8.5	8.1	7.9	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	8.5	7.4	7.5	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	8.5	7.7	7.8	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	7.1	7.2	7.8	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	7.7	7.0	7.5	not applicable
ST044	Little Blackfoot River, below Henry Mine	8.2	8.3	7.6	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	7.9	6.1	7.4	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	7.9	7.6	7.1	not applicable
ST048	Little Blackfoot River, below Reese Creek	8.6	8.2	7.6	not applicable
ST049	Little Blackfoot River, above Reese Creek	8.5	8.1	7.5	not applicable
ST071	State Land Creek, below tributaries	7.8	8.1	6.5	not applicable
ST076	Trail Creek, above Blackfoot River	7.9	7.5	7.3	not applicable
ST078	Trail Creek, above Camp G Creek	7.9	7.7	7.7	not applicable
ST097	Slug Creek, below Goodheart Creek	8.0	7.8	6.4	not applicable
ST098	Slug Creek, above Goodheart Creek	8.2	8.5	7.4	not applicable
ST100	Slug Creek, above Dry Basin Creek	8.3	8.1	7.1	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	8.4	8.3	7.6	not applicable
ST113	Dry Valley Creek, above Blackfoot River	7.8	8.4	7.4	not applicable
ST129	Angus Creek, below Wooley Valley Mine	8.3	8.5	7.6	not applicable
ST131	Rasmussen Creek, above Angus Creek	7.7	8.1	7.1	not applicable
ST132	Angus Creek, above No Name Creek[2]	8.2	8.5	7.3	not applicable
ST137	No Name, above Angus Creek[2]	8.1	station was dry	7.4	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	8.5	ST227 sampled instead	SWST227 sampled instead	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	8.6	ST227 sampled instead	SWST227 sampled instead	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	8.6	8.0	not applicable
ST152	Diamond Creek, below Kendall Creek	8.6	8.5	7.5	not applicable
ST153	Diamond Creek, above Kendall Creek	8.5	8.3	8.0	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	7.9	8.1	8.0	not applicable
ST156	Lanes Creek, below Sheep Creek	7.2	8.6	7.8	not applicable

TABLE D.3
pH RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]		Field-and-Lab-QA-Adjusted Concentration [1]	
		Water (May), std. units	Water (Sept.), std. units	Sediment (Sept.), std. units	Fish (Sept.), std. units
Streams, Continued					
ST161	Sheep Creek, above Lanes Creek	7.7	8.8	7.8	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	8.6	8.7	7.8	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	8.6	8.8	8.0	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	8.5	8.5	7.5	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	8.1	8.6	7.5	not applicable
ST176	Roberts Creek, above tailings ponds	8.4	8.3	7.5	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	8.8	8.6	7.8	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	8.7	8.3	7.8	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	9.3	8.6	8.1	not applicable
ST187	North Fork Sage Creek, below Pole Creek	8.1	8.3	7.6	not applicable
ST188	North Fork Sage Creek, above Pole Creek	8.1	8.2	7.4	not applicable
ST193	South Fork Deer Creek	station snow-covered	8.4	7.8	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	8.4	8.5	7.8	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	7.8	station was dry	7.6	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	8.0	7.8	7.9	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	8.4	8.6	7.8	not applicable
ST218	Formation Creek, headwaters	6.6	7.4	no pH reported	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	8.0	8.0	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	9.6	11	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	9.6	9.9	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	8.5	11	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	8.6	8.6	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	8.7	8.7	not applicable	not applicable

[1]Instruments used for water pH calibrated in field for each sample, sediment pH is adjusted for lab standards.
[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D.4 SPECIFIC CONDUCTIVITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Calibrated Instrument Readings [1]			
		Water (May), uS/cm	Water (Sept.), uS/cm	Sediment (Sept.), uS/cm	Fish (Sept.), uS/cm
Wells					
PW001	FMC Office Well	350	480	not applicable	not applicable
PW002	Huntzeker Well	660	670	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	970	610	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	810	810	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	370	470	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	380	400	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	280	320	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	370	330	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	350	sample not reported	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	330	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	350	sample not reported	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	420	sample not reported	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	sample not reported	440	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	380	430	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	450	620	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	440	450	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	400	420	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	400	420	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	640	500	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	810	840	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	550	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	sample not reported	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	sample not reported	3200	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	810	840	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	800	1100	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	130	160	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	320	410	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	210	240	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	340	420	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	180	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	520	790	not applicable	not applicable
SP025	Gay Mine W Pit Pond	510	690	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	690	720	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	1000	1100	not applicable	not applicable

TABLE D.4
SPECIFIC CONDUCTIVITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]			
		Water (May), uS/cm	Water (Sept.), uS/cm	Sediment (Sept.), uS/cm	Fish (Sept.), uS/cm
Streams					
ST001	Portneuf River, below Bakers Creek	590	820	not applicable	not applicable
ST004	Portneuf River, above U Creek	730	590	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	180	290	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	850	760	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	320	340	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	320	330	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	330	340	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	320	350	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	310	340	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	320	320	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	320	350	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	1000	1100	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	620	600	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	360	670	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	550	860	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	520	770	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	460	500	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	460	510	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	280	370	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	260	330	not applicable	not applicable
ST071	State Land Creek, below tributaries	310	340	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	390	330	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	280	360	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	360	400	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	310	400	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	260	420	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	400	410	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	430	450	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	400	470	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	200	340	not applicable	not applicable
ST132	Angus Creek, above No Name Creek[2]	260	430	not applicable	not applicable
ST137	No Name, above Angus Creek[2]	130	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	400	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	400	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	350	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	320	350	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	320	370	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	5.5 (R)	350	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	3.2 (R)	330	not applicable	not applicable

TABLE D.4 SPECIFIC CONDUCTIVITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		**Calibrated Instrument Readings [1]**			
		Water (May), uS/cm	**Water (Sept.), uS/cm**	**Sediment (Sept.), uS/cm**	**Fish (Sept.), uS/cm**
Streams, Continued					
ST161	Sheep Creek, above Lanes Creek	320	350	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	320	330	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	450	330	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	410	410	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	360	390	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	710	750	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	330	350	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	430	350	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	280	350	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	520	600	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	270	420	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	330	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	380	490	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	220	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	540	600	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	280	300	not applicable	not applicable
ST218	Formation Creek, headwaters	650	930	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	400	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	260	320	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	170	170	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	180	200	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	520	570	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	510	480	not applicable	not applicable

[1]Instruments Calibrated in the Field

[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

R - rejected value during data validation process.

TABLE D.5 TEMPERATURE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Calibrated Instrument Readings [1]			
		Water (May), °C	Water (Sept.), °C	Sediment (Sept.), °C	Fish (Sept.), °C
Wells					
PW001	FMC Office Well	19	38	not applicable	not applicable
PW002	Huntzeker Well	7.5	10	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	7.0	10	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	4.9	sample not reported	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	16	10	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	12	14	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	11	13	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	14	19	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	9.3	sample not reported	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	8.4	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	8.6	sample not reported	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	10	sample not reported	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	sample not reported	8.7	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	8.2	8.6	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	8.6	9.1	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	8.3	8.4	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	7.9	12	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	12	14	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	4.9	6.7	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	9.6	12	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	5.6	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	6.5	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	sample not reported	7.6	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	8.0	11	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	13	16	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	9.4	21	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	11	22	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	9	18	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	8.5	18	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	14	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	6.8	16	not applicable	not applicable
SP025	Gay Mine W Pit Pond	15	20	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	14	19	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	11	19	not applicable	not applicable

TABLE D.5
TEMPERATURE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]			
		Water (May), °C	Water (Sept.), °C	Sediment (Sept.), °C	Fish (Sept.), °C
Streams					
ST001	Portneuf River, below Bakers Creek	13	18	not applicable	not applicable
ST004	Portneuf River, above U Creek	12	8.7	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	11	13	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	17	16	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	7.6	15	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	7.9	16	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	8.7	15	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	6.6	14	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	6.8	15	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	6.8	15	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	5.9	8.1	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	6.8	14	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	7.6	11	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	14	14	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	12	17	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	8.7	17	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	12	16	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	15	16	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	8.3	15	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	8.3	16	not applicable	not applicable
ST071	State Land Creek, below tributaries	8.2	14	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	9.8	16	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	11	16	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	6.6	9.9	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	9.0	12	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	8.8	12	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	5.9	9.3	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	9.2	15	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	10	15	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	10	12	not applicable	not applicable
ST132	Angus Creek, above No Name Creek[2]	11	15	not applicable	not applicable
ST137	No Name, above Angus Creek[2]	7.0	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	6.6	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	6.4	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	7.3	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	4.7	9.0	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	8.5	8.7	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	7.5	13	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	9.9	16	not applicable	not applicable

TABLE D.5
TEMPERATURE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]			
		Water (May), °C	Water (Sept.), °C	Sediment (Sept.), °C	Fish (Sept.), °C
Streams, Continued					
ST161	Sheep Creek, above Lanes Creek	9.2	14	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	8.4	14	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	8.2	14	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	12	13	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	5.5	7.6	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	12	14	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	7.7	12	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	4.9	8.3	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	3.8	13	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	14	11	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	19.5 (R)	17	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	9.2	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	8.5	11	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	4.4	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	10	9.6	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	7.3	8.9	not applicable	not applicable
ST218	Formation Creek, headwaters	11	12	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	12	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	12	19	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	12	18	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	13	18	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	15	20	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	12	20	not applicable	not applicable

[1]Instruments Calibrated in the Field.

[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

R - rejected value during data validation process.

TABLE D.6
TURBIDITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING

Station		Calibrated Instrument Readings [1]			
		Water (May), NTU	Water (Sept.), NTU	Sediment (Sept.), NTU	Fish (Sept.), NTU
Wells					
PW001	FMC Office Well	2.4	0.67	not applicable	not applicable
PW002	Huntzeker Well	0.38	0.95	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	0.23	0.84	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	0.60	0.86	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	sample not reported	0.87	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	9.00	0.80	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	8.9	2.7	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	0.51	0.66	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	0.75	sample not reported	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	9.5	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	78	sample not reported	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	3.8	sample not reported	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	sample not reported	sample not reported	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	3.6	0.99	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	0.42	0.92	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	3.5	2.8	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	1.2	2.2	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	2.3	0.78	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	0.76	0.78	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	0.89	8.8	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	1.2	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	1.4	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	sample not reported	21	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	2.1	2.9	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	13	6.9	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	2.9	3.8	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	3.2	1.5	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	28	2.1	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	7.2	4.0	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	2.8	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	27	25	not applicable	not applicable
SP025	Gay Mine W Pit Pond	0.77	0.88	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	3.1	1.0	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	0.14	0.91	not applicable	not applicable

TABLE D.6 TURBIDITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Calibrated Instrument Readings [1]			
		Water (May), NTU	Water (Sept.), NTU	Sediment (Sept.), NTU	Fish (Sept.), NTU
Wells					
ST001	Portneuf River, below Bakers Creek	0.76	sample not reported	not applicable	not applicable
ST004	Portneuf River, above U Creek	4.5	4.8	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	3.2	5.3	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	0.51	sample not reported	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	14	1.6	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	14	3.0	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	10	2.0	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	9.7	0.97	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	29	0.98	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	13	1.3	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	10	2.5	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	1.6	1.6	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	30	8.6	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	5.0	29	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	4.0	0.85	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	2.9	0.79	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	3.9	8.2	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	1.2	5.5	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	2.6	2.5	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	2.6	4.8	not applicable	not applicable
ST071	State Land Creek, below tributaries	2.2	8.6	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	7.4	1.8	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	2.8	2.0	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	2.1	4.5	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	2.9	4.1	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	sample not reported	5.3	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	30	6.7	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	2.8	1.7	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	11	2.9	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	13	13	not applicable	not applicable
ST132	Angus Creek, above No Name Creek[2]	6.2	7.4	not applicable	not applicable
ST137	No Name, above Angus Creek[2]	18	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	5.8	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	7.6	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	2.3	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	13	2.1	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	8.6	1.6	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	7.2	3.0	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	20	2.2	not applicable	not applicable

TABLE D.6
TURBIDITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Calibrated Instrument Readings [1]			
		Water (May), NTU	Water (Sept.), NTU	Sediment (Sept.), NTU	Fish (Sept.), NTU
Wells					
ST161	Sheep Creek, above Lanes Creek	9.5	1.9	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	6.2	1.6	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	sample not reported	1.8	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	8.6	3.5	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	5.5	11	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	2.9	0.99	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	3.0	0.99	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	2.2	sample not reported	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	1.9	1.6	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	14	16	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	16	8.5	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	1.2	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	2.8	1.2	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	0.34	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	1.2	0.78	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	1.9	0.86	not applicable	not applicable
ST218	Formation Creek, headwaters	0.19	0.80	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	0.57	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	5.5	4.8	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	4.3	8.9	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	14	10	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	3.2	6.2	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	2.6	2.6	not applicable	not applicable

[1]Instruments Calibrated in the Field.
[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D.7 SELENIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		**Field-and-Lab-QA-Adjusted Concentration** [1]			
		Water (May), mg/L	**Water (Sept.), mg/L**	**Sediment (Sept.)**	**Fish (Sept.)**
Wells		**Total**	**Total**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
PW001	FMC Office Well	*0.00088* [2]	*0.00095* [2]	not applicable	not applicable
PW002	Huntzeker Well	*0.00087*	*0.00038*	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	*-0.000018*	*0.00013*	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**0.0083** [3]	**0.0081** [3]	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**0.0054**	**0.0050**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	*0.00080*	*0.00020*	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	*0.0013*	*0.0000064*	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**0.0035**	*0.00064*	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	*0.00037*	*0.00085*	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	*0.00029*	well broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	*0.00036*	*0.0010*	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**0.033**	*0.00077*	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	*0.00095* [4]	*0.00029*	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	*0.0013*	*0.00038*	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	**0.029**	**0.027**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**0.022**	**0.024**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	*0.0014*	**0.0014**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	*0.00070*	**0.0015**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**0.036**	**0.0069**	**7.1** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**0.085**	**0.072**	**28**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**0.037**	station dry	**37**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**1.4**	station dry	**240**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**2.0** [5]	**1.3**	**100**	not applicable
French Drains					
FD001	Conda Mine French Drain	**0.24**	**0.068**	**76**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	*0.00065*	*-0.00028*	**2.9**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.0028**	*0.0011*	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**0.021**	**0.015**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**0.080**	**0.067**	**18**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**0.064**	**0.097**	**28**	not applicable
SP011	Ballard Mine Upper Elk Pond	**0.098**	station dry	**40**	not applicable
SP024	Enoch Valley Mine North Pond	**0.12**	**0.040**	**69**	not applicable
SP025	Gay Mine W Pit Pond	*0.00052*	*0.00081*	**1.2**	not applicable
SP026	Gay Mine Z Pit Pond	**0.055**	**0.062**	**17**	not applicable
SP027	Gay Mine JD Pit Pond	**0.052**	**0.059**	**5.9**	not applicable

TABLE D.7 SELENIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		**Total**	**Total**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST001	Portneuf River, below Bakers Creek	*0.00047*	*0.00058*	**2.5**	station not sampled
ST004	Portneuf River, above U Creek	*0.00045*	*0.00063*	**1.2**	station not sampled
ST013	Ross Fork, below Danielson Creek	*-0.000080*	*-0.00043*	**1.3**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*0.00030*	*0.000097*	**2.2**	station not sampled
ST019	Blackfoot River, below Ballard Creek	**0.0068**	*0.00067*	**0.87**	station not sampled
ST020	Blackfoot River, below State Land Creek	**0.0069**	*0.00091*	**1.4**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	**0.0055**	**0.0019**	**0.49**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	**0.0072**	**0.0028**	**1.2**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	**0.0050**	*0.0012*	**1.4**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	**0.0050**	**0.0020**	**1.0**	**1.2** [3]
ST229	Blackfoot River, below Spring Creek	**0.012**	*0.00046*	**0.84**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	**0.0023**	*0.00013*	**2.9**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	*0.00062*	*0.0000072*	**1.7**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	*0.00019*	*-0.000067*	**1.9**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	*0.00061*	**0.0014**	**1.3**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*0.00038*	*0.00065*	**1.6**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	*0.00036*	*0.00018*	**0.46**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*-0.000024*	*0.00025*	**0.44**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	*-0.00065*	*-0.00013*	**0.69**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	*-0.00043*	*-0.000040*	**0.77**	station not sampled
ST071	State Land Creek, below tributaries	**0.029**	*0.000067*	**9.4**	station not sampled
ST076	Trail Creek, above Blackfoot River	**0.0087**	*0.0000089*	**1.8**	station not sampled
ST078	Trail Creek, above Camp G Creek	*0.00055*	*-0.00053*	**0.63**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*0.0011*	*-0.00026*	**2.6**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*-0.000054*	*-0.00089*	**1.1**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*-0.00036*	*-0.00089*	**2.1**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	*0.00024*	*0.0012*	**0.94**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	**0.056**	*-0.00020*	**3.3**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	**0.0034**	*0.00035*	**0.47**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	**0.0018**	*0.00091*	**2.6**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	**0.0019**	*0.00057*	**1.1**	station not sampled
ST137	No Name, above Angus Creek[4]	**0.0026**	station dry	**2.1**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	**0.21**	ST227 sampled instead	no sample reported	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	**0.26**	ST227 sampled instead	no sample reported	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	**0.032**	**2.9**	**6.0**
ST152	Diamond Creek, below Kendall Creek	*0.00083*	*-0.00042*	**0.87**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*0.00084*	*-0.00051*	**0.56**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	*0.00089*	*-0.00011*	**1.0**	station not sampled
ST156	Lanes Creek, below Sheep Creek	**0.0046**	*-0.00011*	**0.22**	station not sampled

TABLE D.7
SELENIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	**Water (Sept.), mg/L**	**Sediment (Sept.)**	**Fish (Sept.)**
Streams, Continued		**Total**	**Total**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST161	Sheep Creek, above Lanes Creek	**0.0044**	*0.00035*	**0.64**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	**0.0038**	*-0.00016*	**0.46**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*-0.00027*	*-0.00013*	**0.64**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*0.0010*	*0.00016*	**1.0**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*0.00078*	*0.00018*	**2.5**	station not sampled
ST176	Roberts Creek, above tailings ponds	*0.000060*	*-0.00036*	**0.69**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	*0.000070*	*0.00022*	**4.1**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*0.00076*	*-0.00022*	**0.38**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*0.00071*	*0.00055*	**1.2**	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**0.0020**	**1.1**	**1.3**
ST187	North Fork Sage Creek, below Pole Creek	**0.041**	**0.0019**	**4.1**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	*0.00041*	*-0.00056*	**0.48**	station not sampled
ST193	South Fork Deer Creek	station snow-covered	*-0.00014*	**0.95**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	**0.0065**	*0.00032*	**2.6**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*0.00038*	station dry	**0.34**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*0.000077*	*-0.00056*	**0.22**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*-0.00042*	*-0.00068*	**0.69**	station not sampled
ST218	Formation Creek, headwaters	**0.0029**	*0.00071*	no sample reported	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**0.0018**	**0.0031**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	*0.00047*	*0.0012*	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**0.0026**	**0.0035**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**0.018**	**0.017**	not applicable	station not sampled
TP005	Smoky Canyon Mine Tailings Pond #2	**0.029**	**0.030**	not applicable	station not sampled

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.0015 mg/L for spring water, 0.0013 mg/L for fall water, 0.22 mg/kg for sediment, and 0.096 mg/kg for fish; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.0015 mg/L for spring water, 0.0013 mg/L for fall water, 0.22 mg/kg for sediment, and 0.096 mg/kg for fish; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; 95% upper confidence limit of the 95th percentile of the lab blank results is 0.0077 mg/L; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.8 CADMIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
PW001	FMC Office Well	*0.0023* [2]	*0.00059* [2]	not applicable	not applicable
PW002	Huntzeker Well	*0.0026*	*0.00040*	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	*-0.0010*	*0.00040*	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	*-0.0041*	**0.0032** [3]	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	*-0.0017*	*-0.00072*	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	*0.0024*	*0.00029*	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	*0.0017*	*0.0024*	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	*0.0021*	*0.00029*	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	*-0.0022*	*0.0013*	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	*-0.0013*	well broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	*0.00079*	*0.00040*	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	*-0.000027*	**0.0085**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	*0.0029* [5]	*-0.00016*	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	*-0.0018*	*-0.0000050*	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	*-0.0010*	*-0.000050*	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	*0.0019*	**0.0045**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	*-0.00025*	*-0.00094*	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	*0.0037*	*0.0019*	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**0.0064** [3]	*-0.0022*	**5.7** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	*-0.00057*	*-0.00016*	**7.2**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*-0.00025*	station dry	**24**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**0.029**	station dry	**130**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**0.03** [5]	**0.028**	**19**	not applicable
French Drains					
FD001	Conda Mine French Drain	**0.0059**	*0.0013*	**13**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	*0.0030*	*0.00040*	**7.6**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	*-0.0011*	*-0.00083*	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**0.0053**	*0.00096*	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*-0.0010*	*-0.0012*	**14**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	*-0.0014*	*0.0025*	**43**	not applicable
SP011	Ballard Mine Upper Elk Pond	*0.0041*	station dry	**85**	not applicable
SP024	Enoch Valley Mine North Pond	*0.0043*	*0.0014*	**36**	not applicable
SP025	Gay Mine W Pit Pond	*0.0035*	**0.0036**	**6.4**	not applicable
SP026	Gay Mine Z Pit Pond	*0.0023*	*0.0014*	**32**	not applicable
SP027	Gay Mine JD Pit Pond	*0.0052*	*0.00084*	**130**	not applicable

TABLE D.8
CADMIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST001	Portneuf River, below Bakers Creek	*0.00028*	*-0.00027*	**2.9**	station not sampled
ST004	Portneuf River, above U Creek	*0.0019*	*0.0018*	**2.4**	station not sampled
ST013	Ross Fork, below Danielson Creek	*0.0021*	*-0.00061*	**2.9**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*0.0035*	*-0.0012*	**5.7**	station not sampled
ST019	Blackfoot River, below Ballard Creek	*0.0035*	*-0.00083*	**3.4**	station not sampled
ST020	Blackfoot River, below State Land Creek	*0.0023*	*-0.0015*	**3.3**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	*-0.00086*	*0.0027*	**3.3**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	*0.0032*	*-0.00080*	**3.0**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	*0.0037*	**0.0041**	**3.7**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*-0.0029*	*0.0026*	**4.8**	*0.012* [2]
ST229	Blackfoot River, below Spring Creek	*-0.0011*	*0.001*	**2.8**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	*0.0030*	*-0.0013*	**5.7**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	*0.0040*	*0.00029*	**3.1**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	*0.0039*	*-0.0019*	**3.5**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	*0.0046*	**0.0030**	**3.1**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*0.0037*	*-0.0010*	**8.2**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	*0.0034*	*0.0022*	**4.4**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*0.0029*	*0.0015*	**4.2**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	*-0.00055*	*0.00054*	**4.1**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	*-0.00031*	*0.00068*	**4.6**	station not sampled
ST071	State Land Creek, below tributaries	*-0.0021*	**0.0035**	**10**	station not sampled
ST076	Trail Creek, above Blackfoot River	*-0.00079*	**0.0045**	**3.7**	station not sampled
ST078	Trail Creek, above Camp G Creek	*0.0030*	*-0.0027*	**4.1**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*0.0011*	*0.00029*	**4.5**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*0.000082*	*-0.0019*	**7.8**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*-0.0012*	*0.00040*	**9.1**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	*-0.0034*	*0.00052*	**6.8**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	*0.0047*	*-0.00038*	**7.4**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	*-0.00057*	*0.0018*	**4.5**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	*0.0028*	*0.00017*	**6.4**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	*0.0023*	*0.00029*	**5.8**	station not sampled
ST137	No Name, above Angus Creek[4]	*0.0020*	station dry	**11**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	*0.00030*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	*-0.00014*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	*0.00084*	**9.3**	*0.040*
ST152	Diamond Creek, below Kendall Creek	*-0.000027*	*-0.00072*	**4.3**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*0.0014*	*0.0012*	**3.6**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	*-0.000027*	*-0.0027*	**2.4**	station not sampled
ST156	Lanes Creek, below Sheep Creek	*0.0022*	*-0.0035*	**1.9**	station not sampled

TABLE D.8
CADMIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	**Water (Sept.), mg/L**	**Sediment (Sept.)**	**Fish (Sept.)**
Streams, Continued		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST161	Sheep Creek, above Lanes Creek	*0.0020*	*-0.0031*	**2.6**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	*-0.0010*	*-0.00061*	**2.9**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*0.00041*	*-0.0022*	**2.8**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*-0.0016*	*0.0016*	**8.0**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*-0.0021*	*-0.00027*	**4.1**	station not sampled
ST176	Roberts Creek, above tailings ponds	*0.0032*	*0.00084*	**7.3**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	*0.00074*	*0.0012*	**6.2**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*-0.00090*	*0.00084*	**4.0**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*-0.000033*	*0.000062*	**5.4**	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	*0.0010*	**4.0**	*0.025*
ST187	North Fork Sage Creek, below Pole Creek	*0.0023*	*0.0016*	**4.8**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	*0.000082*	*0.0029*	**3.8**	station not sampled
ST193	South Fork Deer Creek	station was dry	*-0.00016*	**5.6**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*0.00063*	*-0.00061*	**8.1**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*-0.0017*	station dry	**4.1**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*-0.00012*	*-0.000050*	**2.5**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*-0.0020*	*0.00045*	**1.8**	station not sampled
ST218	Formation Creek, headwaters	*0.0032*	*0.0016*	sample not reported	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	*0.00019*	*0.0014*	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	*0.0010*	*0.0012*	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	*0.0025*	*0.0016*	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	*0.0016*	*0.0024*	not applicable	station not sampled
TP005	Smoky Canyon Mine Tailings Pond #2	*0.0046*	**0.0083**	not applicable	station not sampled

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.0053 mg/L for spring water, 0.0030 mg/L for fall water, 0.31 mg/kg for sediment, and 0.063 mg/kg for fish; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.0053 mg/L for spring water, 0.0030 mg/L for fall water, 0.31 mg/kg for sediment, and 0.063 mg/kg for fish; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.9 MANGANESE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
PW001	FMC Office Well	*0.0024* [2]	*0.0026* [2]	not applicable	not applicable
PW002	Huntzeker Well	*0.0061*	*0.0032*	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	*-0.00042*	*0.0068*	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	*0.00035*	*0.0031*	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	*0.0043*	*0.012*	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**0.30** [3]	**0.21** [3]	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**0.23**	**0.30**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	*0.0044*	*0.0026*	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	*0.0023*	*0.0049*	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	*0.0047*	well broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**0.072**	**0.035**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	*0.020*	*0.011*	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**0.10** [5]	**0.021**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**0.035**	*0.0050*	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	*-0.00020*	*0.0030*	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	*0.0086*	*0.0030*	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**0.044**	**0.034**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**0.18**	**0.12**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**0.51**	*0.0082*	**740** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	*0.0056*	**0.078**	**440**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*0.00057*	station dry	**230**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**0.23**	station dry	**5,800**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	*0.0081* [5]	**0.027**	**72**	not applicable
French Drains					
FD001	Conda Mine French Drain	**0.056**	**0.067**	**6,000**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**1.3**	**1.5**	**700**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.046**	*0.011*	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	*0.023*	**0.024**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*0.013*	*0.0031*	**740**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	*0.018*	*0.0094*	**540**	not applicable
SP011	Ballard Mine Upper Elk Pond	*0.0052*	station dry	**230**	not applicable
SP024	Enoch Valley Mine North Pond	*0.018*	**0.11**	**420**	not applicable
SP025	Gay Mine W Pit Pond	**0.11**	**0.091**	**690**	not applicable
SP026	Gay Mine Z Pit Pond	*0.0070*	*0.0077*	**290**	not applicable
SP027	Gay Mine JD Pit Pond	*0.011*	**0.017**	**80**	not applicable

TABLE D.9 MANGANESE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST001	Portneuf River, below Bakers Creek	**0.047**	**0.021**	**500**	station not sampled
ST004	Portneuf River, above U Creek	*0.026*	**0.026**	**310**	station not sampled
ST013	Ross Fork, below Danielson Creek	**0.034**	**0.020**	**280**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*0.0067*	*0.0031*	**590**	station not sampled
ST019	Blackfoot River, below Ballard Creek	**0.044**	**0.025**	**440**	station not sampled
ST020	Blackfoot River, below State Land Creek	**0.062**	**0.023**	**1,000**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	**0.061**	**0.12**	**490**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	**0.038**	**0.0048**	**320**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	**0.045**	*0.012*	**330**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*0.013*	*0.0053*	**590**	*0.13* [2]
ST229	Blackfoot River, below Spring Creek	**0.036**	**0.019**	**380**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	*0.0073*	**0.022**	**450**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	**0.039**	**0.050**	**1,700**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**0.076**	**0.17**	**210**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	*0.013*	*0.0020*	**120**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*0.028*	*0.0075*	**460**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	**0.036**	**0.019**	**360**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*0.0068*	*-0.0041*	**230**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	**0.038**	**0.032**	**490**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	**0.058**	**0.082**	**2,000**	station not sampled
ST071	State Land Creek, below tributaries	*0.029*	**0.044**	**420**	station not sampled
ST076	Trail Creek, above Blackfoot River	**0.052**	**0.13**	**160**	station not sampled
ST078	Trail Creek, above Camp G Creek	**0.037**	**0.035**	**600**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*0.017*	**0.32**	**130**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*-0.00075*	**0.038**	**1,800**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*0.0055*	**0.33**	**1,200**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	**0.088**	**0.078**	**1,500**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	**0.072**	**0.087**	**520**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	**0.22**	**0.21**	**1,400**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	**0.036**	**0.50**	**810**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	**0.066**	**0.10**	**1,800**	station not sampled
ST137	No Name, above Angus Creek[4]	**0.042**	station dry	**1,500**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	**0.040**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	**0.050**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	**0.064**	**2,000**	*0.27*
ST152	Diamond Creek, below Kendall Creek	*0.014*	*0.0015*	**220**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*0.0014*	*0.0093*	**1,500**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	**0.034**	**0.021**	**310**	station not sampled
ST156	Lanes Creek, below Sheep Creek	**0.036**	*0.012*	**320**	station not sampled

TABLE D.9
MANGANESE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST161	Sheep Creek, above Lanes Creek	*0.027*	*0.00097*	**490**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	*0.011*	*0.0064*	**510**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*0.019*	*0.0039*	**600**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*0.010*	**0.074**	**1,900**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*0.024*	**0.074**	**3,000**	station not sampled
ST176	Roberts Creek, above tailings ponds	**0.034**	**0.023**	**3,800**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	**0.032**	**0.026**	**1,000**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*0.019*	*0.0074*	**2,200**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*0.018*	*0.0038*	**2,800**	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	*0.0051*	**1,500**	*0.52*
ST187	North Fork Sage Creek, below Pole Creek	**0.42**	**0.53**	**6,500**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	**0.18**	**0.14**	**1,000**	station not sampled
ST193	South Fork Deer Creek	station was dry	**0.018**	**1,700**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*0.0064*	*0.0061*	**190**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*0.0023*	station dry	**3,800**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*-0.00059*	*0.0020*	**160**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*-0.00053*	*0.0014*	**49**	station not sampled
ST218	Formation Creek, headwaters	*0.00057*	*0.0074*	no sample reported	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	*0.0080*	*0.0017*	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**0.037**	**0.032**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**0.077**	**0.027**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**0.043**	**0.047**	not applicable	station not sampled
TP005	Smoky Canyon Mine Tailings Pond #2	*0.015*	**0.026**	not applicable	station not sampled

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.031 mg/L for spring water, 0.014 mg/L for fall water, 4.8 mg/kg for sediment, and 0.96 mg/kg for fish; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.031 mg/L for spring water, 0.014 mg/L for fall water, 4.8 mg/kg for sediment, and 0.96 mg/kg for fish; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.10 NICKEL RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
PW001	FMC Office Well	*-0.0064* [2]	*0.0029* [2]	not applicable	not applicable
PW002	Huntzeker Well	*-0.0033*	*0.0071*	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	*0.012*	*0.011*	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	*0.0052*	*0.014*	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	*-0.0034*	*-0.0017*	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	*0.012*	*0.013*	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	*0.0087*	*0.0058*	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	*0.010*	*0.0030*	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	*-0.0010*	*0.0074*	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	*-0.00034*	well broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	*0.0058*	*0.00016*	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	*0.0068*	*0.00089*	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	*0.012* [5]	*0.0084*	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	*0.0014*	*0.0060*	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	*0.010*	*0.0071*	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**0.021** [3]	*0.016*	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	*-0.0073*	*-0.0012*	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**0.18**	**0.13** [3]	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	*0.015*	*0.011*	**50** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	*0.0072*	*0.015*	**36**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*0.0030*	station dry	**75**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**0.28**	station dry	**630**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**0.46** [5]	**0.48**	**170**	not applicable
French Drains					
FD001	Conda Mine French Drain	**0.048**	**0.030**	**240**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**0.039**	**0.022**	**58**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	*0.010*	*0.010*	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	*0.017*	**0.029**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*-0.0013*	*0.0046*	**77**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**0.018**	**0.030**	**290**	not applicable
SP011	Ballard Mine Upper Elk Pond	**0.022**	station dry	**330**	not applicable
SP024	Enoch Valley Mine North Pond	**0.021**	**0.027**	**320**	not applicable
SP025	Gay Mine W Pit Pond	*0.016*	*0.014*	**40**	not applicable
SP026	Gay Mine Z Pit Pond	**0.030**	*0.019*	**170**	not applicable
SP027	Gay Mine JD Pit Pond	*0.013*	*0.013*	**61**	not applicable

TABLE D.10
NICKEL RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST001	Portneuf River, below Bakers Creek	*0.0091*	*0.0031*	**12**	station not sampled
ST004	Portneuf River, above U Creek	*0.014*	*0.015*	**17**	station not sampled
ST013	Ross Fork, below Danielson Creek	*-0.00051*	*-0.0012*	**19**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*0.0011*	*0.0031*	**40**	station not sampled
ST019	Blackfoot River, below Ballard Creek	*0.016*	*0.0037*	**26**	station not sampled
ST020	Blackfoot River, below State Land Creek	**0.019**	*0.0021*	**54**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	*-0.0023*	*0.011*	**20**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	*-0.0016*	*0.014*	**36**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	*-0.0069*	*0.015*	**43**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*-0.0019*	*0.0092*	**58**	*-0.049* [2]
ST229	Blackfoot River, below Spring Creek	*-0.0061*	*0.016*	**43**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	*0.0057*	*0.0033*	**35**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	*0.0037*	*-0.0012*	**22**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	*0.0047*	*0.017*	**19**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	*0.010*	*0.016*	**49**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*0.0057*	*0.0052*	**47**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	*0.012*	*0.011*	**22**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*-0.0089*	*0.013*	**25**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	*0.00057*	*0.0063*	**69**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	*-0.0026*	*0.0020*	**43**	station not sampled
ST071	State Land Creek, below tributaries	*0.0029*	**0.030**	**61**	station not sampled
ST076	Trail Creek, above Blackfoot River	*0.00085*	**0.029**	**41**	station not sampled
ST078	Trail Creek, above Camp G Creek	**0.026**	*0.0044*	**43**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*0.010*	*0.0040*	**97**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*0.012*	*0.0020*	**46**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*0.0046*	*0.0074*	**43**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	*0.0037*	*0.011*	**55**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	**0.030**	*0.0037*	**52**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	*0.00096*	*0.0031*	**41**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	*-0.0039*	*0.0033*	**43**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	*-0.0062*	*0.0046*	**41**	station not sampled
ST137	No Name, above Angus Creek[4]	*-0.0071*	station dry	**57**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	*-0.0020*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	*-0.0027*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	*0.012*	**57**	*-0.025*
ST152	Diamond Creek, below Kendall Creek	*-0.0055*	*0.016*	**32**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*0.0014*	*0.011*	**32**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	*0.013*	*-0.0076*	**23**	station not sampled
ST156	Lanes Creek, below Sheep Creek	*0.015*	*-0.013*	**26**	station not sampled

TABLE D.10
NICKEL RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST152	Diamond Creek, below Kendall Creek	*-0.0055*	*0.016*	**32**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*0.0014*	*0.011*	**32**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	*0.013*	*-0.0076*	**23**	station not sampled
ST156	Lanes Creek, below Sheep Creek	*0.015*	*-0.013*	**26**	station not sampled
ST161	Sheep Creek, above Lanes Creek	*0.015*	*-0.017*	**30**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	*0.011*	*-0.011*	**24**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*0.0055*	*-0.010*	**28**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*-0.00089*	*0.014*	**46**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*-0.000016*	*0.0075*	**48**	station not sampled
ST176	Roberts Creek, above tailings ponds	*-0.0027*	*0.0033*	**59**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	*-0.0036*	*0.0059*	**40**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*-0.0031*	*0.0091*	**35**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*-0.00051*	*0.0083*	**37**	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	*0.0075*	**44**	*-0.19*
ST187	North Fork Sage Creek, below Pole Creek	*0.0026*	*-0.00029*	**34**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	*-0.0036*	*0.00016*	**32**	station not sampled
ST193	South Fork Deer Creek	station was dry	*-0.0017*	**64**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*0.0085*	*-0.0024*	**24**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*0.0042*	station dry	**33**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*0.0063*	*0.0047*	**40**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*-0.0031*	*0.0016*	**19**	station not sampled
ST218	Formation Creek, headwaters	**0.030**	*0.015*	sample not reported	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	*0.012*	*0.011*	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	*0.0036*	*0.019*	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	*0.011*	*0.016*	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	*0.0059*	*0.013*	not applicable	station not sampled
TP005	Smoky Canyon Mine Tailings Pond #2	*0.016*	**0.031**	not applicable	station not sampled

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.017mg/L for spring water, 0.021 mg/L for fall water, 2.3 mg/kg for sediment, and 0.045 mg/kg for fish; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.017 mg/L for spring water, 0.021 mg/L for fall water, 2.3 mg/kg for sediment, and 0.045 mg/kg for fish; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.11 VALIDATED VANADIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		**Field-and-Lab-QA-Adjusted Concentration [1]**			
		Water (May), mg/L	**Water (Sept.), mg/L**	**Sediment (Sept.)**	**Fish (Sept.)**
Wells		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
PW001	FMC Office Well	*-0.0037* [2]	*0.0060* [2]	not applicable	not applicable
PW002	Huntzeker Well	*0.00081*	*0.016*	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	*-0.0056*	*0.024*	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	*0.000069*	*0.019*	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	*-0.0045*	*-0.0039*	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	*0.0067*	*0.012*	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	*0.0019*	*0.0041*	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	*0.0058*	*0.014*	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	*-0.0064*	*0.0073*	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	*-0.0023*	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	*-0.0015*	*0.00069*	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	*-0.0088*	*0.0074*	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	*0.013* [5]	*0.0064*	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	*-0.011*	*0.0066*	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	*0.025*	*-0.0028*	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	*0.014*	*0.014*	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	*-0.0038*	*-0.0052*	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	*-0.0054*	*0.0078*	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	*0.0080*	*0.0097*	**55** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	*0.016*	*0.011*	**69**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*0.0076*	station was dry	**150**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**0.060** [3]	station was dry	**780**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**0.049** [5]	**0.062** [3]	**170**	not applicable
French Drains					
FD001	Conda Mine French Drain	*0.025*	*0.016*	**120**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	*0.0092*	*0.0075*	**62**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.038**	*0.022*	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**0.035**	*0.039*	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*0.0026*	*0.0043*	**140**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**0.047**	**0.076**	**730**	not applicable
SP011	Ballard Mine Upper Elk Pond	**0.034**	station was dry	**1000**	not applicable
SP024	Enoch Valley Mine North Pond	**0.032**	**0.094**	**440**	not applicable
SP025	Gay Mine W Pit Pond	*-0.010*	*0.012*	**77**	not applicable
SP026	Gay Mine Z Pit Pond	*0.012*	*0.020*	**490**	not applicable
SP027	Gay Mine JD Pit Pond	*0.0067*	*0.039*	**160**	not applicable

TABLE D.11 VANADIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		**Field-and-Lab-QA-Adjusted Concentration [1]**			
		Water (May), mg/L	**Water (Sept.), mg/L**	**Sediment (Sept.)**	**Fish (Sept.)**
Streams		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST001	Portneuf River, below Bakers Creek	*0.0068*	*0.010*	**26**	station not sampled
ST004	Portneuf River, above U Creek	*-0.0018*	*0.011*	**35**	station not sampled
ST013	Ross Fork, below Danielson Creek	*-0.020*	*0.0066*	**32**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*-0.012*	*0.011*	**71**	station not sampled
ST019	Blackfoot River, below Ballard Creek	*0.0040*	*0.012*	**34**	station not sampled
ST020	Blackfoot River, below State Land Creek	*0.012*	*0.0013*	**35**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	*-0.0019*	*0.025*	**32**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	*-0.0066*	*0.021*	**30**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	*-0.00046*	*0.015*	**35**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*-0.0014*	*0.011*	**46**	*-0.23* [2]
ST229	Blackfoot River, below Spring Creek	*0.0043*	*0.017*	**34**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	*-0.014*	*0.0074*	**70**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	*-0.019*	*0.013*	**45**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	*0.020*	*0.021*	**30**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	**0.027**	*0.014*	**39**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*0.019*	*0.0064*	**95**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	**0.028**	*0.011*	**47**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*-0.0033*	*0.010*	**50**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	*-0.0021*	*0.0060*	**39**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	*-0.0018*	*0.0012*	**56**	station not sampled
ST071	State Land Creek, below tributaries	*-0.0086*	*0.024*	**70**	station not sampled
ST076	Trail Creek, above Blackfoot River	*-0.011*	*0.023*	**50**	station not sampled
ST078	Trail Creek, above Camp G Creek	*0.015*	*-0.00043*	**61**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*-0.013*	*0.0022*	**40**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*-0.012*	*0.0011*	**60**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*-0.0090*	*0.0056*	**55**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	*0.0016*	*0.015*	**47**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	*-0.0015*	*0.0068*	**60**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	*-0.00067*	*0.017*	**80**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	*-0.0036*	*0.017*	**71**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	*-0.0025*	*0.019*	**61**	station not sampled
ST137	No Name, above Angus Creek[4]	*0.0020*	station was dry	**62**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	*-0.0041*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	*0.0020*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	*0.015*	**85**	*-0.25*
ST152	Diamond Creek, below Kendall Creek	*0.0012*	**0.18**	**45**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*0.0024*	*0.012*	**59**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	*-0.0035*	*-0.032*	**24**	station not sampled
ST156	Lanes Creek, below Sheep Creek	*0.0023*	*-0.034*	**27**	station not sampled

TABLE D.11
VANADIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	**Water (Sept.), mg/L**	**Sediment (Sept.)**	**Fish (Sept.)**
Streams, Continued		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST161	Sheep Creek, above Lanes Creek	*0.0054*	*-0.031*	**34**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	*-0.012*	*-0.029*	**38**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*-0.012*	*-0.028*	**43**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*0.00070*	*0.020*	**84**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*0.0088*	*0.0044*	**54**	station not sampled
ST176	Roberts Creek, above tailings ponds	*-0.015*	*-0.00043*	**64**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	*-0.025*	*0.015*	**70**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*0.0073*	*0.0075*	**39**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*0.00033*	*0.0089*	**53**	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	*0.013*	**48**	*-0.058*
ST187	North Fork Sage Creek, below Pole Creek	*-0.022*	*0.0035*	**59**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	*-0.0053*	*0.0054*	**43**	station not sampled
ST193	South Fork Deer Creek	station was snow-covered	*0.0057*	**59**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*0.00039*	*0.0060*	**69**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*0.012*	station was dry	**45**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*-0.0053*	*0.015*	**32**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*-0.011*	*0.015*	**16**	station not sampled
ST218	Formation Creek, headwaters	*0.020*	*0.010*	sample not reported	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**0.10**	**0.18**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	*0.025*	**0.063**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**0.051**	**0.11**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**0.081**	**0.084**	not applicable	station not sampled
TP005	Smoky Canyon Mine Tailings Pond #2	**0.091**	**0.15**	not applicable	station not sampled

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.027 mg/L for spring water, 0.040 mg/L for fall water, 3.0 mg/kg for sediment, and 0.27 mg/kg for fish; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.027 mg/L for spring water, 0.040 mg/L for fall water, 3.0 mg/kg for sediment, and 0.27 mg/kg for fish; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.12
ZINC RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
PW001	FMC Office Well	*0.0059* [2]	*0.0049* [2]	not applicable	not applicable
PW002	Huntzeker Well	**0.040** [3]	**0.042** [3]	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**0.12**	**0.10**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**0.20**	**0.14**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**1.1**	**1.3**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**0.15**	**0.079**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**0.11**	**0.10**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**0.34**	**0.26**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**0.019**	**0.13**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**0.012**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**0.035**	**0.13**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**0.025**	**0.019**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**0.66** [5]	**0.30**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**0.16**	**0.12**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	*-0.0015*	**0.052**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**0.087**	**0.10**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**0.058**	**0.084**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**1.1**	**0.78**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**0.056**	*0.010*	**160** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	*0.0081*	*-0.0013*	**140**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*0.0042*	station was dry	**290**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**1.1**	station was dry	**2100**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**1.5** [5]	**1.4**	**690**	not applicable
French Drains					
FD001	Conda Mine French Drain	**0.23**	**0.058**	**930**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	*0.0096*	*0.0023*	**220**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.015**	*0.0075*	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**0.020**	**0.074**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*-0.00042*	*0.0031*	**250**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**0.070**	**0.030**	**1300**	not applicable
SP011	Ballard Mine Upper Elk Pond	*0.0097*	station was dry	**1800**	not applicable
SP024	Enoch Valley Mine North Pond	**0.059**	**0.047**	**1400**	not applicable
SP025	Gay Mine W Pit Pond	*0.0036*	*0.0041*	**130**	not applicable
SP026	Gay Mine Z Pit Pond	**0.020**	*0.0068*	**830**	not applicable
SP027	Gay Mine JD Pit Pond	**0.012**	*0.0052*	**600**	not applicable

TABLE D.12
ZINC RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST001	Portneuf River, below Bakers Creek	*0.0043*	*0.0031*	**35**	station not sampled
ST004	Portneuf River, above U Creek	*0.0053*	*0.0082*	**55**	station not sampled
ST013	Ross Fork, below Danielson Creek	*0.0061*	*0.0018*	**54**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*0.0019*	*0.00050*	**150**	station not sampled
ST019	Blackfoot River, below Ballard Creek	*0.0072*	*0.0015*	**33**	station not sampled
ST020	Blackfoot River, below State Land Creek	*0.0062*	*0.00083*	**42**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	*0.0029*	*0.0051*	**42**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	*0.0064*	*-0.0044*	**31**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	*0.00066*	*0.0058*	**27**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*0.0015*	*0.0060*	**33**	**7.0** [3]
ST229	Blackfoot River, below Spring Creek	*0.0011*	*0.0013*	**35**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	*0.0055*	*0.0041*	**130**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	*0.0084*	*0.0069*	**67**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	*0.0066*	*-0.0019*	**40**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	*0.0017*	*0.0085*	**91**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*0.0026*	*0.0032*	**120**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	*0.00023*	*0.0047*	**68**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*0.0048*	*0.0046*	**67**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	*-0.0021*	*0.0035*	**80**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	*-0.0031*	*0.0065*	**85**	station not sampled
ST071	State Land Creek, below tributaries	*0.0012*	*-0.00016*	**270**	station not sampled
ST076	Trail Creek, above Blackfoot River	*-0.0023*	*-0.0055*	**65**	station not sampled
ST078	Trail Creek, above Camp G Creek	**0.065**	*0.0020*	**68**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*-0.0017*	*0.0047*	**39**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*-0.0090*	*0.0033*	**150**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*-0.0078*	*0.0046*	**140**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	*-0.0020*	*-0.0057*	**130**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	**0.13**	*0.0050*	**260**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	*0.00012*	*0.0056*	**96**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	*0.0096*	*0.012*	**180**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	*0.0083*	*0.0070*	**99**	station not sampled
ST137	No Name, above Angus Creek[4]	**0.017**	station was dry	**210**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	*0.0020*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	*0.0028*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	*0.010*	**180**	**11**
ST152	Diamond Creek, below Kendall Creek	*-0.00063*	*0.00083*	**67**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*-0.0049*	*0.0016*	**52**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	*0.0067*	*-0.0029*	**22**	station not sampled
ST156	Lanes Creek, below Sheep Creek	*0.0054*	*-0.0052*	**23**	station not sampled

TABLE D.12
ZINC RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST162	Sheep Creek, below West Fork Sheep Creek	*-0.0060*	*-0.0063*	**45**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*-0.0059*	*-0.0068*	**44**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*-0.0024*	*0.0038*	**130**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*-0.0043*	*0.0066*	**120**	station not sampled
ST176	Roberts Creek, above tailings ponds	*0.0071*	*0.00083*	**120**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	**0.015**	*0.0070*	**190**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*-0.0056*	*0.0034*	**58**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*-0.0019*	*0.0034*	**95**	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	*0.0041*	**70**	**11**
ST187	North Fork Sage Creek, below Pole Creek	*0.0098*	*0.0037*	**88**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	*0.0042*	*0.0049*	**47**	station not sampled
ST193	South Fork Deer Creek	station was dry	*0.0019*	**140**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*-0.0051*	*0.0046*	**100**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*0.0020*	station was dry	**62**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*-0.0042*	*0.0012*	**20**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*-0.0038*	*0.0011*	**38**	station not sampled
ST218	Formation Creek, headwaters	**0.012**	*0.0023*	sample not reported	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**0.014**	**0.016**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	*0.0083*	*0.013*	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**0.019**	*0.0091*	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**0.014**	*0.0096*	not applicable	station not sampled
TP005	Smoky Canyon Mine Tailings Pond #2	**0.030**	**0.055**	not applicable	station not sampled

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 0.010mg/L for spring water, 0.015 mg/L for fall water, 8.1 mg/kg for sediment, and 0.14 mg/kg for fish; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 0.010 mg/L for spring water, 0.015 mg/L for fall water, 8.1 mg/kg for sediment, and 0.14 mg/kg for fish; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.
[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.
[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.13 CALCIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Spring), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
PW001	FMC Office Well	**55** [3]	**54**	not applicable	not applicable
PW002	Huntzeker Well	**110**	**96**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**140**	**86**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**120**	**100**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**65**	**81**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**47**	**46**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**31**	**34**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**53**	**45**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**48**	**45**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**47**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**64**	**49**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**59**	**46**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**64** [5]	**69**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**72**	**77**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	**110**	**110**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**68**	**69**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**73**	**63**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**59**	**58**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**110**	**84**	**10,000**	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**170**	**140**	**16,000**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**85**	station was dry	**40,000**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**430**	station was dry	**130,000**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**620** [5]	**550**	**150,000**	not applicable
French Drains					
FD001	Conda Mine French Drain	**200**	**200**	**63,000**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**130**	**110**	**12,000**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**17**	**21**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**50**	**45**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**28**	**32**	**23,000**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**51**	**59**	**66,000**	not applicable
SP011	Ballard Mine Upper Elk Pond	**28**	station was dry	**65,000**	not applicable
SP024	Enoch Valley Mine North Pond	**60**	**110**	**39,000**	not applicable
SP025	Gay Mine W Pit Pond	**49**	**52**	**26,000**	not applicable
SP026	Gay Mine Z Pit Pond	**67**	**55**	**78,000**	not applicable
SP027	Gay Mine JD Pit Pond	**110**	**94**	**270,000**	not applicable

TABLE D.13
CALCIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Spring), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST001	Portneuf River, below Bakers Creek	110	91	140,000	station not sampled
ST004	Portneuf River, above U Creek	90	83	23,000	station not sampled
ST013	Ross Fork, below Danielson Creek	24	40	5,400	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	120	130	62,000	station not sampled
ST019	Blackfoot River, below Ballard Creek	52	50	36,000	station not sampled
ST020	Blackfoot River, below State Land Creek	53	49	39,000	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	59	51	53,000	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	53	49	54,000	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	51	51	60,000	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	55	49	110,000	station not sampled
ST229	Blackfoot River, below Spring Creek	55	54	30,000	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	120	100	25,000	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	110	100	120,000	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	65	80	160,000	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	73	120	64,000	station not sampled
ST044	Little Blackfoot River, below Henry Mine	66	63	107,000	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	65	66	23,000	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	67	61	9,100	station not sampled
ST048	Little Blackfoot River, below Reese Creek	50	59	59,000	station not sampled
ST049	Little Blackfoot River, above Reese Creek	41	48	35,000	station not sampled
ST071	State Land Creek, below tributaries	44	55	16,000	station not sampled
ST076	Trail Creek, above Blackfoot River	66	51	21,000	station not sampled
ST078	Trail Creek, above Camp G Creek	61	59	24,000	station not sampled
ST097	Slug Creek, below Goodheart Creek	58	66	33,000	station not sampled
ST098	Slug Creek, above Goodheart Creek	48	60	14,000	station not sampled
ST100	Slug Creek, above Dry Basin Creek	39	64	16,000	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	72	64	38,000	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	69	69	22,000	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	64	76	14,000	station not sampled
ST131	Rasmussen Creek, above Angus Creek	28	57	10,000	station not sampled
ST132	Angus Creek, above No Name Creek[4]	41	73	16,000	station not sampled
ST137	No Name, above Angus Creek[4]	18	station was dry	17,000	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	67	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	69	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	55	18,000	station not sampled
ST152	Diamond Creek, below Kendall Creek	54	57	12,000	station not sampled
ST153	Diamond Creek, above Kendall Creek	51	57	29,000	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	52	53	41,000	station not sampled
ST156	Lanes Creek, below Sheep Creek	51	49	53,000	station not sampled

TABLE D.13
CALCIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Spring), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST161	Sheep Creek, above Lanes Creek	**51**	**54**	**21,000**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	**51**	**51**	**24,000**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	**45**	**51**	**35,000**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	**62**	**59**	**32,000**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	**57**	**58**	**15,000**	station not sampled
ST176	Roberts Creek, above tailings ponds	**85**	**81**	**33,000**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	**58**	**56**	**38,000**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	**54**	**54**	**60,000**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**41**	**51**	**26,000**	station not sampled
ST187	North Fork Sage Creek, below Pole Creek	**100**	**130**	**32,000**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	**44**	**63**	**26,000**	station not sampled
ST193	South Fork Deer Creek	station was snow-covered	**58**	**18,000**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	**61**	**75**	**130,000**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	**72**	station was dry	**24,000**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	**84**	**86**	**46,000**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	**51**	**45**	**160,000**	station not sampled
ST218	Formation Creek, headwaters	**150**	**150**	sample not reported	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**52**	**47,000**	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**34**	**41**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**21**	**15**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**26**	**28**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**80**	**82**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**73**	**53**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 10 mg/L for spring water, 0.85 mg/L for fall water, and 90.8 mg/kg for sediment; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 10 mg/L for spring water, 0.85 mg/L for fall water, and 5100 mg/kg for sediment; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.14 IRON RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (May), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
PW001	FMC Office Well	*0.017* [2]	*-0.0015* [2]	not applicable	not applicable
PW002	Huntzeker Well	*0.067*	**0.070** [3]	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	*-0.021*	*0.036*	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	*-0.066*	*0.038*	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	*-0.0066*	*0.050*	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	*0.036*	**0.11**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	*0.18*	**0.35**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	*0.015*	*0.020*	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	*-0.0013*	**0.26**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	*-0.0036*	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	*0.15*	**3.1**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	*-0.022*	**0.099**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**0.98** [3,4]	**0.23**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	*0.049*	**0.066**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	*-0.039*	*0.023*	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	*-0.096*	*-0.0063*	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	*0.039*	**0.23**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	*0.024*	**0.10**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	*0.012*	*-0.0089*	**22000** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	*-0.10*	*-0.0027*	**20000**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*-0.11*	station was dry	**15000**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	*-0.18*	station was dry	**16000**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	no samples reported	**0.12**	**12000**	not applicable
French Drains					
FD001	Conda Mine French Drain	*-0.034*	*-0.027*	**18000**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	*0.43*	*-0.046*	**18000**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.51**	**0.37**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	*0.036*	*0.047*	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*-0.019*	*0.028*	**22000**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	*-0.080*	*0.051*	**18000**	not applicable
SP011	Ballard Mine Upper Elk Pond	*0.040*	station was dry	**23000**	not applicable
SP024	Enoch Valley Mine North Pond	*0.14*	**0.14**	**25000**	not applicable
SP025	Gay Mine W Pit Pond	*0.0084*	*-0.033*	**16000**	not applicable
SP026	Gay Mine Z Pit Pond	*-0.0047*	*-0.043*	**11000**	not applicable
SP027	Gay Mine JD Pit Pond	*-0.049*	*-0.065*	**6800**	not applicable

TABLE D.14 IRON RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (May), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST001	Portneuf River, below Bakers Creek	*-0.052*	*-0.041*	**6700**	station not sampled
ST004	Portneuf River, above U Creek	*0.077*	**0.097**	**11000**	station not sampled
ST013	Ross Fork, below Danielson Creek	*0.30*	**0.16**	**13000**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*-0.019*	*-0.037*	**28000**	station not sampled
ST019	Blackfoot River, below Ballard Creek	*0.30*	*0.035*	**7000**	station not sampled
ST020	Blackfoot River, below State Land Creek	*0.37*	*0.037*	**8100**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	*0.09*	*-0.0087*	**8700**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	*0.18*	*-0.026*	**6400**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	*0.22*	*0.0088*	**5400**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*-0.0040*	*-0.022*	**6200**	station not sampled
ST229	Blackfoot River, below Spring Creek	*0.18*	*0.042*	**8900**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	*0.020*	*-0.055*	**17000**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	*0.15*	**0.15**	**13000**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	*0.26*	**0.12**	**9400**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	*0.060*	*-0.084*	**11000**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*0.082*	*-0.032*	**20000**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	*0.082*	**0.098**	**13000**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*0.031*	*-0.0090*	**16000**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	*0.09*	**0.087**	**11000**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	*0.085*	**0.22**	**20000**	station not sampled
ST071	State Land Creek, below tributaries	*0.21*	**0.19**	**15000**	station not sampled
ST076	Trail Creek, above Blackfoot River	*0.06*	**0.19**	**12000**	station not sampled
ST078	Trail Creek, above Camp G Creek	*0.037*	**0.11**	**20000**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*0.037*	**0.078**	**5700**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*0.047*	**0.15**	**22000**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*0.079*	**0.25**	**17000**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	*0.063*	*0.059*	**18000**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	*0.12*	*0.051*	**17000**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	*0.14*	**0.22**	**27000**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	**0.48**	**0.20**	**20000**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	*0.33*	**0.20**	**23000**	station not sampled
ST137	No Name, above Angus Creek[4]	*0.25*	station was dry	**12000**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	*-0.0022*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	*-0.0077*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	**0.11**	**32000**	station not sampled
ST152	Diamond Creek, below Kendall Creek	*-0.051*	*-0.0063*	**15000**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*-0.028*	*0.012*	**18000**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	**0.48**	*0.033*	**5800**	station not sampled
ST156	Lanes Creek, below Sheep Creek	*0.39*	*0.0027*	**8600**	station not sampled

TABLE D.14
IRON RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (May), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST161	Sheep Creek, above Lanes Creek	*0.23*	*-0.031*	**12000**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	*0.12*	*-0.038*	**15000**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*0.12*	*-0.015*	**16000**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*-0.068*	**0.12**	**22000**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*-0.063*	*0.061*	**26000**	station not sampled
ST176	Roberts Creek, above tailings ponds	*0.034*	*-0.023*	**11000**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	*0.056*	*0.026*	**14000**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*-0.062*	*-0.0065*	**16000**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*-0.063*	*0.0026*	**17000**	station not sampled
ST187	North Fork Sage Creek, below Pole Creek	**0.46**	*0.049*	**22000**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	**0.64**	**0.27**	**9900**	station not sampled
ST193	South Fork Deer Creek	station snow-covered	*0.021*	**28000**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*0.010*	*-0.029*	**6200**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*-0.064*	station was dry	**26000**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*-0.026*	*-0.029*	**9100**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*-0.011*	*-0.012*	**1900**	station not sampled
ST218	Formation Creek, headwaters	*-0.034*	*-0.050*	sample not reported	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	*-0.019*	**11000**	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	*-0.023*	*0.044*	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	*0.0093*	**0.15**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	*0.16*	**0.18**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	*0.018*	*0.028*	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	*0.030*	*0.017*	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 0.44 mg/L for spring water, 0.066 mg/L for fall water, and 14 mg/kg for sediment; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 0.44 mg/L for spring water, 0.066 mg/L for fall water, and 14 mg/kg for sediment; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.
[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.
[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.15 MAGNESIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (Spring), mg/L	Water (Fall), mg/L	Sediment, mg/kg (dry weight)	Fish, mg/kg (wet weight)
Wells		Dissolved	Dissolved		
PW001	FMC Office Well	**12*** **	**12*** **	not applicable	not applicable
PW002	Huntzeker Well	**21**	**18**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**26**	**14**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**49**	**37**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**7.4**	**10**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**21**	**19**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**15**	**15**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**17**	**16**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**24**	**18**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**24**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**32**	**22**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**23**	**19**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**12***** **	**16**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**6.2**	**7.2**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	**17**	**19**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**21**	**19**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**11**	**20**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**18**	**18**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**18**	**14**	**5200*** **	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**29**	**25**	**5800**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**27**	station was dry	**5600**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**83**	station was dry	**9400**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**260***** **	**260**	**11000**	not applicable
French Drains					
FD001	Conda Mine French Drain	**47**	**43**	**3700**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**38**	**38**	**4000**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**3.9**	**4.8**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**12**	**9.4**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**9.7**	**10**	**4700**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**15**	**15**	**4100**	not applicable
SP011	Ballard Mine Upper Elk Pond	**6.7**	station was dry	**7000**	not applicable
SP024	Enoch Valley Mine North Pond	**36**	**40**	**8600**	not applicable
SP025	Gay Mine W Pit Pond	**31**	**43**	**3900**	not applicable
SP026	Gay Mine Z Pit Pond	**36**	**36**	**2300**	not applicable
SP027	Gay Mine JD Pit Pond	**47**	**46**	**740**	not applicable

TABLE D.15 MAGNESIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (Spring), mg/L	Water (Fall), mg/L	Sediment, mg/kg (dry weight)	Fish, mg/kg (wet weight)
Streams		Dissolved	Dissolved		
ST001	Portneuf River, below Bakers Creek	**32**	**39**	**4100**	station not sampled
ST004	Portneuf River, above U Creek	**19**	**18**	**3300**	station not sampled
ST013	Ross Fork, below Danielson Creek	**8.0**	**13**	**2700**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	**29**	**29**	**7600**	station not sampled
ST019	Blackfoot River, below Ballard Creek	**11**	**14**	**1900**	station not sampled
ST020	Blackfoot River, below State Land Creek	**11**	**14**	**1900**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	**13**	**15**	**4100**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	**11**	**13**	**3100**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	**11**	**14**	**2300**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	**12**	**14**	**2900**	station not sampled
ST229	Blackfoot River, below Spring Creek	**12**	**12**	**2400**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	**46**	**48**	**5800**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	**14**	**13**	**3500**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**16**	**22**	**3600**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	**21**	**34**	**3600**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	**20**	**31**	**52000**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	**15**	**17**	**3400**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	**19**	**18**	**4000**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	**10**	**12**	**23000**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	**9.5**	**14**	**15000**	station not sampled
ST071	State Land Creek, below tributaries	**12**	**12**	**3000**	station not sampled
ST076	Trail Creek, above Blackfoot River	**14**	**12**	**2900**	station not sampled
ST078	Trail Creek, above Camp G Creek	**12**	**12**	**4800**	station not sampled
ST097	Slug Creek, below Goodheart Creek	**13**	**15**	**1500**	station not sampled
ST098	Slug Creek, above Goodheart Creek	**11**	**15**	**5100**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	**9.1**	**15**	**3700**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	**14**	**12**	**6500**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	**14**	**16**	**4700**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	**15**	**17**	**7600**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	**5.8**	**11**	**4400**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	**8.0**	**15**	**4400**	station not sampled
ST137	No Name, above Angus Creek[4]	**3.9**	station was dry	**2400**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	**15**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	**15**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	**13**	**7500**	station not sampled
ST152	Diamond Creek, below Kendall Creek	**12**	**12**	**4200**	station not sampled
ST153	Diamond Creek, above Kendall Creek	**12**	**13**	**5900**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	**9.5**	**13**	**1800**	station not sampled
ST156	Lanes Creek, below Sheep Creek	**12**	**12**	**2500**	station not sampled

TABLE D.15 MAGNESIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		**Field-and-Lab-QA-Adjusted Concentration [1]**			
		Water (Spring), mg/L	**Water (Fall), mg/L**	**Sediment, mg/kg (dry weight)**	**Fish, mg/kg (wet weight)**
Streams, Continued		**Dissolved**	**Dissolved**		
ST161	Sheep Creek, above Lanes Creek	**12**	**13**	**3200**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	**11**	**12**	**3700**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	**8.6**	**12**	**4100**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	**21**	**19**	**7400**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	**18**	**17**	**6500**	station not sampled
ST176	Roberts Creek, above tailings ponds	**29**	**25**	**2300**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	**15**	**15**	**5100**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	**13**	**14**	**5000**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**15**	**18**	**6500**	station not sampled
ST187	North Fork Sage Creek, below Pole Creek	**17**	**21**	**3700**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	**8.9**	**15**	**2600**	station not sampled
ST193	South Fork Deer Creek	station was snow-covered	**12**	**6900**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	**17**	**20**	**4400**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	**3.1**	station was dry	**4800**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	**26**	**23**	**4500**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	**12**	**11**	**2700**	station not sampled
ST218	Formation Creek, headwaters	**40**	**41**	sample not reported	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**21**	**6300**	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**15**	**17**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**10**	**10**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**7.7**	**6.4**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**13**	**12**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**13**	**13**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 2.0 mg/L for spring water, 0.021 mg/L for fall water, and 20 mg/kg for sediment; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 2.0 mg/L for spring water, 0.021 mg/L for fall water, and 20 mg/kg for sediment; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.16
POTASSIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
PW001	FMC Office Well	*0.93* [2]	*0.49* [2]	not applicable	not applicable
PW002	Huntzeker Well	*1.0*	**0.91** [3]	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**28** [3]	**19**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	*0.78*	**1.4**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	*0.42*	**1.3**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	*1.6*	**1.8**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	*1.3*	**1.4**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	*0.81*	**0.95**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	*1.1*	**1.6**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	*0.75*	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	*1.5*	**1.1**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	*1.0*	**1.2**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	*0.90* [5]	**1.3**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	*0.96*	**0.83**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	*2.6*	**1.8**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	*0.77*	**1.5**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	*0.93*	**0.87**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	*0.66*	**1.2**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	*1.3*	**1.2**	**6900** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	*1.9*	**1.8**	**6500**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*1.2*	station was dry	**6000**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**3.3**	station was dry	**3600**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**8.4** [5]	**9.0**	**3700**	not applicable
French Drains					
FD001	Conda Mine French Drain	**3.3**	**5.3**	**6400**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	no samples reported	**2.3**	**4900**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**7.6**	**9.2**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	*0.63*	*0.36*	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*0.79*	**0.69**	**7800**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	*1.1*	**2.0**	**7500**	not applicable
SP011	Ballard Mine Upper Elk Pond	*1.2*	station was dry	**8400**	not applicable
SP024	Enoch Valley Mine North Pond	*2.3*	**7.7**	**10000**	not applicable
SP025	Gay Mine W Pit Pond	**8.4**	**15**	**6000**	not applicable
SP026	Gay Mine Z Pit Pond	**4.0**	**4.5**	**3900**	not applicable
SP027	Gay Mine JD Pit Pond	*1.9*	**2.5**	**3600**	not applicable

TABLE D.16 POTASSIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST001	Portneuf River, below Bakers Creek	**5.8**	**15**	**3100**	station not sampled
ST004	Portneuf River, above U Creek	*1.5*	**2.9**	**4600**	station not sampled
ST013	Ross Fork, below Danielson Creek	*0.41*	**0.87**	**4700**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	*1.5*	**3.1**	**11000**	station not sampled
ST019	Blackfoot River, below Ballard Creek	*0.96*	**1.2**	**3100**	station not sampled
ST020	Blackfoot River, below State Land Creek	*1.2*	**1.1**	**3200**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	*1.2*	**1.6**	**3800**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	*0.92*	**1.4**	**2800**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	**4.1**	**1.0**	**2300**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*1.1*	**1.4**	**2600**	station not sampled
ST229	Blackfoot River, below Spring Creek	*0.56*	**1.2**	**3100**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	**3.3**	**7.3**	**7200**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	*1.4*	**2.0**	**4900**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**5.6**	**13**	**3700**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	*2.8*	**4.0**	**2900**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	*2.6*	**4.0**	**2400**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	*1.9*	**3.0**	**4100**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	*2.2*	**3.2**	**4200**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	*1.3*	**1.4**	**3000**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	*1.4*	**1.8**	**3300**	station not sampled
ST071	State Land Creek, below tributaries	*1.4*	**2.7**	**4400**	station not sampled
ST076	Trail Creek, above Blackfoot River	*1.5*	**2.6**	**4100**	station not sampled
ST078	Trail Creek, above Camp G Creek	*0.86*	**1.2**	**6200**	station not sampled
ST097	Slug Creek, below Goodheart Creek	*1.4*	**2.2**	**3100**	station not sampled
ST098	Slug Creek, above Goodheart Creek	*1.8*	**4.4**	**7500**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*1.4*	**4.8**	**5400**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	*0.81*	**1.4**	**7000**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	*1.6*	**1.3**	**5400**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	*1.1*	**1.8**	**9000**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	*0.65*	**1.6**	**6300**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	*0.76*	**2.0**	**5800**	station not sampled
ST137	No Name, above Angus Creek[4]	*0.56*	station was dry	**4100**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	*0.75*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	*0.76*	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	**1.3**	**10000**	station not sampled
ST152	Diamond Creek, below Kendall Creek	*0.77*	**1.2**	**5400**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*0.35*	**1.0**	**6500**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	*1.1*	**1.3**	**2100**	station not sampled
ST156	Lanes Creek, below Sheep Creek	*0.92*	**1.3**	**2700**	station not sampled

TABLE D.16
POTASSIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST161	Sheep Creek, above Lanes Creek	*1.7*	**1.3**	**3700**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	*0.25*	**1.4**	**5200**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*0.34*	**1.2**	**4900**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	*1.2*	**2.0**	**8500**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*0.95*	**1.3**	**7400**	station not sampled
ST176	Roberts Creek, above tailings ponds	*1.4*	**2.1**	**4700**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	*0.25*	**1.5**	**5700**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*0.39*	**1.1**	**4700**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*0.67*	**1.5**	**5500**	station not sampled
ST187	North Fork Sage Creek, below Pole Creek	*1.1*	**2.1**	**4700**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	*1.7*	**2.0**	**3300**	station not sampled
ST193	South Fork Deer Creek	station snow-covered	**1.1**	**9100**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*0.36*	**1.2**	**3800**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*1.2*	station was dry	**7100**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	*1.4*	**1.4**	**5900**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*1.1*	**0.75**	**1300**	station not sampled
ST218	Formation Creek, headwaters	**3.2**	**2.4**	sample not reported	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**1.5**	**3700**	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	*1.6*	**0.23**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	*1.2*	**0.84**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	*2.2*	**0.65**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	*2.8*	**4.4**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	*2.5*	**3.7**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 3.1 mg/L for spring water, 0.61 mg/L for fall water, and 87 mg/kg for sediment; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 3.1 mg/L for spring water, 0.61 mg/L for fall water, and 87 mg/kg for sediment; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.17 SODIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
PW001	FMC Office Well	**5.0** [3]	**6.2** [3]	not applicable	not applicable
PW002	Huntzeker Well	**6.7**	**7.0**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**13**	**8.9**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**5.3**	**5.8**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**5.9**	**7.9**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**13**	**13**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**12**	**13**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**6.3**	**6.7**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**4.8**	**5.6**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**5.4**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**5.8**	**6.5**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**7.7**	**6.4**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**5.6** [5]	**5.5**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**7.6**	**7.2**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	**7.1**	**6.9**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	*2.4* [2]	**3.1**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**18**	**6.1**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**19**	**4.4**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**8.4**	**7.1**	**200** [3]	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**6.4**	**7.1**	**230**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**4.5**	station was dry	**380**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**6.6**	station was dry	**910**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**20** [5]	**24**	**1600**	not applicable
French Drains					
FD001	Conda Mine French Drain	**20**	**14**	**490**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**11**	**12**	**220**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	*0.72*	**1.8**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	*2.8*	**8.5**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	*0.49*	**1.6**	**300**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	*1.8*	**3.4**	**870**	not applicable
SP011	Ballard Mine Upper Elk Pond	**12**	station was dry	**600**	not applicable
SP024	Enoch Valley Mine North Pond	*0.90*	**3.5**	**510**	not applicable
SP025	Gay Mine W Pit Pond	**16**	**22**	**300**	not applicable
SP026	Gay Mine Z Pit Pond	**29**	**35**	**1300**	not applicable
SP027	Gay Mine JD Pit Pond	**42**	**45**	**1100**	not applicable

TABLE D.17 SODIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet weight)
ST001	Portneuf River, below Bakers Creek	**22**	**24**	**320**	station not sampled
ST004	Portneuf River, above U Creek	**15**	**15**	**220**	station not sampled
ST013	Ross Fork, below Danielson Creek	**3.2**	**5.4**	**180**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	**26**	**27**	**450**	station not sampled
ST019	Blackfoot River, below Ballard Creek	**13**	**4.2**	**330**	station not sampled
ST020	Blackfoot River, below State Land Creek	**14**	**4.0**	**320**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	**3.1**	**4.1**	**220**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	*2.5*	**3.8**	**260**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	*2.6*	**3.7**	**300**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	*2.7*	**3.7**	**410**	station not sampled
ST229	Blackfoot River, below Spring Creek	*2.4*	**3.4**	**270**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	**37**	**49**	**340**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	**13**	**14**	**210**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**21**	**16**	**360**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	**22**	**28**	**410**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	**20**	**54**	**1900**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	**9.8**	**18**	**300**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	**12**	**21**	**300**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	**3.3**	**4.8**	**290**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	**3.3**	**6.0**	**570**	station not sampled
ST071	State Land Creek, below tributaries	**5.3**	**6.5**	**290**	station not sampled
ST076	Trail Creek, above Blackfoot River	**5.5**	**7.0**	**250**	station not sampled
ST078	Trail Creek, above Camp G Creek	**6.3**	**4.8**	**270**	station not sampled
ST097	Slug Creek, below Goodheart Creek	**4.0**	**5.8**	**400**	station not sampled
ST098	Slug Creek, above Goodheart Creek	**3.1**	**4.9**	**230**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	*2.6*	**5.2**	**280**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	**5.3**	**6.5**	**260**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	**4.2**	**5.5**	**280**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	**4.0**	**5.6**	**250**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	**3.3**	**5.2**	**220**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	**3.2**	**5.3**	**250**	station not sampled
ST137	No Name, above Angus Creek[4]	*2.2*	station was dry	**220**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	**3.0**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	**3.2**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	**4.0**	**360**	station not sampled
ST152	Diamond Creek, below Kendall Creek	*2.1*	**3.0**	**260**	station not sampled
ST153	Diamond Creek, above Kendall Creek	*2.0*	**3.1**	**260**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	**15**	**3.9**	**160**	station not sampled
ST156	Lanes Creek, below Sheep Creek	**16**	**4.1**	**190**	station not sampled

TABLE D.17
SODIUM RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		**Dissolved**	**Dissolved**	**mg/kg (dry weight)**	**mg/kg (wet weight)**
ST161	Sheep Creek, above Lanes Creek	**17**	**3.6**	**230**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	*2.3*	**3.6**	**200**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	*1.9*	**3.4**	**230**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	**4.9**	**5.6**	**440**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	*2.7*	**3.7**	**310**	station not sampled
ST176	Roberts Creek, above tailings ponds	**36**	**37**	**490**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	*1.8*	**3.1**	**300**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	*1.7*	**2.8**	**250**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	*1.8*	**3.5**	**310**	station not sampled
ST187	North Fork Sage Creek, below Pole Creek	**3.3**	**6.1**	**310**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	**5.0**	**8.8**	**310**	station not sampled
ST193	South Fork Deer Creek	station snow-covered	**2.2**	**280**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	*1.8*	**3.9**	**450**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	*1.1*	station was dry	**200**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	**4.5**	**5.1**	**240**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	*1.1*	**1.8**	**200**	station not sampled
ST218	Formation Creek, headwaters	**3.0**	**3.8**	sample not reported	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**4.5**	**370**	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**6.5**	**10**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**3.3**	**7.4**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**3.3**	**7.2**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**19**	**23**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**20**	**23**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 2.9 mg/L for spring water, 0.58 mg/L for fall water, and 34 mg/kg for sediment; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 2.9 mg/L for spring water, 0.58 mg/L for fall water, and 34 mg/kg for sediment; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted

TABLE D.18 ALKALINITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Wells					
PW001	FMC Office Well	**170** [3]	**180** [3]	not applicable	not applicable
PW002	Huntzeker Well	**250**	**270**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**300**	**270**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**300**	**300**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**140**	**180**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**180**	**190**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**130**	**140**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**160**	**170**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**170**	**190**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**160**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**170**	**180**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**200**	**180**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**200** [5]	**210**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**180**	**210**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	sample not reported	**240**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**200**	**200**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**200**	**180**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**160**	**180**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**200**	**220**	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**290**	**300**	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**220**	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**160**	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**280** [5]	**280**	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	**340**	**420**	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**390**	**290**	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**42**	**57**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**96**	**33**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**57**	**62**	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**110**	**110**	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	**80**	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	**39**	**96**	not applicable	not applicable
SP025	Gay Mine W Pit Pond	**210**	**240**	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	**120**	**92**	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	**200**	**180**	not applicable	not applicable

TABLE D.18					
ALKALINITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Streams					
ST001	Portneuf River, below Bakers Creek	**260**	**270**	not applicable	not applicable
ST004	Portneuf River, above U Creek	**220**	**210**	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	**75**	**130**	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	**200**	**270**	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	**160**	**170**	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	**160**	**160**	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	**170**	**170**	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	**150**	**180**	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	**150**	**170**	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	**300**	**160**	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	**160**	**180**	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	**230**	**220**	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	**230**	**240**	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**170**	**240**	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	**230**	**330**	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	**200**	**150**	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	**210**	**190**	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	**210**	**180**	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	**140**	**190**	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	**130**	**170**	not applicable	not applicable
ST071	State Land Creek, below tributaries	**61**	**180**	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	**180**	**160**	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	**190**	**190**	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	**180**	**210**	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	**160**	**210**	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	**130**	**220**	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	**200**	**210**	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	**150**	**220**	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	**150**	**180**	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	**62**	**170**	not applicable	not applicable
ST132	Angus Creek, above No Name Creek[4]	**100**	**170**	not applicable	not applicable
ST137	No Name, above Angus Creek[4]	**45**	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	**170**	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	**180**	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	**180**	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	**160**	**180**	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	**160**	**190**	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	**150**	**180**	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	**130**	**170**	not applicable	not applicable

TABLE D.18 ALKALINITY RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Streams, Continued					
ST161	Sheep Creek, above Lanes Creek	**130**	**190**	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	**120**	**180**	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	**130**	**160**	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	**200**	**220**	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	**190**	**200**	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	**180**	**200**	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	**170**	**170**	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	**160**	**190**	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**140**	**180**	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	**230**	**370**	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	**130**	**210**	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	**170**	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	**180**	**170**	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	**170**	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	**130**	**150**	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	**140**	**150**	not applicable	not applicable
ST218	Formation Creek, headwaters	**480**	**510**	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**190**	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**120**	**150**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**78**	**74**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**73**	**85**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**130**	**130**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**130**	**83**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.93 mg/L for spring water, 0.10 mg/L for fall water results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.93 mg/L for spring water, 0.10 mg/L for fall water; results exceeding their corresponding value (those bolded) their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.19 BICARBONATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Wells					
PW001	FMC Office Well	**210**	**220**	not applicable	not applicable
PW002	Huntzeker Well	**300**	**330**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**370**	**330**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**370**	**370**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**170**	**220**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**220**	**230**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**160**	**170**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**200**	sample not reported	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**210**	sample not reported	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**190**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**210**	sample not reported	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**240**	sample not reported	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**240**	**260**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**220**	**260**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	sample not reported	**290**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**240**	**240**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**240**	**220**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**200**	**220**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**240**	**270**	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**350**	**370**	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**270**	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**200**	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**340**	**340**	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	**410**	**510**	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**470**	**350**	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**51**	**63**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**120**	**5.0**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**67**	**58**	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**130**	**130**	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	**92**	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	**45**	**110**	not applicable	not applicable
SP025	Gay Mine W Pit Pond	**250**	**280**	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	**140**	**40**	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	**240**	**210**	not applicable	not applicable

TABLE D.19
BICARBONATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Streams					
ST001	Portneuf River, below Bakers Creek	**310**	**320**	not applicable	not applicable
ST004	Portneuf River, above U Creek	**260**	**250**	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	**90**	**160**	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	**240**	**320**	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	**190**	**210**	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	**190**	**190**	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	**210**	**200**	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	**180**	**220**	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	**180**	**210**	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	**360**	**190**	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	**190**	**220**	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	**280**	**270**	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	**280**	**290**	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**210**	**290**	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	**280**	**100**	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	**240**	**180**	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	**260**	**230**	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	**260**	**220**	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	**170**	**230**	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	**160**	**210**	not applicable	not applicable
ST071	State Land Creek, below tributaries	**74**	**210**	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	**220**	**200**	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	**230**	**230**	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	**220**	**260**	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	**190**	**250**	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	**160**	**270**	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	**240**	**250**	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	**180**	**260**	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	**180**	**220**	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	**75**	**210**	not applicable	not applicable
ST132	Angus Creek, above No Name Creek [4]	**120**	**200**	not applicable	not applicable
ST137	No Name, above Angus Creek[4]	**55**	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	**210**	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	**220**	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	**220**	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	**190**	**220**	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	**190**	**230**	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	**180**	**220**	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	**160**	**200**	not applicable	not applicable

TABLE D.19
BICARBONATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Streams, Continued					
ST161	Sheep Creek, above Lanes Creek	**160**	**220**	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	**150**	**210**	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	**160**	**190**	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	**240**	**260**	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	**230**	**240**	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	**220**	**240**	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	**200**	**200**	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	**160**	**230**	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**160**	**220**	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	**280**	**450**	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	**160**	**250**	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	**210**	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	**220**	**210**	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	**210**	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	**160**	**180**	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	**170**	**180**	not applicable	not applicable
ST218	Formation Creek, headwaters	**580**	**620**	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**230**	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**130**	**46**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**81**	**57**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**88**	**23**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**160**	**150**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**160**	**97**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile is based on blank results of alkalinity for spring and fall water, results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile is based on blank results of alkalinity for spring and fall water, results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D.20 CARBONATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Wells					
PW001	FMC Office Well	**0.41**	**0.89**	not applicable	not applicable
PW002	Huntzeker Well	**0.14**	**0.23**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**0.068**	**0.12**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**0.053**	**0.065**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**0.24**	**0.088**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**0.34**	**0.33**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**0.36**	**0.21**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**0.24**	sample not reported	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**0.25**	sample not reported	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**0.30**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**0.22**	sample not reported	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**0.12**	sample not reported	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**0.14**	**0.16**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**0.14**	**0.13**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	sample not reported	**0.19**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**0.20**	**0.26**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**0.11**	**0.46**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**0.041**	**0.18**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**0.055**	**0.017**	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**0.22**	**0.30**	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**0.028**	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**0.023**	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**0.26**	**0.10**	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	**0.24**	**0.54**	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**0.48**	**0.18**	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.012**	**2.7**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**0.25**	**8.9**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**1.2**	**8.1**	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**0.62**	**1.9**	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	**2.8**	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	**1.4**	**2.6**	not applicable	not applicable
SP025	Gay Mine W Pit Pond	**1.8**	**4.9**	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	**2.3**	**32**	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	**2.1**	**2.6**	not applicable	not applicable

TABLE D.20 CARBONATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Streams					
ST001	Portneuf River, below Bakers Creek	**1.6**	**3.8**	not applicable	not applicable
ST004	Portneuf River, above U Creek	**2.0**	**1.6**	not applicable	not applicable
ST013	Ross Fork, below Danielson Creek	**0.51**	**0.82**	not applicable	not applicable
ST015	Ross Fork, above South 40 of Gay Mine	**2.3**	**2.7**	not applicable	not applicable
ST019	Blackfoot River, below Ballard Creek	**0.32**	**0.36**	not applicable	not applicable
ST020	Blackfoot River, below State Land Creek	**0.29**	**2.3**	not applicable	not applicable
ST022	Blackfoot River, below Wooley Valley Creek	**1.2**	**1.5**	not applicable	not applicable
ST023	Blackfoot River, below Dry Valley Creek	**0.34**	**0.37**	not applicable	not applicable
ST024	Blackfoot River, above Dry Valley Creek	**0.41**	**0.25**	not applicable	not applicable
ST026	Blackfoot River, above Wooley Range Ridge Creek	**2.3**	**1.5**	not applicable	not applicable
ST229	Blackfoot River, below Spring Creek	**0.69**	**0.52**	not applicable	not applicable
ST031	Lincoln Creek, below Dry Hollow Creek	**1.2**	**0.17**	not applicable	not applicable
ST033	Lincoln Creek, above North Limb of Gay Mine	**1.3**	**0.30**	not applicable	not applicable
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**0.063**	**0.12**	not applicable	not applicable
ST043	Little Blackfoot River, below Long Valley Creek	**0.30**	**0.14**	not applicable	not applicable
ST044	Little Blackfoot River, below Henry Mine	**0.60**	**1.2**	not applicable	not applicable
ST046	Little Blackfoot River, below Enoch Valley Creek	**0.44**	**0.0090**	not applicable	not applicable
ST047	Little Blackfoot River, above Enoch Valley Creek	**0.56**	**0.23**	not applicable	not applicable
ST048	Little Blackfoot River, below Reese Creek	**0.85**	**0.85**	not applicable	not applicable
ST049	Little Blackfoot River, above Reese Creek	**0.70**	**0.72**	not applicable	not applicable
ST071	State Land Creek, below tributaries	**0.074**	**0.54**	not applicable	not applicable
ST076	Trail Creek, above Blackfoot River	**0.29**	**0.18**	not applicable	not applicable
ST078	Trail Creek, above Camp G Creek	**0.31**	**0.36**	not applicable	not applicable
ST097	Slug Creek, below Goodheart Creek	**0.27**	**0.28**	not applicable	not applicable
ST098	Slug Creek, above Goodheart Creek	**0.48**	**1.8**	not applicable	not applicable
ST100	Slug Creek, above Dry Basin Creek	**0.50**	**0.65**	not applicable	not applicable
ST101	Caldwell Creek, below Phosphoria Formation outcrop	**0.70**	**0.89**	not applicable	not applicable
ST113	Dry Valley Creek, above Blackfoot River	**0.20**	**2.0**	not applicable	not applicable
ST129	Angus Creek, below Wooley Valley Mine	**0.59**	**1.7**	not applicable	not applicable
ST131	Rasmussen Creek, above Angus Creek	**0.057**	**0.51**	not applicable	not applicable
ST132	Angus Creek, above No Name Creek[4]	**0.35**	**1.7**	not applicable	not applicable
ST137	No Name, above Angus Creek[4]	**0.075**	station was dry	not applicable	not applicable
ST149	East Mill Creek, above Spring Creek on north fork	**0.89**	ST227 sampled instead	not applicable	not applicable
ST150	East Mill Creek, above Spring Creek on south fork	**1.1**	ST227 sampled instead	not applicable	not applicable
ST227	East Mill Creek, at fish sampling reach	station not yet established	**1.3**	not applicable	not applicable
ST152	Diamond Creek, below Kendall Creek	**0.87**	**1.1**	not applicable	not applicable
ST153	Diamond Creek, above Kendall Creek	**0.89**	**0.68**	not applicable	not applicable
ST155	Lanes Creek, below 6500 Feet Creek	**0.18**	**0.56**	not applicable	not applicable
ST156	Lanes Creek, below Sheep Creek	**0.032**	**2.5**	not applicable	not applicable

TABLE D.20
CARBONATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.), mg/kg (dry wt.)	Fish (Sept.), mg/kg (wet wt.)
Stream, Continued					
ST161	Sheep Creek, above Lanes Creek	**0.13**	**3.8**	not applicable	not applicable
ST162	Sheep Creek, below West Fork Sheep Creek	**0.74**	**2.5**	not applicable	not applicable
ST163	Sheep Creek, above West Fork Sheep Creek	**0.92**	**3.1**	not applicable	not applicable
ST173	Smoky Creek, below Smoky Canyon Mine	**1.7**	**1.7**	not applicable	not applicable
ST174	Smoky Creek, above activity at Smoky Canyon Mine	**0.29**	**1.4**	not applicable	not applicable
ST176	Roberts Creek, above tailings ponds	**1.0**	**1.2**	not applicable	not applicable
ST183	Sage Creek, below Smoky Canyon Mine	**1.6**	**1.7**	not applicable	not applicable
ST184	Sage Creek, above Smoky Canyon Mine	**1.1**	**0.61**	not applicable	not applicable
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**3.2**	**2.0**	not applicable	not applicable
ST187	North Fork Sage Creek, below Pole Creek	**0.88**	**1.7**	not applicable	not applicable
ST188	North Fork Sage Creek, above Pole Creek	**0.78**	**1.2**	not applicable	not applicable
ST193	South Fork Deer Creek	station snow-covered	**0.88**	not applicable	not applicable
ST196	Georgetown Creek, below irrigation diversion dam	**0.81**	**1.2**	not applicable	not applicable
ST200	Georgetown Creek, above Georgetown Canyon Mine	**0.12**	station was dry	not applicable	not applicable
ST201	Right Hand Fork, below Georgetown Canyon Mine	**0.26**	**0.19**	not applicable	not applicable
ST202	Right Hand Fork, above Georgetown Canyon Mine	**0.60**	**1.1**	not applicable	not applicable
ST218	Formation Creek, headwaters	**0.047**	**0.34**	not applicable	not applicable
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**0.49**	not applicable	not applicable
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**9.5**	**61**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**6.4**	**15**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**0.55**	**33**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**1.7**	**2.2**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**1.6**	**1.9**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile is based on blank results of alkalinity for spring and fall water, results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile is based on blank results of alkalinity for spring and fall water, results exceeding their corresponding value (those bolded) are discernibly greater than a blank.
[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D.21 CHLORIDE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet wt.)
PW001	FMC Office Well	**4.7** [3]	**4.305** [3]	not applicable	not applicable
PW002	Huntzeker Well	**60**	**39**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**46**	**13**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**13**	**10**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**7.5**	**6.8**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**5.0**	**4.5**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**4.7**	**4.2**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**8.7**	**6.0**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**5.2**	**4.8**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**6.1**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**6.4**	**5.7**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**5.9**	**5.7**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**3.4**	**3.1**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**4.9**	**7.8**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	sample not reported	**15**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**4.6**	**5.3**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**6.0**	**4.6**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**5.7**	**4.4**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**8.6**	**6.8**	not applicable	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**4.5**	**4.7**	not applicable	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**1.1**	station was dry	not applicable	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**1.2**	station was dry	not applicable	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**9.1**	**8.0**	not applicable	not applicable
French Drains					
FD001	Conda Mine French Drain	**6.2**	**7.6**	not applicable	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**4.6**	**3.8**	not applicable	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.70**	*0.4276* [2]	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**4.5**	**37**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**0.59**	*0.54*	not applicable	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**14**	**18**	not applicable	not applicable
SP011	Ballard Mine Upper Elk Pond	**0.60**	station was dry	not applicable	not applicable
SP024	Enoch Valley Mine North Pond	**35**	**24**	not applicable	not applicable
SP025	Gay Mine W Pit Pond	**10**	**11**	not applicable	not applicable
SP026	Gay Mine Z Pit Pond	**52**	**57**	not applicable	not applicable
SP027	Gay Mine JD Pit Pond	**150**	**150**	not applicable	not applicable

TABLE D.21 CHLORIDE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet wt.)
ST001	Portneuf River, below Bakers Creek	58	39	not applicable	station not sampled
ST004	Portneuf River, above U Creek	51	46	not applicable	station not sampled
ST013	Ross Fork, below Danielson Creek	6.8	8.3	not applicable	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	110	110	not applicable	station not sampled
ST019	Blackfoot River, below Ballard Creek	2.4	2.7	not applicable	station not sampled
ST020	Blackfoot River, below State Land Creek	2.5	2.7	not applicable	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	2.0	2.2	not applicable	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	2.3	1.8	not applicable	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	2.3	1.8	not applicable	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	1.4	1.7	not applicable	station not sampled
ST229	Blackfoot River, below Spring Creek	1.2	1.6	not applicable	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	130	130	not applicable	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	48	43	not applicable	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	25	19	not applicable	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	19	26	not applicable	station not sampled
ST044	Little Blackfoot River, below Henry Mine	23	58	not applicable	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	10	24	not applicable	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	17	27	not applicable	station not sampled
ST048	Little Blackfoot River, below Reese Creek	2.4	2.7	not applicable	station not sampled
ST049	Little Blackfoot River, above Reese Creek	2.5	3.2	not applicable	station not sampled
ST071	State Land Creek, below tributaries	2.3	5.7	not applicable	station not sampled
ST076	Trail Creek, above Blackfoot River	5.8	5.5	not applicable	station not sampled
ST078	Trail Creek, above Camp G Creek	6.9	4.5	not applicable	station not sampled
ST097	Slug Creek, below Goodheart Creek	2.7	4.7	not applicable	station not sampled
ST098	Slug Creek, above Goodheart Creek	1.8	3.5	not applicable	station not sampled
ST100	Slug Creek, above Dry Basin Creek	1.5	4.5	not applicable	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	6.5	7.0	not applicable	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	6.9	4.9	not applicable	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	5.7	3.9	not applicable	station not sampled
ST131	Rasmussen Creek, above Angus Creek	9.1	5.7	not applicable	station not sampled
ST132	Angus Creek, above No Name Creek[4]	5.7	4.1	not applicable	station not sampled
ST137	No Name, above Angus Creek[4]	3.9	station was dry	not applicable	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	1.7	ST227 sampled instead	not applicable	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	1.9	ST227 sampled instead	not applicable	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	1.8	not applicable	station not sampled
ST152	Diamond Creek, below Kendall Creek	0.97	1.2	not applicable	station not sampled
ST153	Diamond Creek, above Kendall Creek	1.1	1.2	not applicable	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	1.6	1.8	not applicable	station not sampled
ST156	Lanes Creek, below Sheep Creek	1.7	2.0	not applicable	station not sampled

TABLE D.21
CHLORIDE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		Dissolved	Dissolved	mg/kg (dry weight)	mg/kg (wet wt.)
ST161	Sheep Creek, above Lanes Creek	**2.0**	**1.7**	not applicable	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	**1.5**	**1.7**	not applicable	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	**1.3**	**1.7**	not applicable	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	**10**	**4.4**	not applicable	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	**0.89**	**1.2**	not applicable	station not sampled
ST176	Roberts Creek, above tailings ponds	**74**	**68**	not applicable	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	**1.1**	**1.1**	not applicable	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	**0.99**	**1.0**	not applicable	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**0.78**	**1.0**	not applicable	station not sampled
ST187	North Fork Sage Creek, below Pole Creek	**2.0**	**3.9**	not applicable	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	**3.5**	**6.0**	not applicable	station not sampled
ST193	South Fork Deer Creek	station snow-covered	**0.79**	not applicable	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	**1.1**	**1.5**	not applicable	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	**0.6**	station was dry	not applicable	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	**1.6**	**1.3**	not applicable	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	**1.4**	**0.72**	not applicable	station not sampled
ST218	Formation Creek, headwaters	**5.3**	**3.5**	not applicable	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**4.3**	not applicable	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**17**	**18**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**2.7**	**6.3**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**3.6**	**5.5**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**32**	**33**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**37**	**34**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.15 mg/L for spring water and 0.55 mg/L for fall water; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.15 mg/L for spring water and 0.55 mg/L for fall water; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

TABLE D.22
SULFATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Wells		Dissolved	Dissolved	mg/kg (dry weight) [4]	mg/kg (wet weight)
PW001	FMC Office Well	**5.3** [3]	**6.7** [3]	not applicable	not applicable
PW002	Huntzeker Well	**14**	**11**	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	**48**	**22**	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	**130**	**130**	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	**35**	**55**	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	**19**	**19**	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	**12**	**20**	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	**19**	**5.5**	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	**8.1**	**7.9**	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	**5.8**	well was broken	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	**6.0**	**5.9**	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	**19**	**5.9**	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	**7.5** [5]	**19**	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	**7.6**	**7.5**	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	sample not reported	**62**	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	**32**	**29**	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	**8.7**	**7.5**	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	**42**	**33**	not applicable	not applicable
Waste Rock Dump Seeps					
DS003	Dry Valley Mine South B Dump Seep	**93**	**37**	**650**	not applicable
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**170**	**160**	**750**	not applicable
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**71**	station was dry	**1200**	not applicable
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**950**	station was dry	**2900**	not applicable
DS015	Conda Mine West Limb Waste Dump Seep	**1900** [5]	**1800**	**5100**	not applicable
French Drains					
FD001	Conda Mine French Drain	**340**	**260**	**1600**	not applicable
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	**64**	**74**	**720**	not applicable
Miscellaneous Facilities					
MF001	Central Farmers Plant Thickener	**0.23**	**0.17**	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	**62**	**65**	not applicable	not applicable
Stock Ponds					
MP022	Wooley Valley Mine Unit IV Pit Pond	**44**	**50**	**970**	not applicable
MP032	Smoky Canyon Mine A Pit Pond	**49**	**66**	**1400**	not applicable
SP011	Ballard Mine Upper Elk Pond	**16**	station was dry	**1900**	not applicable
SP024	Enoch Valley Mine North Pond	**160**	**280**	**1600**	not applicable
SP025	Gay Mine W Pit Pond	**55**	**110**	**970**	not applicable
SP026	Gay Mine Z Pit Pond	**140**	**170**	**4100**	not applicable
SP027	Gay Mine JD Pit Pond	**90**	**100**	**3500**	not applicable

TABLE D.22 SULFATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING (CONTINUED)					
Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams		**Dissolved**	**Dissolved**	**mg/kg (dry weight) [4]**	**mg/kg (wet weight)**
ST001	Portneuf River, below Bakers Creek	**63**	**110**	**1000**	station not sampled
ST004	Portneuf River, above U Creek	**29**	**25**	**720**	station not sampled
ST013	Ross Fork, below Danielson Creek	**4.1**	**4.9**	**590**	station not sampled
ST015	Ross Fork, above South 40 of Gay Mine	**45**	**42**	**1400**	station not sampled
ST019	Blackfoot River, below Ballard Creek	**12**	**10**	**1100**	station not sampled
ST020	Blackfoot River, below State Land Creek	**12**	**10**	**1000**	station not sampled
ST022	Blackfoot River, below Wooley Valley Creek	**11**	**10**	**700**	station not sampled
ST023	Blackfoot River, below Dry Valley Creek	**11**	**10**	**840**	station not sampled
ST024	Blackfoot River, above Dry Valley Creek	**9.0**	**10**	**970**	station not sampled
ST026	Blackfoot River, above Wooley Range Ridge Creek	**9.6**	**10**	**1300**	station not sampled
ST229	Blackfoot River, below Spring Creek	**9.1**	**9.4**	**860**	station not sampled
ST031	Lincoln Creek, below Dry Hollow Creek	**110**	**120**	**1100**	station not sampled
ST033	Lincoln Creek, above North Limb of Gay Mine	**28**	**15**	**680**	station not sampled
ST042	Grizzly Creek, below Phosphoria Formation outcrop	**31**	**73**	**1200**	station not sampled
ST043	Little Blackfoot River, below Long Valley Creek	**39**	**73**	**1300**	station not sampled
ST044	Little Blackfoot River, below Henry Mine	**45**	**140**	**6000**	station not sampled
ST046	Little Blackfoot River, below Enoch Valley Creek	**16**	**38**	**970**	station not sampled
ST047	Little Blackfoot River, above Enoch Valley Creek	**15**	**42**	**970**	station not sampled
ST048	Little Blackfoot River, below Reese Creek	**4.0**	**5.2**	**950**	station not sampled
ST049	Little Blackfoot River, above Reese Creek	**3.3**	**4.6**	**1800**	station not sampled
ST071	State Land Creek, below tributaries	**82**	**6.4**	**940**	station not sampled
ST076	Trail Creek, above Blackfoot River	**18**	**9.0**	**810**	station not sampled
ST078	Trail Creek, above Camp G Creek	**9.3**	**7.0**	**880**	station not sampled
ST097	Slug Creek, below Goodheart Creek	**12**	**15**	**1300**	station not sampled
ST098	Slug Creek, above Goodheart Creek	**2.9**	**2.8**	**750**	station not sampled
ST100	Slug Creek, above Dry Basin Creek	**1.9**	**2.9**	**910**	station not sampled
ST101	Caldwell Creek, below Phosphoria Formation outcrop	**13**	**11**	**830**	station not sampled
ST113	Dry Valley Creek, above Blackfoot River	**67**	**14**	**910**	station not sampled
ST129	Angus Creek, below Wooley Valley Mine	**51**	**71**	**810**	station not sampled
ST131	Rasmussen Creek, above Angus Creek	**22**	**12**	**720**	station not sampled
ST132	Angus Creek, above No Name Creek[4]	**25**	**54**	**810**	station not sampled
ST137	No Name, above Angus Creek[4]	**14**	station was dry	**720**	station not sampled
ST149	East Mill Creek, above Spring Creek on north fork	**36**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST150	East Mill Creek, above Spring Creek on south fork	**39**	ST227 sampled instead	ST227 sampled instead	station not sampled
ST227	East Mill Creek, at fish sampling reach	station not yet established	**9.4**	**1200**	station not sampled
ST152	Diamond Creek, below Kendall Creek	**8.4**	**8.9**	**840**	station not sampled
ST153	Diamond Creek, above Kendall Creek	**7.9**	**9.0**	**840**	station not sampled
ST155	Lanes Creek, below 6500 Feet Creek	**8.4**	**9.0**	**540**	station not sampled
ST156	Lanes Creek, below Sheep Creek	**38**	**7.8**	**620**	station not sampled

TABLE D.22
SULFATE RESULTS FROM 1998 WATER, SEDIMENT, AND FISH SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]			
		Water (May), mg/L	Water (Sept.), mg/L	Sediment (Sept.)	Fish (Sept.)
Streams, Continued		Dissolved	Dissolved	mg/kg (dry weight) [4]	mg/kg (wet weight)
ST161	Sheep Creek, above Lanes Creek	**38**	**7.4**	**750**	station not sampled
ST162	Sheep Creek, below West Fork Sheep Creek	**36**	**7.6**	**650**	station not sampled
ST163	Sheep Creek, above West Fork Sheep Creek	**4.8**	**5.6**	**750**	station not sampled
ST173	Smoky Creek, below Smoky Canyon Mine	**18**	**18**	**1400**	station not sampled
ST174	Smoky Creek, above activity at Smoky Canyon Mine	**13**	**16**	**1000**	station not sampled
ST176	Roberts Creek, above tailings ponds	**77**	**80**	**1600**	station not sampled
ST183	Sage Creek, below Smoky Canyon Mine	**13**	**19**	**970**	station not sampled
ST184	Sage Creek, above Smoky Canyon Mine	**12**	**17**	**810**	station not sampled
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**7.6**	**11**	**1000**	station not sampled
ST187	North Fork Sage Creek, below Pole Creek	**55**	**49**	**1000**	station not sampled
ST188	North Fork Sage Creek, above Pole Creek	**9.5**	**19**	**1000**	station not sampled
ST193	South Fork Deer Creek	station snow-covered	**5.9**	**910**	station not sampled
ST196	Georgetown Creek, below irrigation diversion dam	**22**	**91**	**1400**	station not sampled
ST200	Georgetown Creek, above Georgetown Canyon Mine	**1.7**	station was dry	**650**	station not sampled
ST201	Right Hand Fork, below Georgetown Canyon Mine	**150**	**170**	**780**	station not sampled
ST202	Right Hand Fork, above Georgetown Canyon Mine	**6.2**	**8.6**	**650**	station not sampled
ST218	Formation Creek, headwaters	**32**	**30**	sample not reported	station not sampled
ST228	South Fork Sage Creek, at fish sampling reach	station not yet established	**13**	**1200**	station not sampled
Tailings Ponds					
TP001	Wooley Valley Mine Tailings Pond #1	**1.2**	**0.69**	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	**5.1**	**5.1**	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	**11**	**3.6**	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	**78**	**100**	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	**75**	**90**	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.062 mg/L for spring water, 0.10 mg/L for fall water, and 2.6 mg/kg for sediment; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.062 mg/L for spring water, 0.10 mg/L for fall water, and 2.6 mg/kg for sediment; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

[4]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

[5]Station was sampled in July; no equipment blanks or matrix spikes were analyzed, thus results presented are only lab-QA adjusted.

[6]Sediment data reported as sulfate-sulfur.

TABLE D-23 FLOW RATES FROM 1998 WATER SAMPLING			
Station		Flow (ft³/s)-May	Flow (ft³/s)-Sept.
Water Supply Wells			
GW001	FMC Office Well	Not applicable	Not applicable
GW002	Huntzeker Well	Not applicable	Not applicable
GW003	Upper Dry Valley Stock Well #1	Not applicable	Not applicable
GW004	Upper Dry Valley Stock Well #2	Not applicable	Not applicable
GW005	Upper Dry Valley Stock Well #3	Not applicable	Not applicable
GW006	Rasmussen Ridge Mine Dust Control Well #1	Not applicable	Not applicable
GW007	Rasmussen Ridge Mine Dust Control Well #2	Not applicable	Not applicable
GW008	Rasmussen Ridge Mine Shop/Office Well	Not applicable	Not applicable
GW009	Rasmussen Ridge Mine Wash Plant Well #1	Not applicable	Not applicable
GW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist	well does not exist
GW011	Rasmussen Ridge Mine Wash Plant Well #3	Not applicable	Not applicable
GW012	Rasmussen Ridge Mine Wash Plant Well #4	Not applicable	Not applicable
GW013	Rasmussen Ridge Mine Wash Plant Well #5	Not applicable	Not applicable
GW014	Rasmussen Ridge Mine House Well	Not applicable	Not applicable
GW015	Rasmussen Ridge Mine Laboratory Well	Not applicable	Not applicable
GW016	Conda Mine Water Supply Well #11	Not applicable	Not applicable
GW017	Smoky Canyon Mine Potable Supply Well	Not applicable	Not applicable
GW018	Smoky Canyon Mine Industrial Supply Well	well not in use	well not in use
GW019	Enoch Valley Shop/Office Well	Not applicable	Not applicable
GW020	Enoch Valley Mine Dust Control Well	Not applicable	Not applicable
Waste Rock Dump Seeps			
SWDS003	Dry Valley Mine South B Dump Seep	**No Flow Taken**	**0.15**
SWDS010	Wooley Valley Mine Unit I Overburden Dump Seep	**No Flow Taken**	**Stagnant**
SWDS011	Wooley Valley Mine Unit III Overburden Dump Seep	**No Flow Taken**	**Station was dry**
SWDS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**No Flow Taken**	**Station was dry**
SWDS015	Conda Mine West Limb Waste Dump Seep	**No Flow Taken**	**0.02**
French Drains			
SWFD001	Conda Mine French Drain	**0.12**	**0.06**
SWFD002	Henry Mine South Pit Overburden Dump Limestone Drain	**No Flow Taken**	**No Flow Taken**
Miscellaneous Facilities			
SWMF001	Central Farmers Plant Thickener	Not applicable	Not applicable
SWMF002	Dry Valley Mine Pit Dewatering Pond	Not applicable	Not applicable
Stock Ponds			
SWMP022	Wooley Valley Mine Unit IV Pit Pond	Not applicable	Not applicable
SWMP032	Smoky Canyon Mine A Pit Pond	Not applicable	Not applicable
SWSP011	Ballard Mine Upper Elk Pond	Not applicable	Not applicable
SWSP024	Enoch Valley Mine North Pond	Not applicable	Not applicable
SWSP025	Gay Mine W Pit Pond	Not applicable	Not applicable
SWSP026	Gay Mine Z Pit Pond	Not applicable	Not applicable
SWSP027	Gay Mine JD Pit Pond	Not applicable	Not applicable
Streams			
SWST001	Portneuf River, below Bakers Creek	**19**	**21**
SWST004	Portneuf River, above U Creek	**5.2**	**1.9**
SWST013	Ross Fork, below Danielson Creek	**21**	**5.1**
SWST015	Ross Fork, above South 40 of Gay Mine	**0.37**	**0.090**
SWST019	Blackfoot River, below Ballard Creek	**No Flow Taken**	**95**
SWST020	Blackfoot River, below State Land Creek	**No Flow Taken**	**130**
SWST022	Blackfoot River, below Wooley Valley Creek	**No Flow Taken**	**No Flow Taken**
SWST023	Blackfoot River, below Dry Valley Creek	**No Flow Taken**	**91**
SWST024	Blackfoot River, above Dry Valley Creek	**No Flow Taken**	**84**
SWST026	Blackfoot River, above Wooley Range Ridge Creek	**No Flow Taken**	**76**
SWST229	Blackfoot River, below Spring Creek	**No Flow Taken**	**60**
SWST031	Lincoln Creek, below Dry Hollow Creek	**Stagnant**	**Stagnant**
SWST033	Lincoln Creek, above North Limb of Gay Mine	**1.8**	**0.23**
SWST042	Grizzly Creek, below Phosphoria Formation outcrop	**0.25**	**No Flow Taken**
SWST043	Little Blackfoot River, below Long Valley Creek	**33**	**0.88**
SWST044	Little Blackfoot River, below Henry Mine	**21**	**2.6**
SWST046	Little Blackfoot River, below Enoch Valley Creek	**Stagnant**	**Stagnant**
SWST047	Little Blackfoot River, above Enoch Valley Creek	**2.0**	**Stagnant**
SWST048	Little Blackfoot River, below Reese Creek	**11**	**1.1**
SWST049	Little Blackfoot River, above Reese Creek	**7.1**	**0.22**
SWST071	State Land Creek, below tributaries	**1.2**	**0.060**

TABLE D-23 FLOW RATES FROM 1998 WATER SAMPLING (CONTINUED)			
Station		Flow (ft^3/s)-May	Flow (ft^3/s)-Sept.
Streams, Continued			
SWST076	Trail Creek, above Blackfoot River	**No Flow Taken**	**Stagnant-Beaver Dam**
SWST078	Trail Creek, above Camp G Creek	**13**	**4.2**
SWST097	Slug Creek, below Goodheart Creek	**23**	**6.1**
SWST098	Slug Creek, above Goodheart Creek	**11**	**1.0**
SWST100	Slug Creek, above Dry Basin Creek	**5.4**	**0.68**
SWST101	Caldwell Creek, below Phosphoria Formation outcrop	**1.7**	**0.25**
SWST113	Dry Valley Creek, above Blackfoot River	**22**	**0.060**
SWST129	Angus Creek, below Wooley Valley Mine	**5.5**	**0.98**
SWST131	Rasmussen Creek, above Angus Creek	**11**	**Stagnant**
SWST132	Angus Creek, above No Name Creek[1]	**31**	**1.5**
SWST137	No Name, above Angus Creek[1]	**5.1**	**Stream was dry**
SWST149	East Mill Creek, above Spring Creek on north fork	**1.9**	**ST227**
SWST150	East Mill Creek, above Spring Creek on south fork	**2.8**	**ST227**
SWST227	East Mill Creek, at fish sampling reach	**Station did not exist**	
SWST152	Diamond Creek, below Kendall Creek	**48**	**18**
SWST153	Diamond Creek, above Kendall Creek	**71**	**21**
SWST155	Lanes Creek, below 6500 Feet Creek	**No Flow Taken**	**29**
SWST156	Lanes Creek, below Sheep Creek	**No Flow Taken**	**16**
SWST161	Sheep Creek, above Lanes Creek	**36**	**5.8**
SWST162	Sheep Creek, below West Fork Sheep Creek	**22**	**4.9**
SWST163	Sheep Creek, above West Fork Sheep Creek	**16**	**3.9**
SWST173	Smoky Creek, below Smoky Canyon Mine	**0.070**	**1.3**
SWST174	Smoky Creek, above activity at Smoky Canyon Mine	**0.10**	**0.40**
SWST176	Roberts Creek, above tailings ponds	**0.62**	**0.28**
SWST183	Sage Creek, below Smoky Canyon Mine	**9.8**	**2.8**
SWST184	Sage Creek, above Smoky Canyon Mine	**15.8**	**6.6**
SWST185	South Fork Sage Creek, below Phosphoria Formation outcrop	**5.0**	**0.16**
SWST228	South Fork Sage Creek, at fish sampling reach	**Station did not exist**	**?**
SWST187	North Fork Sage Creek, below Pole Creek	**4.0**	**0.12**
SWST188	North Fork Sage Creek, above Pole Creek	**0.23**	**0.06**
SWST193	South Fork Deer Creek	**No Flow Taken**	**0.090**
SWST196	Georgetown Creek, below irrigation diversion dam	**31**	**4.8**
SWST200	Georgetown Creek, above Georgetown Canyon Mine	**0.17**	**Station was dry**
SWST201	Right Hand Fork, below Georgetown Canyon Mine	**0.45**	**2.7**
SWST202	Right Hand Fork, above Georgetown Canyon Mine	**0.095**	**0.016**
SWST218	Formation Creek, headwaters	**No Flow Taken**	**No Flow Taken**
Tailings Ponds			
SWTP001	Wooley Valley Mine Tailings Pond #1	Not applicable	Not applicable
SWTP002	Wooley Valley Mine Tailings Pond #2	Not applicable	Not applicable
SWTP003	Wooley Valley Mine Tailings Pond #3	Not applicable	Not applicable
SWTP004	Smoky Canyon Mine Tailings Pond #1	Not applicable	Not applicable
SWTP005	Smoky Canyon Mine Tailings Pond #2	Not applicable	Not applicable
[1]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.			

TABLE D-24 HARDNESS-SPECIFIC WATER QUALITY CRITERIA RESULTS FROM 1998 WATER SAMPLING									
Station		May Sampling				September Sampling			
		Hardness, mg $CaCO_3$/L	Hardness-Specific Criterion, mg/L[3]			Hardness, mg $CaCO_3$/L	Hardness-Specific Criterion, mg/L[3]		
			Cd	*Ni*	*Zn*		*Cd*	*Ni*	*Zn*
Water Supply Wells									
GW001	FMC Office Well	190	**0.0017**	0.27	0.18	180	0.0016	0.26	0.17
GW002	Huntzeker Well	360	0.0027	0.46	0.31	310	0.0024	0.41	0.27
GW003	Upper Dry Valley Stock Well #1	460	0.0029	0.51	0.34	270	0.0021	0.36	0.24
GW004	Upper Dry Valley Stock Well #2	500	0.0029	0.51	0.34	400	**0.0029**	0.51	0.34
GW005	Upper Dry Valley Stock Well #3	190	0.0017	0.27	**0.18**	240	0.0020	0.33	**0.22**
GW006	Rasmussen Ridge Mine Dust Control Well #1	200	**0.0017**	0.28	0.19	190	0.0017	0.27	0.18
GW007	Rasmussen Ridge Mine Dust Control Well #2	140	**0.0013**	0.21	0.14	150	**0.0014**	0.22	0.15
GW008	Rasmussen Ridge Mine Shop/Office Well	200	**0.0017**	0.28	**0.19**	180	0.0016	0.26	**0.17**
GW009	Rasmussen Ridge Mine Wash Plant Well #1	220	0.0018	0.31	0.20	190	0.0017	0.27	0.18
GW010	Rasmussen Ridge Mine Wash Plant Well #2	well does not exist				well does not exist			
GW011	Rasmussen Ridge Mine Wash Plant Well #3	220	0.0018	0.31	0.20	well was broken			
GW012	Rasmussen Ridge Mine Wash Plant Well #4	290	0.0023	0.39	0.26	210	0.0018	0.29	0.20
GW013	Rasmussen Ridge Mine Wash Plant Well #5	240	0.0020	0.33	0.22	190	**0.0017**	0.27	0.18
GW014	Rasmussen Ridge Mine House Well	210	**0.0018**	0.29	**0.20**	240	0.0020	**0.33**	**0.22**
GW015	Rasmussen Ridge Mine Laboratory Well	210	0.0018	0.29	0.20	220	0.0018	0.31	0.20
GW016	Conda Mine Water Supply Well #11	350	0.0026	0.45	0.30	350	0.0026	0.45	0.30
GW017	Smoky Canyon Mine Potable Supply Well	260	0.0021	0.35	0.23	250	**0.0020**	0.34	0.23
GW018	Smoky Canyon Mine Industrial Supply Well	well not in use				well not in use			
GW019	Enoch Valley Shop/Office Well	230	0.0019	0.32	0.21	240	0.0020	0.33	0.22
GW020	Enoch Valley Mine Dust Control Well	220	**0.0018**	0.31	**0.20**	220	**0.0018**	0.31	**0.20**
Waste Rock Dump Seeps									
SWDS003	Dry Valley Mine South B Dump Seep	350	**0.0026**	0.45	0.30	270	0.0021	0.36	0.24
SWDS010	Wooley Valley Mine Unit I Overburden Dump Seep	540	0.0029	0.51	0.34	450	0.0029	0.51	0.34
SWDS011	Wooley Valley Mine Unit III Overburden Dump Seep	320	0.0024	0.42	0.28	station was dry			
SWDS012	Wooley Valley Mine Unit IV Overburden Dump Seep	1,400	**0.0029**	0.5	**0.34**	station was dry			
SWDS015	Conda Mine West Limb Waste Dump Seep	2600	**0.0029**	0.51	0.34	2,400	**0.0029**	0.51	**0.34**
French Drains									
SWFD001	Conda Mine French Drain	690	**0.0029**	0.51	0.34	670	0.0029	0.51	0.34
SWFD002	Henry Mine South Pit Overburden Dump Limestone Drain	480	**0.0029**	0.51	0.34	430	0.0029	0.51	0.34
Miscellaneous Facilities									
SWMF001	Central Farmers Plant Thickener	59	0.00070	0.10	0.067	72	0.00081	0.12	0.079
SWMF002	Dry Valley Mine Pit Dewatering Pond	170	**0.0015**	0.25	**0.16**	150	0.0014	0.22	0.15
Stock Ponds									
SWMP022	Wooley Valley Mine Unit IV Pit Pond	110	0.0011	0.17	0.11	120	0.0012	0.18	0.12
SWMP032	Smoky Canyon Mine A Pit Pond	190	0.0017	0.27	0.18	210	**0.0018**	0.29	0.20
SWSP011	Ballard Mine Upper Elk Pond	98	**0.0010**	0.15	0.10	station was dry			
SWSP024	Enoch Valley Mine North Pond	300	**0.0023**	0.40	0.27	440	0.0031	0.55	0.37
SWSP025	Gay Mine W Pit Pond	250	**0.0020**	0.34	0.23	310	**0.0024**	0.41	0.27
SWSP026	Gay Mine Z Pit Pond	320	0.0024	0.42	0.28	280	0.0022	0.38	0.25
SWSP027	Gay Mine JD Pit Pond	470	**0.0029**	0.51	0.34	420	0.0029	0.51	0.34

TABLE D-24
HARDNESS-SPECIFIC WATER QUALITY CRITERIA RESULTS FROM 1998 WATER SAMPLING
(CONTINUED)

Station		May Sampling				September Sampling			
		Hardness, mg $CaCO_3$/L	Hardness-Specific Criterion, mg/L[3]			Hardness, mg $CaCO_3$/L	Hardness-Specific Criterion, mg/L[3]		
			Cd	*Ni*	*Zn*		*Cd*	*Ni*	*Zn*
Streams									
SWST001	Portneuf River, below Bakers Creek	410	0.0029	0.51	0.34	390	0.0028	0.50	0.33
SWST004	Portneuf River, above U Creek	300	0.0023	0.40	0.27	280	0.0022	0.38	0.25
SWST013	Ross Fork, below Danielson Creek	93	**0.00098**	0.15	0.098	150	0.0014	0.22	0.15
SWST015	Ross Fork, above South 40 of Gay Mine	420	**0.0029**	0.51	0.34	440	0.0029	0.51	0.34
SWST019	Blackfoot River, below Ballard Creek	180	**0.0016**	0.26	0.17	180	0.0016	0.26	0.17
SWST020	Blackfoot River, below State Land Creek	180	**0.0016**	0.26	0.17	180	0.0016	0.26	0.17
SWST022	Blackfoot River, below Wooley Valley Creek	200	0.0017	0.28	0.19	190	**0.0017**	0.27	0.18
SWST023	Blackfoot River, below Dry Valley Creek	180	**0.0016**	0.26	0.17	180	0.0016	0.26	0.17
SWST024	Blackfoot River, above Dry Valley Creek	170	**0.0015**	0.25	0.16	190	**0.0017**	0.27	0.18
SWST026	Blackfoot River, above Wooley Range Ridge Creek	190	0.0017	0.27	0.18	180	**0.0016**	0.26	0.17
SWST229	Blackfoot River, below Spring Creek	190	0.0017	0.27	0.18	190	0.0017	0.27	0.18
SWST031	Lincoln Creek, below Dry Hollow Creek	490	**0.0029**	0.51	0.34	450	0.0029	0.51	0.34
SWST033	Lincoln Creek, above North Limb of Gay Mine	330	**0.0025**	0.43	0.29	300	0.0023	0.40	0.27
SWST042	Grizzly Creek, below Phosphoria Formation outcrop	230	**0.0019**	0.32	0.21	290	0.0023	0.39	0.26
SWST043	Little Blackfoot River, below Long Valley Creek	270	**0.0021**	0.36	0.24	440	**0.0029**	0.51	0.34
SWST044	Little Blackfoot River, below Henry Mine	320	**0.0024**	0.42	0.28	290	0.0023	0.39	0.26
SWST046	Little Blackfoot River, below Enoch Valley Creek	220	**0.0018**	0.31	0.20	240	**0.0020**	0.33	0.22
SWST047	Little Blackfoot River, above Enoch Valley Creek	250	**0.0020**	0.34	0.23	230	0.0019	0.32	0.21
SWST048	Little Blackfoot River, below Reese Creek	170	0.0015	0.25	0.16	200	0.0017	0.28	0.19
SWST049	Little Blackfoot River, above Reese Creek	140	0.0013	0.21	0.14	180	0.0016	0.26	0.17
SWST071	State Land Creek, below tributaries	160	0.0015	0.23	0.16	190	**0.0017**	0.27	0.18
SWST076	Trail Creek, above Blackfoot River	220	0.0018	0.31	0.20	180	**0.0016**	0.26	0.17
SWST078	Trail Creek, above Camp G Creek	200	**0.0017**	0.28	0.19	200	0.0017	0.28	0.19
SWST097	Slug Creek, below Goodheart Creek	200	0.0017	0.28	0.19	230	0.0019	0.32	0.21
SWST098	Slug Creek, above Goodheart Creek	170	0.0015	0.25	0.16	210	0.0018	0.29	0.20
SWST100	Slug Creek, above Dry Basin Creek	130	0.0013	0.20	0.13	220	0.0018	0.31	0.20
SWST101	Caldwell Creek, below Phosphoria Formation outcrop	240	0.0020	0.33	0.22	210	0.0018	0.29	0.20
SWST113	Dry Valley Creek, above Blackfoot River	230	**0.0019**	0.32	0.21	240	0.0020	0.33	0.22
SWST129	Angus Creek, below Wooley Valley Mine	220	0.0018	0.31	0.20	260	0.0021	0.35	0.23
SWST131	Rasmussen Creek, above Angus Creek	94	**0.0010**	0.15	0.099	190	0.0017	0.27	0.18
SWST132	Angus Creek, above No Name Creek[2]	140	**0.0013**	0.21	0.14	240	0.0020	0.33	0.22
SWST137	No Name, above Angus Creek[2]	61	**0.00072**	0.10	0.069	station was dry			
SWST149	East Mill Creek, above Spring Creek on north fork	230	0.0019	0.32	0.21	ST227 sampled instead			
SWST150	East Mill Creek, above Spring Creek on south fork	230	0.0019	0.32	0.21	ST227 sampled instead			
SWST227	East Mill Creek, at fish sampling reach	station not yet established				190	0.0017	0.27	0.18
SWST152	Diamond Creek, below Kendall Creek	180	0.0016	0.26	0.17	190	0.0017	0.27	0.18
SWST153	Diamond Creek, above Kendall Creek	180	0.0016	0.26	0.17	190	0.0017	0.27	0.18
SWST155	Lanes Creek, below 6500 Feet Creek	170	0.0015	0.25	0.16	190	0.0017	0.27	0.18
SWST156	Lanes Creek, below Sheep Creek	180	**0.0016**	0.26	0.17	170	0.0015	0.25	0.16

TABLE D-24
HARDNESS-SPECIFIC WATER QUALITY CRITERIA RESULTS FROM 1998 WATER SAMPLING
(CONTINUED)

Station		May Sampling				September Sampling			
		Hardness, mg $CaCO_3$/L	Hardness-Specific Criterion, mg/L[3]			Hardness, mg $CaCO_3$/L	Hardness-Specific Criterion, mg/L[3]		
			Cd	*Ni*	*Zn*		*Cd*	*Ni*	*Zn*
Streams									
SWST161	Sheep Creek, above Lanes Creek	180	**0.0016**	0.26	0.17	190	0.0017	0.27	0.18
SWST162	Sheep Creek, below West Fork Sheep Creek	170	0.0015	0.25	0.16	170	0.0015	0.25	0.16
SWST163	Sheep Creek, above West Fork Sheep Creek	150	0.0014	0.22	0.15	170	0.0015	0.25	0.16
SWST173	Smoky Creek, below Smoky Canyon Mine	240	0.0020	0.33	0.22	220	0.0018	0.31	0.20
SWST174	Smoky Creek, above activity at Smoky Canyon Mine	220	0.0018	0.31	0.20	220	0.0018	0.31	0.20
SWST176	Roberts Creek, above tailings ponds	330	**0.0025**	0.43	0.29	310	0.0024	0.41	0.27
SWST183	Sage Creek, below Smoky Canyon Mine	210	0.0018	0.29	0.20	200	0.0017	0.28	0.19
SWST184	Sage Creek, above Smoky Canyon Mine	190	0.0017	0.27	0.18	190	0.0017	0.27	0.18
SWST185	South Fork Sage Creek, below Phosphoria Formation outcrop	160	0.0015	0.23	0.16	200	0.0017	0.28	0.19
SWST187	North Fork Sage Creek, below Pole Creek	320	0.0024	0.42	0.28	410	0.0029	0.51	0.34
SWST188	North Fork Sage Creek, above Pole Creek	150	0.0014	0.22	0.15	220	**0.0018**	0.31	0.20
SWST193	South Fork Deer Creek	station was snow-covered				190	0.0017	0.27	0.18
SWST196	Georgetown Creek, below irrigation diversion dam	220	0.0018	0.31	0.20	270	0.0021	0.36	0.24
SWST200	Georgetown Creek, above Georgetown Canyon Mine	190	0.0017	0.27	0.18	station was dry			
SWST201	Right Hand Fork, below Georgetown Canyon Mine	320	0.0024	0.42	0.28	310	0.0024	0.41	0.27
SWST202	Right Hand Fork, above Georgetown Canyon Mine	180	0.0016	0.26	0.17	160	0.0015	0.23	0.16
SWST218	Formation Creek, headwaters	540	0.0029	0.51	0.34	540	0.0029	0.51	0.34
SWST228	South Fork Sage Creek, at fish sampling reach	station not yet established				220	0.0018	0.31	0.20
Tailings Ponds									
SWTP001	Wooley Valley Mine Tailings Pond #1	150	0.0014	0.22	0.15	170	0.0015	0.25	0.16
SWTP002	Wooley Valley Mine Tailings Pond #2	94	**0.00098**	0.15	0.099	78	**0.00086**	0.13	0.085
SWTP003	Wooley Valley Mine Tailings Pond #3	97	**0.0010**	0.15	0.10	96	**0.0010**	0.15	0.10
SWTP004	Smoky Canyon Mine Tailings Pond #1	250	0.0020	0.34	0.23	250	**0.0020**	0.34	0.23
SWTP005	Smoky Canyon Mine Tailings Pond #2	240	**0.0020**	0.33	0.22	180	**0.0016**	0.26	0.17

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples; UC-Davis results not yet factored in.
[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.
[3]Bolded and shaded criteria are exceeded by their corresponding concentration at that station.

TABLE D-25
ORGANIC CARBON RESULTS FROM 1998 SEDIMENT SAMPLING

Station		Organic Carbon, (%)
Wells		
PW001	FMC Office Well	not applicable
PW002	Huntzeker Well	not applicable
PW003	Upper Dry Valley Stock Well #1	not applicable
PW004	Upper Dry Valley Stock Well #2	not applicable
PW005	Upper Dry Valley Stock Well #3	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	not applicable
PW014	Rasmussen Ridge Mine House Well	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	not applicable
PW016	Conda Mine Water Supply Well #11	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	not applicable
PW019	Enoch Valley Shop/Office Well	not applicable
PW020	Enoch Valley Mine Dust Control Well	not applicable
Waste Rock Dump Seeps		
DS003	Dry Valley Mine South B Dump Seep	6.0
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	6.2
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	7.2
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	7.1
DS015	Conda Mine West Limb Waste Dump Seep	5.9
French Drains		
FD001	Conda Mine French Drain	4.7
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	2.5
Miscellaneous Facilities		
MF001	Central Farmers Plant Thickener	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	not applicable
Stock Ponds		
MP022	Wooley Valley Mine Unit IV Pit Pond	0.85
MP032	Smoky Canyon Mine A Pit Pond	2.6
SP011	Ballard Mine Upper Elk Pond	2.8
SP024	Enoch Valley Mine North Pond	3.3
SP025	Gay Mine W Pit Pond	1.4
SP026	Gay Mine Z Pit Pond	1.1
SP027	Gay Mine JD Pit Pond	0.68
Streams		
ST001	Portneuf River, below Bakers Creek	2.8
ST004	Portneuf River, above U Creek	3.6
ST013	Ross Fork, below Danielson Creek	4.2
ST015	Ross Fork, above South 40 of Gay Mine	5.9
ST019	Blackfoot River, below Ballard Creek	1.1
ST020	Blackfoot River, below State Land Creek	0.48
ST022	Blackfoot River, below Wooley Valley Creek	1.0
ST023	Blackfoot River, below Dry Valley Creek	0.80
ST024	Blackfoot River, above Dry Valley Creek	0.45
ST026	Blackfoot River, above Wooley Range Ridge Creek	0.76
ST229	Blackfoot River, below Spring Creek	0.48
ST031	Lincoln Creek, below Dry Hollow Creek	3.0
ST033	Lincoln Creek, above North Limb of Gay Mine	2.0
ST042	Grizzly Creek, below Phosphoria Formation outcrop	5.1
ST043	Little Blackfoot River, below Long Valley Creek	2.2
ST044	Little Blackfoot River, below Henry Mine	0.95
ST046	Little Blackfoot River, below Enoch Valley Creek	2.8
ST047	Little Blackfoot River, above Enoch Valley Creek	3.9
ST048	Little Blackfoot River, below Reese Creek	2.3

TABLE D-25
ORGANIC CARBON RESULTS FROM 1998 SEDIMENT SAMPLING
(CONTINUED)

Station		Organic Carbon, (%)
Wells		
ST049	Little Blackfoot River, above Reese Creek	1.1
ST071	State Land Creek, below tributaries	5.8
ST076	Trail Creek, above Blackfoot River	5.8
ST078	Trail Creek, above Camp G Creek	1.8
ST097	Slug Creek, below Goodheart Creek	0.75
ST098	Slug Creek, above Goodheart Creek	2.8
ST100	Slug Creek, above Dry Basin Creek	3.6
ST101	Caldwell Creek, below Phosphoria Formation outcrop	1.1
ST113	Dry Valley Creek, above Blackfoot River	3.9
ST129	Angus Creek, below Wooley Valley Mine	0.64
ST131	Rasmussen Creek, above Angus Creek	4.0
ST132	Angus Creek, above No Name Creek[2]	1.2
ST137	No Name, above Angus Creek[2]	0.67
ST149	East Mill Creek, above Spring Creek on north fork	sample not reported
ST150	East Mill Creek, above Spring Creek on south fork	sample not reported
ST227	East Mill Creek, at fish sampling reach	0.41
ST152	Diamond Creek, below Kendall Creek	0.84
ST153	Diamond Creek, above Kendall Creek	0.43
ST155	Lanes Creek, below 6500 Feet Creek	0.38
ST156	Lanes Creek, below Sheep Creek	0.40
ST161	Sheep Creek, above Lanes Creek	0.67
ST162	Sheep Creek, below West Fork Sheep Creek	1.8
ST163	Sheep Creek, above West Fork Sheep Creek	0.61
ST173	Smoky Creek, below Smoky Canyon Mine	0.93
ST174	Smoky Creek, above activity at Smoky Canyon Mine	1.1
ST176	Roberts Creek, above tailings ponds	0.75
ST183	Sage Creek, below Smoky Canyon Mine	3.0
ST184	Sage Creek, above Smoky Canyon Mine	0.59
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	0.64
ST187	North Fork Sage Creek, below Pole Creek	1.7
ST188	North Fork Sage Creek, above Pole Creek	2.7
ST193	South Fork Deer Creek	0.79
ST196	Georgetown Creek, below irrigation diversion dam	1.3
ST200	Georgetown Creek, above Georgetown Canyon Mine	0.68
ST201	Right Hand Fork, below Georgetown Canyon Mine	0.48
ST202	Right Hand Fork, above Georgetown Canyon Mine	1.4
ST218	Formation Creek, headwaters	sample not reported
ST228	South Fork Sage Creek, at fish sampling reach	0.48
Tailings Ponds		
TP001	Wooley Valley Mine Tailings Pond #1	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D.26
PARTICLE SIZE DISTRIBUTION RESULTS FROM 1998 SEDIMENT SAMPLING

Station		Particle Distribution		
		Sand, %	Silt, %	Clay, %
Wells				
PW001	FMC Office Well	not applicable	not applicable	not applicable
PW002	Huntzeker Well	not applicable	not applicable	not applicable
PW003	Upper Dry Valley Stock Well #1	not applicable	not applicable	not applicable
PW004	Upper Dry Valley Stock Well #2	not applicable	not applicable	not applicable
PW005	Upper Dry Valley Stock Well #3	not applicable	not applicable	not applicable
PW006	Rasmussen Ridge Mine Dust Control Well #1	not applicable	not applicable	not applicable
PW007	Rasmussen Ridge Mine Dust Control Well #2	not applicable	not applicable	not applicable
PW008	Rasmussen Ridge Mine Shop/Office Well	not applicable	not applicable	not applicable
PW009	Rasmussen Ridge Mine Wash Plant Well #1	not applicable	not applicable	not applicable
PW010	Rasmussen Ridge Mine Wash Plant Well #2	not applicable	not applicable	not applicable
PW011	Rasmussen Ridge Mine Wash Plant Well #3	not applicable	not applicable	not applicable
PW012	Rasmussen Ridge Mine Wash Plant Well #4	not applicable	not applicable	not applicable
PW013	Rasmussen Ridge Mine Wash Plant Well #5	not applicable	not applicable	not applicable
PW014	Rasmussen Ridge Mine House Well	not applicable	not applicable	not applicable
PW015	Rasmussen Ridge Mine Laboratory Well	not applicable	not applicable	not applicable
PW016	Conda Mine Water Supply Well #11	not applicable	not applicable	not applicable
PW017	Smoky Canyon Mine Potable Supply Well	not applicable	not applicable	not applicable
PW018	Smoky Canyon Mine Industrial Supply Well	not applicable	not applicable	not applicable
PW019	Enoch Valley Shop/Office Well	not applicable	not applicable	not applicable
PW020	Enoch Valley Mine Dust Control Well	not applicable	not applicable	not applicable
Waste Rock Dump Seeps				
DS003	Dry Valley Mine South B Dump Seep	44	41	15
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	32	52	16
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	43	46	11
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	50	35	15
DS015	Conda Mine West Limb Waste Dump Seep	69	22	9
French Drains				
FD001	Conda Mine French Drain	51	34	15
FD002	Henry Mine South Pit Overburden Dump Limestone Drain	38	50	12
Miscellaneous Facilities				
MF001	Central Farmers Plant Thickener	not applicable	not applicable	not applicable
MF002	Dry Valley Mine Pit Dewatering Pond	not applicable	not applicable	not applicable
Stock Ponds				
MP022	Wooley Valley Mine Unit IV Pit Pond	29	46	25
MP032	Smoky Canyon Mine A Pit Pond	20	62	18
SP011	Ballard Mine Upper Elk Pond	16	45	39
SP024	Enoch Valley Mine North Pond	18	48	34
SP025	Gay Mine W Pit Pond	32	60	8
SP026	Gay Mine Z Pit Pond	55	29	16
SP027	Gay Mine JD Pit Pond	80	15	5

TABLE D.26 PARTICLE SIZE DISTRIBUTION RESULTS FROM 1998 SEDIMENT SAMPLING (CONTINUED)				
Station		**Particle Distribution**		
		Sand, %	**Silt, %**	**Clay, %**
Streams				
ST001	Portneuf River, below Bakers Creek	56	39	5
ST004	Portneuf River, above U Creek	31	57	12
ST013	Ross Fork, below Danielson Creek	36	53	11
ST015	Ross Fork, above South 40 of Gay Mine	27	52	21
ST019	Blackfoot River, below Ballard Creek	74	21	5
ST020	Blackfoot River, below State Land Creek	85	12	3
ST022	Blackfoot River, below Wooley Valley Creek	69	27	4
ST023	Blackfoot River, below Dry Valley Creek	75	20	4
ST024	Blackfoot River, above Dry Valley Creek	77	19	4
ST026	Blackfoot River, above Wooley Range Ridge Creek	75	21	4
ST229	Blackfoot River, below Spring Creek	68	28	4
ST031	Lincoln Creek, below Dry Hollow Creek	28	55	17
ST033	Lincoln Creek, above North Limb of Gay Mine	57	36	7
ST042	Grizzly Creek, below Phosphoria Formation outcrop	39	42	19
ST043	Little Blackfoot River, below Long Valley Creek	63	32	6
ST044	Little Blackfoot River, below Henry Mine	75	21	4
ST046	Little Blackfoot River, below Enoch Valley Creek	51	45	4
ST047	Little Blackfoot River, above Enoch Valley Creek	32	52	16
ST048	Little Blackfoot River, below Reese Creek	63	30	7
ST049	Little Blackfoot River, above Reese Creek	60	34	6
ST071	State Land Creek, below tributaries	27	60	13
ST076	Trail Creek, above Blackfoot River	56	32	12
ST078	Trail Creek, above Camp G Creek	45	46	9
ST097	Slug Creek, below Goodheart Creek	74	22	4
ST098	Slug Creek, above Goodheart Creek	48	42	10
ST100	Slug Creek, above Dry Basin Creek	37	51	12
ST101	Caldwell Creek, below Phosphoria Formation outcrop	65	27	8
ST113	Dry Valley Creek, above Blackfoot River	45	39	16
ST129	Angus Creek, below Wooley Valley Mine	66	28	6
ST131	Rasmussen Creek, above Angus Creek	25	68	7
ST132	Angus Creek, above No Name Creek[2]	52	38	10
ST137	No Name, above Angus Creek[2]	68	26	6
ST149	East Mill Creek, above Spring Creek on north fork		sample not reported	
ST150	East Mill Creek, above Spring Creek on south fork		sample not reported	
ST227	East Mill Creek, at fish sampling reach	77	19	4
ST152	Diamond Creek, below Kendall Creek	52	43	5
ST153	Diamond Creek, above Kendall Creek	42	48	9
ST155	Lanes Creek, below 6500 Feet Creek	73	24	3
ST156	Lanes Creek, below Sheep Creek	69	26	5

TABLE D.26
PARTICLE SIZE DISTRIBUTION RESULTS FROM 1998 SEDIMENT SAMPLING
(CONTINUED)

Station		Particle Distribution		
		Sand, %	Silt, %	Clay, %
Streams, Continued				
ST161	Sheep Creek, above Lanes Creek	67	29	4
ST162	Sheep Creek, below West Fork Sheep Creek	65	31	4
ST163	Sheep Creek, above West Fork Sheep Creek	67	27	6
ST173	Smoky Creek, below Smoky Canyon Mine	54	38	8
ST174	Smoky Creek, above activity at Smoky Canyon Mine	69	28	3
ST176	Roberts Creek, above tailings ponds	67	28	5
ST183	Sage Creek, below Smoky Canyon Mine	44	42	14
ST184	Sage Creek, above Smoky Canyon Mine	62	34	4
ST185	South Fork Sage Creek, below Phosphoria Formation outcrop	66	30	4
ST187	North Fork Sage Creek, below Pole Creek	62	33	5
ST188	North Fork Sage Creek, above Pole Creek	61	35	4
ST193	South Fork Deer Creek	80	16	4
ST196	Georgetown Creek, below irrigation diversion dam	78	18	4
ST200	Georgetown Creek, above Georgetown Canyon Mine	53	38	9
ST201	Right Hand Fork, below Georgetown Canyon Mine	79	16	5
ST202	Right Hand Fork, above Georgetown Canyon Mine	78	18	4
ST218	Formation Creek, headwaters		sample not reported	
ST228	South Fork Sage Creek, at fish sampling reach	71	25	4
Tailings Ponds				
TP001	Wooley Valley Mine Tailings Pond #1	not applicable	not applicable	not applicable
TP002	Wooley Valley Mine Tailings Pond #2	not applicable	not applicable	not applicable
TP003	Wooley Valley Mine Tailings Pond #3	not applicable	not applicable	not applicable
TP004	Smoky Canyon Mine Tailings Pond #1	not applicable	not applicable	not applicable
TP005	Smoky Canyon Mine Tailings Pond #2	not applicable	not applicable	not applicable

[1]Data adjusted, in the sequence presented here, for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]Rasmussen Creek and No Name Creek are not currently confluent; therefore, this station has been renamed to reflect current flow conditions.

TABLE D-27
FISH INFORMATION FOR 1998 SAMPLING

Station		Fish Information		
		Common Name	**Species Name**	**Length, mm**
Streams				
ST026	Blackfoot River, above Wooley Range Ridge Creek	Cutthroat Trout	Onchorhyncus clarkii	369
		Cutthroat Trout	Onchorhyncus clarkii	367
		Cutthroat Trout	Onchorhyncus clarkii	380
ST227	East Mill Creek, at fish sampling reach	Cutthroat Trout	Onchorhyncus clarkii	129
		Cutthroat Trout	Onchorhyncus clarkii	136
		Brook Trout	Salvelinus fontinalis	160
ST228	South Fork Sage Creek, at fish sampling reach	Brown Trout	Salmo trutta	134
		Brown Trout	Salmo trutta	125
		Brown Trout	Salmo trutta	240

Appendix E

APPENDIX E – VALIDATED SOIL AND VEGETATION DATA

TABLE E.1 SELENIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**7.2** [3]	**1.2** [3]
	Quadrant 2	**15**	**4.9**
	Quadrant 3	**22**	**1.0**
	Quadrant 4	**8.7**	**0.21**
	Quadrant 5	**16**	**0.19**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**18**	**3.1**
	Quadrant 2	**2.3**	**8.4**
	Quadrant 3	**31**	**6.6**
	Quadrant 4	**10**	**5.8**
	Quadrant 5	**1.8**	**7.2**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**33**	**24**
	Quadrant 2	**17**	**5.0**
	Quadrant 3	**17**	**12**
	Quadrant 4	**17**	**1.4**
	Quadrant 5	**11**	**4.3**
WD052	Champ Mine Dump		
	Quadrant 1	**3.7**	**0.32**
	Quadrant 2	**16**	**0.80**
	Quadrant 3	**3.2**	**2.2**
	Quadrant 4	**59**	**19**
	Quadrant 5	**14**	**0.84**
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**8.1**	**5.5**
	Quadrant 2	**120**	**24**
	Quadrant 3	**18**	**2.4**
	Quadrant 4	**56**	**17**
	Quadrant 5	**8.2**	**3.7**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**12**	**32**
	Quadrant 2	**28**	**7.6**
	Quadrant 3	**25**	**17**
	Quadrant 4	**11**	**26**
	Quadrant 5	**4.1**	**16**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**16**	**3.7**
	Quadrant 2	**8.1**	**20**
	Quadrant 3	**18**	**84**
	Quadrant 4	**35**	**55**
	Quadrant 5	**38**	**37**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**18**	**33**
	Quadrant 2	**77**	**38**
	Quadrant 3	**150**	**56**
	Quadrant 4	**75**	**36**
	Quadrant 5	**210**	**43**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**35**	**0.29**
	Quadrant 2	**37**	**0.57**
	Quadrant 3	**110**	**7.1**
	Quadrant 4	**30**	**9.6**
	Quadrant 5	**30**	**0.71**

TABLE E.1
SELENIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**0.69** [3]	**0.18** [3]
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**64**	**17**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**10**	**4.2**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**220**	**48**
DS015	Conda Mine Waste Dump West Limb Seep	**330**	**31**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**16**	**0.78**
	Quadrant 2	**11**	**0.46**
	Quadrant 3	**2.0**	**0.12**
	Quadrant 4	**3.7**	**0.19**
	Quadrant 5	**0.68**	*0.080* [2]
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**0.70**	**0.12**
	Quadrant 2	**1.3**	*0.080*
	Quadrant 3	**1.3**	*0.0015*
	Quadrant 4	**0.99**	*0.019*
	Quadrant 5	**0.75**	**0.11**
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**0.64**	**0.14**
	Quadrant 2	**0.61**	*-0.015*
	Quadrant 3	**1.0**	*0.0079*
	Quadrant 4	**1.4**	*0.019*
	Quadrant 5	**1.4**	*0.063*

1Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.17 mg/kg for soil and 0.088 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.17 mg/kg for soil and 0.088 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.2 CADMIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		***Field-and-Lab-QA-Adjusted Concentration*** [1]	
Identification No.	***Name***	***Soil, mg/kg (dry weight)***	***Vegetation, mg/kg (dry weight)***
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**26** [3]	**2.0** [3]
	Quadrant 2	**44**	**2.9**
	Quadrant 3	**44**	**2.6**
	Quadrant 4	**40**	**2.6**
	Quadrant 5	**35**	**2.0**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**65**	**2.2**
	Quadrant 2	**15**	**2.3**
	Quadrant 3	**76**	**2.4**
	Quadrant 4	**37**	**0.85**
	Quadrant 5	**19**	**3.0**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**41**	**2.4**
	Quadrant 2	**64**	**1.9**
	Quadrant 3	**72**	**4.0**
	Quadrant 4	**77**	**3.6**
	Quadrant 5	**63**	**2.0**
WD052	Champ Mine Dump		
	Quadrant 1	**4.9**	**0.24**
	Quadrant 2	**5.3**	**1.8**
	Quadrant 3	**28**	*0.093* [2]
	Quadrant 4	**6.5**	**2.3**
	Quadrant 5	**38**	**0.94**
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**38**	**3.2**
	Quadrant 2	**43**	**1.1**
	Quadrant 3	**91**	**3.8**
	Quadrant 4	**47**	**2.1**
	Quadrant 5	**55**	**8.4**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**48**	**1.7**
	Quadrant 2	**41**	**2.0**
	Quadrant 3	**55**	**2.5**
	Quadrant 4	**23**	**1.1**
	Quadrant 5	**19**	**1.0**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**42**	**1.5**
	Quadrant 2	**36**	**2.3**
	Quadrant 3	**35**	**2.8**
	Quadrant 4	**44**	**2.0**
	Quadrant 5	**47**	**2.4**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**34**	**0.91**
	Quadrant 2	**41**	**1.1**
	Quadrant 3	**34**	**1.1**
	Quadrant 4	**50**	**1.3**
	Quadrant 5	**59**	**1.3**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**31**	**0.72**
	Quadrant 2	**30**	**1.0**
	Quadrant 3	**19**	**0.43**
	Quadrant 4	**34**	**0.69**
	Quadrant 5	**31**	**0.75**

TABLE E.2
CADMIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		*Field-and-Lab-QA-Adjusted Concentration* [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**7.4** [3]	**0.39** [3]
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**42**	**0.79**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**30**	**0.59**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**110**	**0.69**
DS015	Conda Mine Waste Dump West Limb Seep	**30**	**1.2**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**16**	**1.8**
	Quadrant 2	**14**	**1.2**
	Quadrant 3	**8.9**	**0.75**
	Quadrant 4	**9.5**	**0.95**
	Quadrant 5	**4.9**	**0.52**
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**24**	**0.85**
	Quadrant 2	**28**	**2.1**
	Quadrant 3	**6.2**	**0.39**
	Quadrant 4	**6.4**	**0.59**
	Quadrant 5	**9.2**	**1.3**
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**5.7**	*0.10* [2]
	Quadrant 2	**9.2**	*0.15*
	Quadrant 3	**7.5**	**0.67**
	Quadrant 4	**4.7**	**0.33**
	Quadrant 5	**4.7**	**0.29**

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 0.58 mg/kg for soil and 0.19 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 0.58 mg/kg for soil and 0.19 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.3 MANGANESE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**370** [3]	**16** [3]
	Quadrant 2	**340**	**20**
	Quadrant 3	**280**	**17**
	Quadrant 4	**410**	**20**
	Quadrant 5	**320**	**20**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**130**	**24**
	Quadrant 2	**650**	**32**
	Quadrant 3	**86**	**20**
	Quadrant 4	**520**	**27**
	Quadrant 5	**520**	**30**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**350**	**46**
	Quadrant 2	**94**	**41**
	Quadrant 3	**400**	**59**
	Quadrant 4	**120**	**43**
	Quadrant 5	**230**	**34**
WD052	Champ Mine Dump		
	Quadrant 1	**490**	**39**
	Quadrant 2	**320**	**40**
	Quadrant 3	**5,500**	**120**
	Quadrant 4	**220**	**28**
	Quadrant 5	**440**	**58**
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**380**	**47**
	Quadrant 2	**280**	**48**
	Quadrant 3	**94**	**39**
	Quadrant 4	**130**	**35**
	Quadrant 5	**370**	**33**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**510**	**39**
	Quadrant 2	**320**	**33**
	Quadrant 3	**210**	**50**
	Quadrant 4	**1,500**	**110**
	Quadrant 5	**1,500**	**41**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**360**	**20**
	Quadrant 2	**450**	**30**
	Quadrant 3	**410**	**17**
	Quadrant 4	**440**	**21**
	Quadrant 5	**410**	**29**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**230**	**39**
	Quadrant 2	**300**	**24**
	Quadrant 3	**280**	**26**
	Quadrant 4	**290**	**20**
	Quadrant 5	**200**	**12**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**260**	**40**
	Quadrant 2	**320**	**41**
	Quadrant 3	**270**	**26**
	Quadrant 4	**260**	**19**
	Quadrant 5	**280**	**28**

TABLE E.3
MANGANESE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**1,500** [3]	**44** [3]
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**740**	**11**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**220**	**27**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**2,400**	**94**
DS015	Conda Mine Waste Dump West Limb Seep	**77**	**18**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**510**	**35**
	Quadrant 2	**530**	**33**
	Quadrant 3	**960**	**60**
	Quadrant 4	**830**	**63**
	Quadrant 5	**650**	**59**
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**580**	**40**
	Quadrant 2	**650**	**46**
	Quadrant 3	**710**	**52**
	Quadrant 4	**700**	**35**
	Quadrant 5	**790**	**52**
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**4,300**	**92**
	Quadrant 2	**2,300**	**44**
	Quadrant 3	**1,800**	**74**
	Quadrant 4	**1,100**	**60**
	Quadrant 5	**1,100**	**27**

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 6.5 mg/kg for soil and 0.29 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 6.5 mg/kg for soil and 0.29 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.4 NICKEL RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**820** [3]	**2.9** [3]
	Quadrant 2	**1,300**	**4.2**
	Quadrant 3	**1,800**	**3.1**
	Quadrant 4	**1,100**	**2.2**
	Quadrant 5	**1,400**	**3.0**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**2,200**	**3.0**
	Quadrant 2	**740**	**8.3**
	Quadrant 3	**1,700**	**5.0**
	Quadrant 4	**1,500**	**3.0**
	Quadrant 5	**840**	**5.5**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**1,300**	**3.7**
	Quadrant 2	**2,100**	**3.3**
	Quadrant 3	**3,200**	**17**
	Quadrant 4	**1,800**	**2.8**
	Quadrant 5	**1,800**	**1.7**
WD052	Champ Mine Dump		
	Quadrant 1	**770**	**1.3**
	Quadrant 2	**2,200**	**4.1**
	Quadrant 3	**1,100**	**1.0**
	Quadrant 4	**2,800**	**12**
	Quadrant 5	**1,400**	**0.92**
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**1,700**	**3.3**
	Quadrant 2	**3,500**	**6.7**
	Quadrant 3	**1,400**	**4.1**
	Quadrant 4	**3,900**	**18**
	Quadrant 5	**1,700**	**17**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**2,000**	**4.8**
	Quadrant 2	**1,300**	**11**
	Quadrant 3	**1,300**	**12**
	Quadrant 4	**1,500**	**5.9**
	Quadrant 5	**1,200**	**4.6**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**1,800**	**3.8**
	Quadrant 2	**1,500**	**12**
	Quadrant 3	**1,400**	**9.2**
	Quadrant 4	**2,100**	**6.9**
	Quadrant 5	**2,200**	**2.8**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**820**	**1.9**
	Quadrant 2	**2,500**	**5.5**
	Quadrant 3	**3,100**	**2.5**
	Quadrant 4	**1,700**	**12**
	Quadrant 5	**2,600**	**18**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**2,200**	**3.1**
	Quadrant 2	**2,000**	**1.3**
	Quadrant 3	**2,800**	**2.0**
	Quadrant 4	**3,400**	**3.6**
	Quadrant 5	**3,400**	**2.4**

TABLE E.4 NICKEL RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING (CONTINUED)			
Station		**Field-and-Lab-QA-Adjusted Concentration [1]**	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**380** [3]	**1.7** [3]
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**1,400**	**1.8**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**1,100**	**1.2**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**4,000**	**8.4**
DS015	Conda Mine Waste Dump West Limb Seep	**2,800**	**10**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**1,100**	**2.0**
	Quadrant 2	**970**	**1.8**
	Quadrant 3	**500**	**1.1**
	Quadrant 4	**570**	**1.3**
	Quadrant 5	**310**	*0.70* [2]
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**450**	**1.1**
	Quadrant 2	**500**	*0.52*
	Quadrant 3	**350**	**1.0**
	Quadrant 4	**370**	*0.72*
	Quadrant 5	**350**	**0.92**
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**450**	*0.58*
	Quadrant 2	**670**	**1.0**
	Quadrant 3	**800**	**1.4**
	Quadrant 4	**560**	*0.60*
	Quadrant 5	**730**	**1.1**

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 1.6 mg/kg for soil and 0.76 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 1.6 mg/kg for soil and 0.76 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.5 VANADIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**230** [3]	*0.049* [2]
	Quadrant 2	**350**	*0.065*
	Quadrant 3	**330**	*-0.69*
	Quadrant 4	**370**	*-0.71*
	Quadrant 5	**320**	*-0.39*
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**640**	**0.79** [3]
	Quadrant 2	**150**	*0.18*
	Quadrant 3	**320**	*0.51*
	Quadrant 4	**200**	**1.3**
	Quadrant 5	**140**	*0.15*
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**310**	**0.73**
	Quadrant 2	**340**	**0.69**
	Quadrant 3	**420**	**1.2**
	Quadrant 4	**400**	*0.52*
	Quadrant 5	**530**	**1.4**
WD052	Champ Mine Dump		
	Quadrant 1	**60**	*-0.51*
	Quadrant 2	**210**	*-0.59*
	Quadrant 3	**77**	*0.29*
	Quadrant 4	**270**	**0.70**
	Quadrant 5	**220**	*0.11*
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**280**	*0.47*
	Quadrant 2	**270**	*0.13*
	Quadrant 3	**420**	**9.0**
	Quadrant 4	**320**	*-0.23*
	Quadrant 5	**180**	**2.0**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**290**	**3.4**
	Quadrant 2	**150**	**1.0**
	Quadrant 3	**230**	**1.2**
	Quadrant 4	**180**	**5.7**
	Quadrant 5	**150**	**1.2**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**300**	**1.4**
	Quadrant 2	**220**	**1.7**
	Quadrant 3	**200**	**2.5**
	Quadrant 4	**190**	**0.83**
	Quadrant 5	**260**	**1.1**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**150**	*0.21*
	Quadrant 2	**310**	*-0.16*
	Quadrant 3	**250**	*-0.40*
	Quadrant 4	**200**	*-0.093*
	Quadrant 5	**210**	**1.1**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**170**	*-0.14*
	Quadrant 2	**160**	*-0.14*
	Quadrant 3	**190**	*0.19*
	Quadrant 4	**230**	*-0.15*
	Quadrant 5	**250**	*-0.16*

TABLE E.5
VANADIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**66** [3]	*0.30* [2]
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**300**	*-1.3*
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**200**	*-0.41*
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**520**	*0.41*
DS015	Conda Mine Waste Dump West Limb Seep	**210**	*0.15*
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**120**	**0.94** [3]
	Quadrant 2	**110**	**1.2**
	Quadrant 3	**66**	*-0.22*
	Quadrant 4	**60**	*-0.32*
	Quadrant 5	**48**	*-0.25*
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**98**	*0.62*
	Quadrant 2	**150**	**0.72**
	Quadrant 3	**53**	*0.050*
	Quadrant 4	**54**	*0.11*
	Quadrant 5	**56**	*0.11*
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**47**	*-0.18*
	Quadrant 2	**53**	*-0.51*
	Quadrant 3	**62**	*-0.41*
	Quadrant 4	**43**	*-0.83*
	Quadrant 5	**58**	*-0.89*

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 1.9 mg/kg for soil and 0.67 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 1.9 mg/kg for soil and 0.67 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.6 ZINC RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**450** [3]	**47** [3]
	Quadrant 2	**820**	**94**
	Quadrant 3	**800**	**70**
	Quadrant 4	**730**	**59**
	Quadrant 5	**760**	**65**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**1,100**	**92**
	Quadrant 2	**280**	**120**
	Quadrant 3	**860**	**110**
	Quadrant 4	**720**	**81**
	Quadrant 5	**380**	**100**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**550**	**72**
	Quadrant 2	**960**	**62**
	Quadrant 3	**1,300**	**110**
	Quadrant 4	**790**	**70**
	Quadrant 5	**790**	**66**
WD052	Champ Mine Dump		
	Quadrant 1	**200**	**19**
	Quadrant 2	**920**	**36**
	Quadrant 3	**320**	**22**
	Quadrant 4	**1,100**	**110**
	Quadrant 5	**540**	**31**
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**760**	**58**
	Quadrant 2	**1,300**	**80**
	Quadrant 3	**1,800**	**130**
	Quadrant 4	**1,800**	**110**
	Quadrant 5	**780**	**98**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**920**	**62**
	Quadrant 2	**1,500**	**110**
	Quadrant 3	**1,400**	**140**
	Quadrant 4	**620**	**43**
	Quadrant 5	**440**	**39**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**780**	**40**
	Quadrant 2	**650**	**73**
	Quadrant 3	**650**	**73**
	Quadrant 4	**990**	**64**
	Quadrant 5	**1,100**	**62**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**1,000**	**64**
	Quadrant 2	**1,300**	**71**
	Quadrant 3	**1,300**	**49**
	Quadrant 4	**1,600**	**86**
	Quadrant 5	**1,600**	**71**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**1,600**	**95**
	Quadrant 2	**1,200**	**48**
	Quadrant 3	**1,000**	**44**
	Quadrant 4	**1,100**	**45**
	Quadrant 5	**1,200**	**33**

TABLE E.6
ZINC RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**130** [3]	**24** [3]
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**690**	**29**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**450**	**31**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**2,100**	**80**
DS015	Conda Mine Waste Dump West Limb Seep	**1,200**	**100**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**450**	**34**
	Quadrant 2	**400**	**37**
	Quadrant 3	**230**	**36**
	Quadrant 4	**280**	**36**
	Quadrant 5	**110**	**26**
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**220**	**38**
	Quadrant 2	**290**	**43**
	Quadrant 3	**120**	**24**
	Quadrant 4	**170**	**35**
	Quadrant 5	**170**	**41**
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**210**	**38**
	Quadrant 2	**310**	**36**
	Quadrant 3	**330**	**43**
	Quadrant 4	**220**	**39**
	Quadrant 5	**270**	**19**

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 6.8 mg/kg for soil and 2.5 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 6.8 mg/kg for soil and 2.5 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.7 CALCIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**92000** [3]	n/a
	Quadrant 2	**120000**	n/a
	Quadrant 3	**120000**	n/a
	Quadrant 4	**100000**	n/a
	Quadrant 5	**100000**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**160000**	n/a
	Quadrant 2	**37000**	n/a
	Quadrant 3	**130000**	n/a
	Quadrant 4	**87000**	n/a
	Quadrant 5	**51000**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**81000**	n/a
	Quadrant 2	**150000**	n/a
	Quadrant 3	**130000**	n/a
	Quadrant 4	**170000**	n/a
	Quadrant 5	**140000**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**57000**	n/a
	Quadrant 2	**150000**	n/a
	Quadrant 3	**25000**	n/a
	Quadrant 4	**130000**	n/a
	Quadrant 5	**79000**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**130000**	n/a
	Quadrant 2	**99000**	n/a
	Quadrant 3	**220000**	n/a
	Quadrant 4	**120000**	n/a
	Quadrant 5	**130000**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**140000**	n/a
	Quadrant 2	**130000**	n/a
	Quadrant 3	**120000**	n/a
	Quadrant 4	**60000**	n/a
	Quadrant 5	**41000**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**90000**	n/a
	Quadrant 2	**160000**	n/a
	Quadrant 3	**82000**	n/a
	Quadrant 4	**130000**	n/a
	Quadrant 5	**130000**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**130000**	n/a
	Quadrant 2	**140000**	n/a
	Quadrant 3	**94000**	n/a
	Quadrant 4	**140000**	n/a
	Quadrant 5	**130000**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**120000**	n/a
	Quadrant 2	**130000**	n/a
	Quadrant 3	**140000**	n/a
	Quadrant 4	**130000**	n/a
	Quadrant 5	**130000**	n/a

TABLE E.7
CALCIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**6100** [3]	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**47000**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**87000**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**150000**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**100000**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**15000**	n/a
	Quadrant 2	**14000**	n/a
	Quadrant 3	**8800**	n/a
	Quadrant 4	**7500**	n/a
	Quadrant 5	**4600**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**18000**	n/a
	Quadrant 2	**22000**	n/a
	Quadrant 3	**5400**	n/a
	Quadrant 4	**6900**	n/a
	Quadrant 5	**8100**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**10000**	n/a
	Quadrant 2	**6900**	n/a
	Quadrant 3	**10000**	n/a
	Quadrant 4	**59000**	n/a
	Quadrant 5	**8300**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 132 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 132 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.8 IRON RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**15,000** [3]	**55** [3]
	Quadrant 2	**15,000**	**68**
	Quadrant 3	**16,000**	**74**
	Quadrant 4	**15,000**	**79**
	Quadrant 5	**16,000**	**59**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**15,000**	**64**
	Quadrant 2	**21,000**	**63**
	Quadrant 3	**14,000**	**98**
	Quadrant 4	**19,000**	**120**
	Quadrant 5	**21,000**	**69**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**19,000**	**110**
	Quadrant 2	**15,000**	**76**
	Quadrant 3	**19,000**	**100**
	Quadrant 4	**14,000**	**70**
	Quadrant 5	**14,000**	**93**
WD052	Champ Mine Dump		
	Quadrant 1	**6,400**	**56**
	Quadrant 2	**16,000**	**72**
	Quadrant 3	**35,000**	**59**
	Quadrant 4	**19,000**	**93**
	Quadrant 5	**14,000**	**49**
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**14,000**	**110**
	Quadrant 2	**19,000**	**78**
	Quadrant 3	**6,500**	**400**
	Quadrant 4	**19,000**	**67**
	Quadrant 5	**8,400**	**190**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**14,000**	**210**
	Quadrant 2	**11,000**	**120**
	Quadrant 3	**10,000**	**140**
	Quadrant 4	**14,000**	**930**
	Quadrant 5	**17,000**	**91**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**16,000**	**120**
	Quadrant 2	**15,000**	**150**
	Quadrant 3	**14,000**	**200**
	Quadrant 4	**9,000**	**120**
	Quadrant 5	**13,000**	**130**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**5,800**	**82**
	Quadrant 2	**15,000**	**54**
	Quadrant 3	**22,000**	**53**
	Quadrant 4	**9,000**	**55**
	Quadrant 5	**14,000**	**110**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**13,000**	**46**
	Quadrant 2	**13,000**	**49**
	Quadrant 3	**22,000**	**48**
	Quadrant 4	**20,000**	**64**
	Quadrant 5	**19,000**	**45**

TABLE E.8
IRON RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration [1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**23,000** [3]	**67** [3]
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**23,000**	**49**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**17,000**	**59**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**20,000**	**250**
DS015	Conda Mine Waste Dump West Limb Seep	**17,000**	**220**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**19,000**	**130**
	Quadrant 2	**20,000**	**170**
	Quadrant 3	**23,000**	**71**
	Quadrant 4	**10,000**	**49**
	Quadrant 5	**10,000**	**100**
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**13,000**	**190**
	Quadrant 2	**14,000**	**190**
	Quadrant 3	**16,000**	**120**
	Quadrant 4	**16,000**	**150**
	Quadrant 5	**10,000**	**130**
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**29,000**	**79**
	Quadrant 2	**14,000**	**53**
	Quadrant 3	**13,000**	**64**
	Quadrant 4	**8,100**	**93**
	Quadrant 5	**17,000**	**92**

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 16 mg/kg for soil and 3.9 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 16 mg/kg for soil and 3.9 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.9 MAGNESIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**9500** [3]	n/a
	Quadrant 2	**7500**	n/a
	Quadrant 3	**5700**	n/a
	Quadrant 4	**9900**	n/a
	Quadrant 5	**7400**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**1000**	n/a
	Quadrant 2	**5500**	n/a
	Quadrant 3	**1300**	n/a
	Quadrant 4	**3100**	n/a
	Quadrant 5	**4800**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**3400**	n/a
	Quadrant 2	**1100**	n/a
	Quadrant 3	**910**	n/a
	Quadrant 4	**1100**	n/a
	Quadrant 5	**2100**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**1600**	n/a
	Quadrant 2	**1800**	n/a
	Quadrant 3	**5300**	n/a
	Quadrant 4	**7800**	n/a
	Quadrant 5	**2100**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**4000**	n/a
	Quadrant 2	**6300**	n/a
	Quadrant 3	**6700**	n/a
	Quadrant 4	**8200**	n/a
	Quadrant 5	**3600**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**3800**	n/a
	Quadrant 2	**2900**	n/a
	Quadrant 3	**1100**	n/a
	Quadrant 4	**6500**	n/a
	Quadrant 5	**5400**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**3200**	n/a
	Quadrant 2	**5400**	n/a
	Quadrant 3	**4300**	n/a
	Quadrant 4	**4300**	n/a
	Quadrant 5	**4400**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**7500**	n/a
	Quadrant 2	**5800**	n/a
	Quadrant 3	**2800**	n/a
	Quadrant 4	**6500**	n/a
	Quadrant 5	**3600**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**3300**	n/a
	Quadrant 2	**4500**	n/a
	Quadrant 3	**3800**	n/a
	Quadrant 4	**2000**	n/a
	Quadrant 5	**10000**	n/a

TABLE E.9
MAGNESIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**6600** [3]	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**7900**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**15000**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**11000**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**1000**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**4400**	n/a
	Quadrant 2	**4200**	n/a
	Quadrant 3	**4700**	n/a
	Quadrant 4	**4500**	n/a
	Quadrant 5	**5400**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**4200**	n/a
	Quadrant 2	**5000**	n/a
	Quadrant 3	**5400**	n/a
	Quadrant 4	**4500**	n/a
	Quadrant 5	**4100**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**5000**	n/a
	Quadrant 2	**4700**	n/a
	Quadrant 3	**4100**	n/a
	Quadrant 4	**3300**	n/a
	Quadrant 5	**3000**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 42 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 42 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.10 POTASSIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**3600** [3]	n/a
	Quadrant 2	**3700**	n/a
	Quadrant 3	**3200**	n/a
	Quadrant 4	**3800**	n/a
	Quadrant 5	**3400**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**2900**	n/a
	Quadrant 2	**4200**	n/a
	Quadrant 3	**2800**	n/a
	Quadrant 4	**3700**	n/a
	Quadrant 5	**3900**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**3800**	n/a
	Quadrant 2	**2700**	n/a
	Quadrant 3	**2300**	n/a
	Quadrant 4	**2700**	n/a
	Quadrant 5	**3400**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**2000**	n/a
	Quadrant 2	**3700**	n/a
	Quadrant 3	**9500**	n/a
	Quadrant 4	**3200**	n/a
	Quadrant 5	**3700**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**3900**	n/a
	Quadrant 2	**2600**	n/a
	Quadrant 3	**4000**	n/a
	Quadrant 4	**2900**	n/a
	Quadrant 5	**3900**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**4000**	n/a
	Quadrant 2	**3200**	n/a
	Quadrant 3	**2900**	n/a
	Quadrant 4	**4800**	n/a
	Quadrant 5	**5300**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**4200**	n/a
	Quadrant 2	**4500**	n/a
	Quadrant 3	**4100**	n/a
	Quadrant 4	**4300**	n/a
	Quadrant 5	**4400**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**2300**	n/a
	Quadrant 2	**2700**	n/a
	Quadrant 3	**2400**	n/a
	Quadrant 4	**2600**	n/a
	Quadrant 5	**2000**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**2900**	n/a
	Quadrant 2	**2800**	n/a
	Quadrant 3	**2600**	n/a
	Quadrant 4	**3200**	n/a
	Quadrant 5	**2800**	n/a

TABLE E.10
POTASSIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING

Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**5400** [3]	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**5100**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**3400**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**2400**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**2700**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**4900**	n/a
	Quadrant 2	**4800**	n/a
	Quadrant 3	**5200**	n/a
	Quadrant 4	**4600**	n/a
	Quadrant 5	**4500**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**4500**	n/a
	Quadrant 2	**5300**	n/a
	Quadrant 3	**5200**	n/a
	Quadrant 4	**4400**	n/a
	Quadrant 5	**4000**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**5600**	n/a
	Quadrant 2	**3700**	n/a
	Quadrant 3	**4100**	n/a
	Quadrant 4	**2800**	n/a
	Quadrant 5	**3100**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 110 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 110 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.11 SODIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**930** [3]	n/a
	Quadrant 2	**1300**	n/a
	Quadrant 3	**1000**	n/a
	Quadrant 4	**970**	n/a
	Quadrant 5	**980**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**1300**	n/a
	Quadrant 2	**450**	n/a
	Quadrant 3	**1000**	n/a
	Quadrant 4	**890**	n/a
	Quadrant 5	**550**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**770**	n/a
	Quadrant 2	**1400**	n/a
	Quadrant 3	**1100**	n/a
	Quadrant 4	**1300**	n/a
	Quadrant 5	**1400**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**280**	n/a
	Quadrant 2	**1000**	n/a
	Quadrant 3	**580**	n/a
	Quadrant 4	**1300**	n/a
	Quadrant 5	**500**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**1100**	n/a
	Quadrant 2	**970**	n/a
	Quadrant 3	**3300**	n/a
	Quadrant 4	**1100**	n/a
	Quadrant 5	**1000**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**1000**	n/a
	Quadrant 2	**1200**	n/a
	Quadrant 3	**1100**	n/a
	Quadrant 4	**610**	n/a
	Quadrant 5	**540**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**1100**	n/a
	Quadrant 2	**880**	n/a
	Quadrant 3	**1000**	n/a
	Quadrant 4	**980**	n/a
	Quadrant 5	**980**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**820**	n/a
	Quadrant 2	**1700**	n/a
	Quadrant 3	**810**	n/a
	Quadrant 4	**1600**	n/a
	Quadrant 5	**960**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**1000**	n/a
	Quadrant 2	**960**	n/a
	Quadrant 3	**920**	n/a
	Quadrant 4	**1100**	n/a
	Quadrant 5	**930**	n/a

TABLE E.11 SODIUM RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING (CONTINUED)			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**190** [3]	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**510**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**670**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**1100**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**1300**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**340**	n/a
	Quadrant 2	**410**	n/a
	Quadrant 3	**270**	n/a
	Quadrant 4	**230**	n/a
	Quadrant 5	**210**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**290**	n/a
	Quadrant 2	**330**	n/a
	Quadrant 3	**190**	n/a
	Quadrant 4	**230**	n/a
	Quadrant 5	**240**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**260**	n/a
	Quadrant 2	**160**	n/a
	Quadrant 3	**180**	n/a
	Quadrant 4	**240**	n/a
	Quadrant 5	**190**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 62 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 62 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.12 SULFATE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, mg/kg (dry weight)	Vegetation, mg/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	*0.38*	**860** [3]
	Quadrant 2	**86**	**960**
	Quadrant 3	**11**	**680**
	Quadrant 4	*-0.90*	*120* [2]
	Quadrant 5	**16**	**860**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**9.8**	**860**
	Quadrant 2	*1.7*	**3600**
	Quadrant 3	*4.5*	**750**
	Quadrant 4	*0.38*	**670**
	Quadrant 5	*0.06*	**1900**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**810**	**3400**
	Quadrant 2	*3.6*	**2200**
	Quadrant 3	**100**	**3000**
	Quadrant 4	**32**	**1600**
	Quadrant 5	*2.3*	**1400**
WD052	Champ Mine Dump		
	Quadrant 1	*-6.3*	*140*
	Quadrant 2	*5.2*	**580**
	Quadrant 3	*-4.1*	**490**
	Quadrant 4	**1300**	**3500**
	Quadrant 5	*-1.2*	**1100**
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	*0.38*	**25000**
	Quadrant 2	**35**	**2500**
	Quadrant 3	*3.3*	**860**
	Quadrant 4	**290**	**4700**
	Quadrant 5	*8.9*	**3100**
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	*8.1*	**1800**
	Quadrant 2	**10**	**-**
	Quadrant 3	*-0.58*	**3800**
	Quadrant 4	**35**	**3200**
	Quadrant 5	**12**	**1300**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	*3.3*	**5600**
	Quadrant 2	**16**	**28000**
	Quadrant 3	**42**	**26000**
	Quadrant 4	**99**	**3700**
	Quadrant 5	**61**	**3400**
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	*-2.2*	**11000**
	Quadrant 2	**12**	**26000**
	Quadrant 3	*1.0*	**13000**
	Quadrant 4	**10**	**1500**
	Quadrant 5	**90**	**750**
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	*-0.58*	**360**
	Quadrant 2	*-1.9*	*300*
	Quadrant 3	*6.1*	**2500**
	Quadrant 4	*-2.5*	**1300**
	Quadrant 5	*-0.26*	**630**

TABLE E.12
SULFATE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, mg/kg (dry weight)**	**Vegetation, mg/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	*-0.26*	*36*
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**150**	**1200**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**100**	**1400**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**460**	**7700**
DS015	Conda Mine Waste Dump West Limb Seep	**1000**	**5200**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	*-2.5*	*36*
	Quadrant 2	*-1.1*	*78*
	Quadrant 3	*1.7*	**680**
	Quadrant 4	*3.6*	*47*
	Quadrant 5	**16**	**730**
BB002	Caldwell Creek Outcrop		
	Quadrant 1	*5.8*	*230*
	Quadrant 2	*8.1*	**1500**
	Quadrant 3	*6.5*	**960**
	Quadrant 4	*2.3*	**540**
	Quadrant 5	*3.6*	**490**
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**11**	**3200**
	Quadrant 2	*8.7*	**670**
	Quadrant 3	*4.2*	*99*
	Quadrant 4	*-0.90*	*88*
	Quadrant 5	*-0.90*	*68*

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 9.7 mg/kg for soil and 300 mg/kg for vegetation; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[2]95% upper confidence limit of the 95th percentile of blank results is 9.7 mg/kg for soil and 300 for vegetation; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.13 NITRATE-NITROGEN RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, ppm (dry weight)**	**Vegetation, ppm (dry weight)**
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**6.4** [3]	n/a
	Quadrant 2	**37**	n/a
	Quadrant 3	**15**	n/a
	Quadrant 4	*5.9* [2]	n/a
	Quadrant 5	*5.7*	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**8.4**	n/a
	Quadrant 2	*5.0*	n/a
	Quadrant 3	*4.0*	n/a
	Quadrant 4	*3.4*	n/a
	Quadrant 5	*4.5*	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	*5.9*	n/a
	Quadrant 2	*4.0*	n/a
	Quadrant 3	**7.4**	n/a
	Quadrant 4	*5.4*	n/a
	Quadrant 5	**7.4**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**13**	n/a
	Quadrant 2	**15**	n/a
	Quadrant 3	**13**	n/a
	Quadrant 4	**26**	n/a
	Quadrant 5	**10**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**7.9**	n/a
	Quadrant 2	*4.5*	n/a
	Quadrant 3	*2.9*	n/a
	Quadrant 4	**8.8**	n/a
	Quadrant 5	*5.2*	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	*2.1*	n/a
	Quadrant 2	**6.9**	n/a
	Quadrant 3	*3.5*	n/a
	Quadrant 4	*5.0*	n/a
	Quadrant 5	**20**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	*3.2*	n/a
	Quadrant 2	*3.3*	n/a
	Quadrant 3	*2.8*	n/a
	Quadrant 4	**9.8**	n/a
	Quadrant 5	**9.3**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	*5.4*	n/a
	Quadrant 2	*5.0*	n/a
	Quadrant 3	*2.8*	n/a
	Quadrant 4	*5.0*	n/a
	Quadrant 5	**30**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**7.4**	n/a
	Quadrant 2	*5.4*	n/a
	Quadrant 3	**18**	n/a
	Quadrant 4	*5.4*	n/a
	Quadrant 5	**14**	n/a

TABLE E.13
NITRATE-NITROGEN RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		**Field-and-Lab-QA-Adjusted Concentration[1]**	
Identification No.	**Name**	**Soil, ppm (dry weight)**	**Vegetation, ppm (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**11**	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**6.9**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	*3.5*	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	*3.5*	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**6.9**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	*4.5*	n/a
	Quadrant 2	*4.2*	n/a
	Quadrant 3	**13**	n/a
	Quadrant 4	**26**	n/a
	Quadrant 5	**60**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**46**	n/a
	Quadrant 2	**28**	n/a
	Quadrant 3	**11**	n/a
	Quadrant 4	**8.4**	n/a
	Quadrant 5	**18**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**14**	n/a
	Quadrant 2	**79**	n/a
	Quadrant 3	**42**	n/a
	Quadrant 4	**23**	n/a
	Quadrant 5	**15**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 6.2 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 6.2mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.14 AMMONIA AS NITRATE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, ppm (dry weight)**	**Vegetation, ppm (dry weight)**
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**3.7**	n/a
	Quadrant 2	**190**	n/a
	Quadrant 3	**5.6**	n/a
	Quadrant 4	*0.33*	n/a
	Quadrant 5	**4.8**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**4.3**	n/a
	Quadrant 2	**5.7**	n/a
	Quadrant 3	**2.8**	n/a
	Quadrant 4	**4.4**	n/a
	Quadrant 5	**4.5**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**5.7**	n/a
	Quadrant 2	**5.2**	n/a
	Quadrant 3	**3.4**	n/a
	Quadrant 4	**4.1**	n/a
	Quadrant 5	**4.0**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**2.6**	n/a
	Quadrant 2	**3.3**	n/a
	Quadrant 3	**3.3**	n/a
	Quadrant 4	*1.1*	n/a
	Quadrant 5	**2.6**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**3.2**	n/a
	Quadrant 2	**1.9**	n/a
	Quadrant 3	**2.3**	n/a
	Quadrant 4	**2.2**	n/a
	Quadrant 5	**2.3**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**1.9**	n/a
	Quadrant 2	**2.9**	n/a
	Quadrant 3	**2.1**	n/a
	Quadrant 4	**2.8**	n/a
	Quadrant 5	**3.0**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**1.9**	n/a
	Quadrant 2	**2.1**	n/a
	Quadrant 3	**2.9**	n/a
	Quadrant 4	**2.8**	n/a
	Quadrant 5	**3.0**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**3.8**	n/a
	Quadrant 2	**2.6**	n/a
	Quadrant 3	**3.3**	n/a
	Quadrant 4	**2.3**	n/a
	Quadrant 5	**2.9**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**3.6**	n/a
	Quadrant 2	**3.4**	n/a
	Quadrant 3	**6.3**	n/a
	Quadrant 4	**3.2**	n/a
	Quadrant 5	**2.8**	n/a

TABLE E.14
AMMONIA AS NITRATE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Field-and-Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, ppm (dry weight)**	**Vegetation, ppm (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**2.8**	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**9.8**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**5.7**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**6.4**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**6.9**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**3.6**	n/a
	Quadrant 2	**2.6**	n/a
	Quadrant 3	**4.0**	n/a
	Quadrant 4	**6.5**	n/a
	Quadrant 5	**30**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**12**	n/a
	Quadrant 2	**13**	n/a
	Quadrant 3	**6.3**	n/a
	Quadrant 4	**4.4**	n/a
	Quadrant 5	**7.6**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**37**	n/a
	Quadrant 2	**23**	n/a
	Quadrant 3	**8.7**	n/a
	Quadrant 4	**4.8**	n/a
	Quadrant 5	**4.2**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 1.2 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 1.2 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.15 PHOSPHORUS ON SODIUM BICARBONATE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, mg/g (dry weight)	Vegetation, mg/g (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**17**	n/a
	Quadrant 2	**60**	n/a
	Quadrant 3	**58**	n/a
	Quadrant 4	**13**	n/a
	Quadrant 5	**13**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**15**	n/a
	Quadrant 2	**47**	n/a
	Quadrant 3	**20**	n/a
	Quadrant 4	**56**	n/a
	Quadrant 5	**27**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**57**	n/a
	Quadrant 2	**60**	n/a
	Quadrant 3	**39**	n/a
	Quadrant 4	**60**	n/a
	Quadrant 5	**38**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**28**	n/a
	Quadrant 2	**36**	n/a
	Quadrant 3	**30**	n/a
	Quadrant 4	**31**	n/a
	Quadrant 5	**21**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**72**	n/a
	Quadrant 2	**34**	n/a
	Quadrant 3	**8.6**	n/a
	Quadrant 4	**14**	n/a
	Quadrant 5	**67**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**61**	n/a
	Quadrant 2	**32**	n/a
	Quadrant 3	**21**	n/a
	Quadrant 4	**61**	n/a
	Quadrant 5	**82**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**55**	n/a
	Quadrant 2	**65**	n/a
	Quadrant 3	**84**	n/a
	Quadrant 4	**62**	n/a
	Quadrant 5	**52**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**19**	n/a
	Quadrant 2	**12**	n/a
	Quadrant 3	**33**	n/a
	Quadrant 4	**25**	n/a
	Quadrant 5	**95**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**39**	n/a
	Quadrant 2	**29**	n/a
	Quadrant 3	**60**	n/a
	Quadrant 4	**41**	n/a
	Quadrant 5	**33**	n/a

TABLE E.15 PHOSPHORUS ON SODIUM BICARBONATE RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING (CONTINUED)			
Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, cmol+/kg (dry weight)	Vegetation, cmol+/kg (dry weight)
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**67**	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**56**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**93**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**55**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**82**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**25**	n/a
	Quadrant 2	**30**	n/a
	Quadrant 3	**39**	n/a
	Quadrant 4	**47**	n/a
	Quadrant 5	**56**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**57**	n/a
	Quadrant 2	**59**	n/a
	Quadrant 3	**73**	n/a
	Quadrant 4	**63**	n/a
	Quadrant 5	**68**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**84**	n/a
	Quadrant 2	**95**	n/a
	Quadrant 3	**84**	n/a
	Quadrant 4	**44**	n/a
	Quadrant 5	**43**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is 2.5 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is 2.5 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.16 CATION EXCHANGE CAPACITY (CEC) RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, cmol+/kg (dry weight)	Vegetation, cmol+/kg (dry weight)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**17**	n/a
	Quadrant 2	**23**	n/a
	Quadrant 3	**22**	n/a
	Quadrant 4	**18**	n/a
	Quadrant 5	**21**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**15**	n/a
	Quadrant 2	**23**	n/a
	Quadrant 3	**20**	n/a
	Quadrant 4	**23**	n/a
	Quadrant 5	**17**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**20**	n/a
	Quadrant 2	**24**	n/a
	Quadrant 3	**20**	n/a
	Quadrant 4	**24**	n/a
	Quadrant 5	**19**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**10**	n/a
	Quadrant 2	**18**	n/a
	Quadrant 3	**23**	n/a
	Quadrant 4	**11**	n/a
	Quadrant 5	**15**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**17**	n/a
	Quadrant 2	**24**	n/a
	Quadrant 3	**12**	n/a
	Quadrant 4	**22**	n/a
	Quadrant 5	**20**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**18**	n/a
	Quadrant 2	**24**	n/a
	Quadrant 3	**20**	n/a
	Quadrant 4	**25**	n/a
	Quadrant 5	**26**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**20**	n/a
	Quadrant 2	**17**	n/a
	Quadrant 3	**20**	n/a
	Quadrant 4	**23**	n/a
	Quadrant 5	**21**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**16**	n/a
	Quadrant 2	**24**	n/a
	Quadrant 3		n/a
	Quadrant 4	**22**	n/a
	Quadrant 5	**28**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**26**	n/a
	Quadrant 2	**27**	n/a
	Quadrant 3	**29**	n/a
	Quadrant 4	**31**	n/a
	Quadrant 5	**27**	n/a

TABLE E.16
CATION EXCHANGE CAPACITY (CEC) RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, cmol+/kg (dry weight)**	**Vegetation, cmol+/kg (dry weight)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**29**	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**34**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**24**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**19**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**18**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**24**	n/a
	Quadrant 2	**26**	n/a
	Quadrant 3	**29**	n/a
	Quadrant 4	**37**	n/a
	Quadrant 5	**32**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**44**	n/a
	Quadrant 2	**42**	n/a
	Quadrant 3	**43**	n/a
	Quadrant 4	**25**	n/a
	Quadrant 5	**35**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**47**	n/a
	Quadrant 2	**55**	n/a
	Quadrant 3	**52**	n/a
	Quadrant 4	**42**	n/a
	Quadrant 5	**29**	n/a

[1]Data adjusted for lab blanks and lab-standards slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 4.4 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 4.4 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.17 MOISTURE CONTENT RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station			
Identification No.	**Name**	**Soil, (%)**	**Vegetation, (%)**
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**3.1**	**42**
	Quadrant 2	**7.3**	**45**
	Quadrant 3	**3.7**	**45**
	Quadrant 4	**2.5**	**49**
	Quadrant 5	**3.3**	**41**
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**2.8**	**33**
	Quadrant 2	**5.7**	**61**
	Quadrant 3	**2.7**	**34**
	Quadrant 4	**4.9**	not reported
	Quadrant 5	**3.8**	**44**
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**3.2**	**54**
	Quadrant 2	**3.6**	**54**
	Quadrant 3	**3.2**	**49**
	Quadrant 4	**4.1**	**55**
	Quadrant 5	**3.7**	**43**
WD052	Champ Mine Dump		
	Quadrant 1	**10**	not reported
	Quadrant 2	**8.1**	not reported
	Quadrant 3	**15**	not reported
	Quadrant 4	not reported	not reported
	Quadrant 5	not reported	not reported
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**5.9**	not reported
	Quadrant 2	**4.5**	not reported
	Quadrant 3	**2.3**	**50**
	Quadrant 4	**2.8**	not reported
	Quadrant 5	**8.3**	not reported
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**8.2**	not reported
	Quadrant 2	**9.2**	not reported
	Quadrant 3	**11**	not reported
	Quadrant 4	**10**	not reported
	Quadrant 5	**13**	**63**
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**5.3**	not reported
	Quadrant 2	**6.6**	not reported
	Quadrant 3	**4.7**	not reported
	Quadrant 4	**8.2**	not reported
	Quadrant 5	**6.1**	not reported
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**2.8**	**59**
	Quadrant 2	**2.9**	not reported
	Quadrant 3	**3.2**	not reported
	Quadrant 4	**3.1**	not reported
	Quadrant 5	**4.2**	not reported
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**5.2**	not reported
	Quadrant 2	**5.4**	not reported
	Quadrant 3	**4.0**	not reported
	Quadrant 4	**5.5**	not reported
	Quadrant 5	**3.6**	not reported

TABLE E.17
MOISTURE CONTENT RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station			
Identification No.	**Name**	**Soil, (%)**	**Vegetation, (%)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**8.9**	not reported
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**17**	**64**
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**13**	**69**
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**55**	**74**
DS015	Conda Mine Waste Dump West Limb Seep	**24**	**72**
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**4.6**	**42**
	Quadrant 2	**3.7**	not reported
	Quadrant 3	**8.9**	not reported
	Quadrant 4	**13**	not reported
	Quadrant 5	**6.7**	not reported
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**36**	not reported
	Quadrant 2	**34**	not reported
	Quadrant 3	**12**	not reported
	Quadrant 4	**7.1**	not reported
	Quadrant 5	**12**	not reported
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**35**	**77**
	Quadrant 2	**23**	**65**
	Quadrant 3	**17**	**77**
	Quadrant 4	**9.9**	**65**
	Quadrant 5	**6.1**	**55**

TABLE E.18 ORGANIC MATTER RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, (%)	Vegetation, (%)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**2.8**	n/a
	Quadrant 2	**6.2**	n/a
	Quadrant 3	**5.5**	n/a
	Quadrant 4	**2.8**	n/a
	Quadrant 5	**3.4**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**3.0**	n/a
	Quadrant 2	**2.7**	n/a
	Quadrant 3	**4.6**	n/a
	Quadrant 4	**4.1**	n/a
	Quadrant 5	**2.6**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**4.7**	n/a
	Quadrant 2	**5.6**	n/a
	Quadrant 3	**4.4**	n/a
	Quadrant 4	**5.4**	n/a
	Quadrant 5	**3.9**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**1.6**	n/a
	Quadrant 2	**2.6**	n/a
	Quadrant 3	**2.2**	n/a
	Quadrant 4	**7.5**	n/a
	Quadrant 5	**1.9**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**1.7**	n/a
	Quadrant 2	**9.4**	n/a
	Quadrant 3	**2.4**	n/a
	Quadrant 4	**11**	n/a
	Quadrant 5	**2.6**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**2.6**	n/a
	Quadrant 2	**4.7**	n/a
	Quadrant 3	**4.0**	n/a
	Quadrant 4	**4.1**	n/a
	Quadrant 5	**3.9**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**1.9**	n/a
	Quadrant 2	**2.5**	n/a
	Quadrant 3	**2.9**	n/a
	Quadrant 4	**5.1**	n/a
	Quadrant 5	**4.1**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**2.7**	n/a
	Quadrant 2	**5.9**	n/a
	Quadrant 3	**5.7**	n/a
	Quadrant 4	**7.2**	n/a
	Quadrant 5	**11**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**6.7**	n/a
	Quadrant 2	**6.2**	n/a
	Quadrant 3	**8.1**	n/a
	Quadrant 4	**7.4**	n/a
	Quadrant 5	**6.4**	n/a

TABLE E.18 ORGANIC MATTER RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING (CONTINUED)			
Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, (%)	Vegetation, (%)
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**5.2**	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**8.8**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**2.8**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**10**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**10**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**4.0**	n/a
	Quadrant 2	**4.2**	n/a
	Quadrant 3	**6.2**	n/a
	Quadrant 4	**10**	n/a
	Quadrant 5	**6.2**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	*0.020*	n/a
	Quadrant 2	*0.020*	n/a
	Quadrant 3	*0.020*	n/a
	Quadrant 4	**5.7**	n/a
	Quadrant 5	*0.020*	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**13**	n/a
	Quadrant 2	**18**	n/a
	Quadrant 3	**13**	n/a
	Quadrant 4	**12**	n/a
	Quadrant 5	**6.8**	n/a

[1]Data adjusted for lab blanks and lab-standards slope; mean reported for stations with replicate samples.

[2]95% upper confidence limit of the 95th percentile of blank results is .093 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.

[3]95% upper confidence limit of the 95th percentile of blank results is .093 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.19 Ph RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	Name	Soil, (%)	Vegetation, (%)
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	**7.5**	n/a
	Quadrant 2	**7.7**	n/a
	Quadrant 3	**7.5**	n/a
	Quadrant 4	**7.7**	n/a
	Quadrant 5	**7.6**	n/a
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	**6.6**	n/a
	Quadrant 2	**7.1**	n/a
	Quadrant 3	**6.6**	n/a
	Quadrant 4	**6.4**	n/a
	Quadrant 5	**7.3**	n/a
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	**6.5**	n/a
	Quadrant 2	**6.6**	n/a
	Quadrant 3	**6.3**	n/a
	Quadrant 4	**6.6**	n/a
	Quadrant 5	**6.9**	n/a
WD052	Champ Mine Dump		
	Quadrant 1	**7.5**	n/a
	Quadrant 2	**7.3**	n/a
	Quadrant 3	**7.1**	n/a
	Quadrant 4	**7.2**	n/a
	Quadrant 5	**7.5**	n/a
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	**7.2**	n/a
	Quadrant 2	**7.3**	n/a
	Quadrant 3	**7.6**	n/a
	Quadrant 4	**6.9**	n/a
	Quadrant 5	**6.8**	n/a
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	**7.4**	n/a
	Quadrant 2	**7.4**	n/a
	Quadrant 3	**6.6**	n/a
	Quadrant 4	**7.5**	n/a
	Quadrant 5	**7.2**	n/a
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	**7.4**	n/a
	Quadrant 2	**7.4**	n/a
	Quadrant 3	**7.3**	n/a
	Quadrant 4	**7.3**	n/a
	Quadrant 5	**7.6**	n/a
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	**7.4**	n/a
	Quadrant 2	**7.3**	n/a
	Quadrant 3	**7.2**	n/a
	Quadrant 4	**7.3**	n/a
	Quadrant 5	**6.7**	n/a
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	**6.8**	n/a
	Quadrant 2	**7.0**	n/a
	Quadrant 3	**6.7**	n/a
	Quadrant 4	**6.8**	n/a
	Quadrant 5	**7.1**	n/a

TABLE E.19
pH RESULTS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station		Lab-QA-Adjusted Concentration[1]	
Identification No.	**Name**	**Soil, (%)**	**Vegetation, (%)**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	**6.2**	n/a
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	**7.0**	n/a
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	**7.3**	n/a
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	**7.2**	n/a
DS015	Conda Mine Waste Dump West Limb Seep	**7.1**	n/a
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	**6.5**	n/a
	Quadrant 2	**6.2**	n/a
	Quadrant 3	**6.2**	n/a
	Quadrant 4	**6.0**	n/a
	Quadrant 5	**6.3**	n/a
BB002	Caldwell Creek Outcrop		
	Quadrant 1	**6.3**	n/a
	Quadrant 2	**6.2**	n/a
	Quadrant 3	**6.1**	n/a
	Quadrant 4	**5.9**	n/a
	Quadrant 5	**6.0**	n/a
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	**6.6**	n/a
	Quadrant 2	**6.0**	n/a
	Quadrant 3	**6.4**	n/a
	Quadrant 4	**7.4**	n/a
	Quadrant 5	**6.7**	n/a

[1]Data adjusted for lab blanks, lab-standards slope, field blanks, and matrix-spike slope; mean reported for stations with replicate samples.
[2]95% upper confidence limit of the 95th percentile of blank results is 62 mg/kg; results not exceeding their corresponding value (those italicized) are not discernibly different from a blank.
[3]95% upper confidence limit of the 95th percentile of blank results is 62 mg/kg; results exceeding their corresponding value (those bolded) are discernibly greater than a blank.

TABLE E.20
PARTICLE SIZE DISTRIBUTION FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING

Station				
Identification No.	**Name**	**Sand (%)**	**Silt (%)**	***Clay (%)***
Waste Rock Dumps				
WD019	Gay Mine North Limb O/P Fill			
	Quadrant 1	40	52	8.0
	Quadrant 2	49	41	10
	Quadrant 3	49	37	14
	Quadrant 4	45	47	8.0
	Quadrant 5	46	43	8.0
WD031	Gay Mine East Limb Dump 4E			
	Quadrant 1	46	36	18
	Quadrant 2	35	54	11
	Quadrant 3	50	35	15
	Quadrant 4	52	36	12
	Quadrant 5	39	50	11
WD034	Gay Mine East Limb Dump 19			
	Quadrant 1	48	42	10
	Quadrant 2	52	28	20
	Quadrant 3	51	34	15
	Quadrant 4	56	28	16
	Quadrant 5	59	30	11
WD052	Champ Mine Dump			
	Quadrant 1	69	18	14
	Quadrant 2	48	27	25
	Quadrant 3	61	19	20
	Quadrant 4	52	32	16
	Quadrant 5	52	27	21
WD074	Smoky Canyon Mine A Pit Backfill			
	Quadrant 1	52	31	17
	Quadrant 2	51	31	18
	Quadrant 3	QNS	QNS	QNS
	Quadrant 4	66	24	10
	Quadrant 5	65	23	12
WD075	Smoky Canyon Mine Waste Dump A1			
	Quadrant 1	46	38	16
	Quadrant 2	51	35	14
	Quadrant 3	52	38	10
	Quadrant 4	49	35	16
	Quadrant 5	47	41	12
WD076	Smoky Canyon Mine Pole Canyon Waste Dump			
	Quadrant 1	49	32	19
	Quadrant 2	50	34	16
	Quadrant 3	49	37	14
	Quadrant 4	47	38	15
	Quadrant 5	53	33	14
WD080	Ballard Mine Pit #1 Overburden Dump #1			
	Quadrant 1	57	33	10
	Quadrant 2	54	31	15
	Quadrant 3	42	38	20
	Quadrant 4	56	29	15
	Quadrant 5	55	31	14
WD089	Henry Mine Center Pit #2 Canyon Fill Dump			
	Quadrant 1	46	36	18
	Quadrant 2	40	42	18
	Quadrant 3	74	17	9.0
	Quadrant 4	43	39	18
	Quadrant 5	50	34	16

TABLE E.20
PARTICLE SIZE DISTRIBUTION FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station				
Identification No.	**Name**	**Sand (%)**	**Silt (%)**	**Clay (%)**
Waste Rock Dump Seeps				
DS003	Dry Valley Mine South B Dump Seep	32	52	16
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	QNS	QNS	QNS
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	49	35	16
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	55	31	14
DS015	Conda Mine Waste Dump West Limb Seep	60	29	11
Phosphoria Formation Outcrops (Background)				
BB001	Grizzly Creek Outcrop			
	Quadrant 1	43	54	3
	Quadrant 2	60	37	3
	Quadrant 3	26	54	20
	Quadrant 4	26	55	19
	Quadrant 5	20	64	16
BB002	Caldwell Creek Outcrop			
	Quadrant 1	37	49	14
	Quadrant 2	37	52	11
	Quadrant 3	36	52	12
	Quadrant 4	30	56	14
	Quadrant 5	30	56	14
BB003	South Fork Sage Creek Outcrop			
	Quadrant 1	QNS	QNS	QNS
	Quadrant 2	47	43	10
	Quadrant 3	56	34	10
	Quadrant 4	59	32	9.0
	Quadrant 5	58	31	11

QNS: Quantity Not Sufficient.

TABLEE.21 COORDINATES OF SAMPLE STATIONS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING			
Station		Cooordinates	
Identification No.	Name	Easting	Northing
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	411195	4772504
	Quadrant 2	411206	4772439
	Quadrant 3	411224	4772441
	Quadrant 4	411342	4772394
	Quadrant 5	411300	4772365
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	416500	4765433
	Quadrant 2	416486	4765355
	Quadrant 3	416531	4765320
	Quadrant 4	416454	4765305
	Quadrant 5	416504	4765297
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	416392	4763827
	Quadrant 2	416303	4763725
	Quadrant 3	416426	4763655
	Quadrant 4	416372	4763557
	Quadrant 5	416495	4763521
WD052	Champ Mine Dump		
	Quadrant 1	477107	4724332
	Quadrant 2	477616	4724307
	Quadrant 3	476995	4724180
	Quadrant 4	477669	4724032
	Quadrant 5	476914	4723928
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	489825	4726613
	Quadrant 2	489825	4726579
	Quadrant 3	489759	4726319
	Quadrant 4	489942	4726258
	Quadrant 5	489881	4725923
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	489162	4726455
	Quadrant 2	489388	4725918
	Quadrant 3	489477	4725715
	Quadrant 4	489188	4725655
	Quadrant 5	489375	4725383
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	490036	4725000
	Quadrant 2	490188	4724926
	Quadrant 3	490281	4725028
	Quadrant 4	489171	4726291
	Quadrant 5	490435	4725055
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	459692	4742727
	Quadrant 2	459625	4742545
	Quadrant 3	459636	4742467
	Quadrant 4	459674	4742363
	Quadrant 5	459697	4742310
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	460756	4747691
	Quadrant 2	460782	4747580
	Quadrant 3	460880	4747584
	Quadrant 4	460836	4747536
	Quadrant 5	460810	4747447
DS003	Dry Valley Mine South B Dump Seep	470587	4734798
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	468319	4738042
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	465400	4744826
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	467398	4741095
DS015	Conda Mine Waste Dump West Limb Seep	458444	4732992

TABLE E.21 COORDINATES OF SAMPLE STATIONS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING (CONTINUED)			
Station		Cooordinates	
Identification No.	Name	Easting	Northing
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	433440	4756936
	Quadrant 2	433503	4756894
	Quadrant 3	433575	4756960
	Quadrant 4	433608	4756889
	Quadrant 5	433809	4756792
BB002	Caldwell Creek Outcrop		
	Quadrant 1	469716	4730944
	Quadrant 2	469655	4730822
	Quadrant 3	469777	4730456
	Quadrant 4	469991	4730182
	Quadrant 5	469991	4730030
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	488751	4721280
	Quadrant 2	488926	4721187
	Quadrant 3	488892	4721179
	Quadrant 4	488764	4721139
	Quadrant 5	488753	4721096

TABLE E.22
SLOPE AND ASPECT OF STATIONS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING

Station			
Identification No.	**Name**	**Slope, %**	**Aspect**
Waste Rock Dumps			
WD019	Gay Mine North Limb O/P Fill		
	Quadrant 1	0-10	SW
	Quadrant 2	10-30	SW
	Quadrant 3	10-30	W
	Quadrant 4	10-30	SW
	Quadrant 5	10-30	SW
WD031	Gay Mine East Limb Dump 4E		
	Quadrant 1	0-10	NE
	Quadrant 2	0-10	SE
	Quadrant 3	0-10	SE
	Quadrant 4	0-10	SE
	Quadrant 5	0-10	SE
WD034	Gay Mine East Limb Dump 19		
	Quadrant 1	10-30	E
	Quadrant 2	0-10	NW
	Quadrant 3	0-10	W
	Quadrant 4	10-30	NW
	Quadrant 5	0-10	SW
WD052	Champ Mine Dump		
	Quadrant 1	0-10	S
	Quadrant 2	0-10	S
	Quadrant 3	0-10	S
	Quadrant 4	0-10	E
	Quadrant 5	0-10	E
WD074	Smoky Canyon Mine A Pit Backfill		
	Quadrant 1	10-30	S-SW
	Quadrant 2	0-10	N-NE
	Quadrant 3	0-10	SE
	Quadrant 4	10-30	E
	Quadrant 5	0-10	SE
WD075	Smoky Canyon Mine Waste Dump A1		
	Quadrant 1	10-30	E
	Quadrant 2	0-10	N
	Quadrant 3	Flat	-
	Quadrant 4	10-30	SW-W
	Quadrant 5	10-30	SW
WD076	Smoky Canyon Mine Pole Canyon Waste Dump		
	Quadrant 1	10-30	S-SW
	Quadrant 2	10-30	SE
	Quadrant 3	10-30	NE
	Quadrant 4	10-30	NE
	Quadrant 5	10-30	E
WD080	Ballard Mine Pit #1 Overburden Dump #1		
	Quadrant 1	10-30	SW
	Quadrant 2	0-10	SW
	Quadrant 3	0-10	SW
	Quadrant 4	0-10	SW
	Quadrant 5	0-10	SW
WD089	Henry Mine Center Pit #2 Canyon Fill Dump		
	Quadrant 1	0-10	E
	Quadrant 2	10-30	SE
	Quadrant 3	10-30	N
	Quadrant 4	0-10	SW
	Quadrant 5	0-10	N

TABLE E.22
SLOPE AND ASPECT OF STATIONS FROM SUMMER 1998 SOIL AND VEGETATION SAMPLING
(CONTINUED)

Station			
Identification No.	**Name**	**Slope, %**	**Aspect**
Waste Rock Dump Seeps			
DS003	Dry Valley Mine South B Dump Seep	0-10	NW
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	0-10	S
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	10-30	N
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	0-10	N
DS015	Conda Mine Waste Dump West Limb Seep	0-10	E
Phosphoria Formation Outcrops (Background)			
BB001	Grizzly Creek Outcrop		
	Quadrant 1	10-30	NW
	Quadrant 2	10-30	N
	Quadrant 3	10-30	NW
	Quadrant 4	0-10	NE
	Quadrant 5	10-30	N
BB002	Caldwell Creek Outcrop		
	Quadrant 1	10-30	W
	Quadrant 2	0-10	W
	Quadrant 3	0-10	-
	Quadrant 4	0-10	S
	Quadrant 5	0-10	-
BB003	South Fork Sage Creek Outcrop		
	Quadrant 1	10-30	SW
	Quadrant 2	30-40	NE
	Quadrant 3	30-40	SE
	Quadrant 4	30-40	S
	Quadrant 5	>45	S

Appendix F

Statistical Analyses Calculations

Replicate sampling results allows for statistical analysis. At a given sample location at a given time there is a true, but unknown concentration of selenium or other trace element. The variability in the replicated results arises from laboratory analytical and sampling uncertainties. Such uncertainties are known to be normally distributed. The mean or average values of these results, when the number of replicates is small, are known to be distributed according to Student's t-distribution. Therefore, t-tests are used for hypothesis testing to compare means and t-statistics are used to calculate confidence limits about the means. Prior to conducting t-tests to compare means, variances are compared with an F-test. The ratio of two variances is known to be distributed according to a F-distribution. If no difference in variances of results at two stations being compared are found, a single pooled variance is calculated. Laboratory method blanks and equipment blanks are also evaluated with t- and F-tests.

Procedures for conducting t-tests and F-tests can be found in any introductory statistics text book. The equation for calculating confidence limits about a mean is:

$$\hat{\mu} = \overline{x} \pm \frac{t_{(1-\alpha/2;\nu)} s}{\sqrt{n}} \qquad \text{(Equation F-1)}$$

where:

- $\hat{\mu}$ is the estimate of the population mean, μ (in this case, the true concentration);
- $\overline{x}$ is the sample mean (the arithmetic average of the observations);
- $t_{(1-\alpha/2;\nu)}$ is the Student's t-statistic, with a [100×(1-α)] percent degree of confidence (where α is the type-I, or false-positive, error rate, i.e., the likelihood of discerning a difference when in reality no difference exists), for ν degrees of freedom;
- s is the sample standard deviation; and,
- n is the sample size.

The sample mean is calculated as follows:

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad \text{(Equation F-2)}$$

where x_i is the ith observation of x. The value of $t_{(\nu;1-\alpha)}$ is obtained from a table. Degrees of freedom for one set of samples is calculated as:

$$\nu = n - 1 \qquad \text{(Equation F-3)}$$

The sample standard deviation is calculated as follows:

$$s = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n-1}} \qquad \text{(Equation F-4)}$$

The F-statistic is calculated as:

$$F = \frac{\text{larger of } s_1^2 \text{ and } s_2^2}{\text{smaller of } s_1^2 \text{ and } s_2^2} \qquad \text{(Equation F-5)}$$

where s_2 is the standard deviation of the second sample set and s_1 is the standard deviation of the first sample set. The square of s is called the sample variance. The calculated F is compared to a table of $F_{(1-\alpha/2;\text{the larger of } \nu_1 \text{ and } \nu_2, \text{the smaller of } \nu_1 \text{ and } \nu_2)}$ where ν_1 and ν_2 are the respective degrees of freedom for the first and second sample sets. If the calculated F does not exceed the tabulated F, one cannot assume that the two sample variances are different, and therefore one can combine them to calculate a pooled variance as follows:

$$s_{1,2} = \sqrt{\frac{\nu_1 s_1^2 + \nu_2 s_2^2}{\nu_1 + \nu_2}} \qquad \text{(Equation F-6)}$$

A t-statistic to compare two sample means, $\bar{x}_1$ and $\bar{x}_2$, to see if $\bar{x}_2$ is greater than $\bar{x}_1$ when the two variances are pooled is calculated as:

$$t = \frac{\bar{x}_2 - \bar{x}_1}{s_{1,2}\sqrt{\frac{1}{n_2} + \frac{1}{n_1}}} \qquad \text{(Equation F-7)}$$

The calculated t is compared to a table of $t_{(1-\alpha;\nu_{1,2})}$. If the calculated t does not exceed the tabulated t, one cannot assume that the two sample means are different, and therefore one can combine them to calculate a pooled mean as follows:

$$\bar{x}_{1,2} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2} \qquad \text{(Equation F-8)}$$

If the two sample variances are different, a t'-statistic is calculated (Kvanli, 1988):

$$t' = \frac{\overline{x}_2 - \overline{x}_1}{\sqrt{\frac{s_2^2}{n_2} + \frac{s_1^2}{n_1}}} \qquad \text{(Equation F-9)}$$

The t' is compared to a table of $t_{(1-\alpha;\nu_{1,2})}$ as in the case of equal variances, but $\nu_{1,2}$ is calculated as:

$$\nu_{1,2} = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{\nu_1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{\nu_2}} \qquad \text{(Equation F-10)}$$

For any subsequent hypothesis testing, the degrees of freedom for the pooled statistics are calculated as:

$$\nu_{1,2} = (n_1 - 1) + (n_2 - 1) = \nu_1 + \nu_2 \qquad \text{(Equation F-11)}$$

The t-test can also be used to compare a sample mean to a benchmark value, B, such as a regulatory standard. For such a test to see if a sample mean is greater than B, the numerator of Equation F-7 is replaced with $\overline{x}$ - B, and the denominator is replaced with $s/\sqrt{n}$. The t-statistic thus calculated is compared with the tabulated value of $t_{(1-\alpha;\nu)}$.

To compare an inter-laboratory duplicate at a given station to assess inter-laboratory performance, a prediction interval to encompass one additional analysis from the quality assurance (QA) laboratory was calculated on the replicated results from the primary laboratory. This test also assumes a normal distribution, and the procedure for calculating a prediction interval is presented in Hahn and Meeker (1991). The formula for the prediction interval is:

$$\overline{x}_m = \overline{x} \pm t_{(1-\alpha/2;\nu)} s \sqrt{\left(\frac{1}{m} + \frac{1}{n}\right)} \qquad \text{(Equation F-12)}$$

where m is the number of future, independently and randomly selected observations (in this case, 1).

To differentiate between blank results and results truly indicative of the presence of selenium or other trace element, an upper confidence limit on the 95^{th} percentile of the distribution of blank results is calculated. The distribution of blank results is assumed to be attributable to only analytical and, for equipment blanks, sampling uncertainties and is therefore assumed to be normally distributed. The procedure for calculating the upper bound of a percentile (also referred to as a tolerance bound), is presented in Hahn and Meeker (1991). The formula is:

$$\tilde{p} = \bar{x} + g_{(1-\alpha;p,\nu+1)}s \qquad \text{(Equation F-13)}$$

where $g_{(1-\alpha;p,\nu+1)}$ is the tabulated tolerance factor which is a function of the type-I error rate, the percentile of interest (in this case, the 95th percentile or 0.95), and the degrees of freedom.

To characterize the background concentration of selenium and other trace elements on a regional basis, a tolerance bound approach is also used. However, rather than assuming a normal distribution, the spatial distribution of selenium and trace element concentrations are appropriately assumed to be lognormal. A lognormal distribution is known to well describe the patchy nature of trace element occurrence in the environment (Gilbert, 1987). The procedure for calculating the upper bound of a percentile from a lognormal distribution is also presented in Hahn and Meeker (1991). The procedure is identical to that used for determining the tolerance bound for a normal distribution except that the calculations are performed on the logarithms of the observations, then the logarithmic result is transformed to a normal result using the exponential function to yield the sought-after statistic. If the data set contains zero or negative values, a constant must be added to all values that is of sufficient magnitude to produce all positive values before ln-transforming. During the back-transformation, this constant is subtracted out following the exponentiation step.

The correlation coefficient, r, between variables, x and y, are calculated as follows:

$$r = \frac{\sum_{i=1}^{n} x_i y_i - \dfrac{\sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n}}{\sqrt{\dfrac{\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}{n}}\sqrt{\dfrac{\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)^2}{n}}}. \qquad \text{(Equation F-14)}$$

The coefficient of determination, r^2, explains the degree of correlation between two variables and is simply the square of the correlation coefficient. Procedures for calculating correlations are found in any introductory statistics text. To determine whether a correlation is statistically significant, r is compared to a tabulated value of $r_{(\nu;1-\alpha/2)}$. If the calculated r exceeds the tabulated r, one cannot conclude that there is no correlation between variables x and y. Values of $r_{(\nu;1-\alpha/2)}$ were obtained from Diem (1962).

To assess the value of information gained from minimal sample replication—two replicate samples per station—the confidence factors for the replicated QA stations are adjusted to predict the confidence factors if only two replicates would have been obtained. If Equation F-1 is rewritten as follows:

$$\hat{\mu} = \bar{x} \pm \frac{t_{(1-\alpha/2;\nu)}s}{\sqrt{n}} = \bar{x} \pm c_e s \qquad \text{(Equation F-15)}$$

where c_e can be regarded as the empirical confidence factor, which is a function of the degrees of freedom, the confidence level, the sample standard deviation, and the sample size. The confidence factor for a sample size of 2, c_2, can be estimated as follows:

$$c_2 = c_e \left(\frac{t_{(1-\alpha/2;1)}}{t_{(1-\alpha/2;\nu)}} \right) \left(\frac{\sqrt{n}}{\sqrt{2}} \right) \left(\frac{k_{s(\nu)}}{1.2533} \right) \qquad \text{(Equation F-16)}$$

where $t_{(1-\alpha/2;\nu)}$ is the tabulated t-statistic associated with the c_e, n is the sample size associated with c_e, and $k_{s(\nu)}$ is the sample standard deviation correction factor associated with the empirical value of s. For a sample size of 2, $k_{s(1)}$ is 1.2533. The sample standard deviation correction factor is needed because s underestimates σ, the true, population standard deviation, and the smaller the sample size, the greater the degree of bias. Mathematically:

$$\hat{\sigma} = k_{s(\nu)} s \qquad \text{(Equation F-17)}$$

where $\hat{\sigma}$ is the estimate of σ. The t-statistic takes this underestimation into account, but double counting of this phenomenon would occur without the $k_{s(\nu)}$ ratio in the equation. The values of $k_{s(\nu)}$ are obtained from Diem (1962).

Appendix G

APPENDIX G – SELENIUM AND CADMIUM DATA FEQUENCY HISTORGRAMS

FIGURE G.1
Spring 1998 Stream Selenium Frequency Data

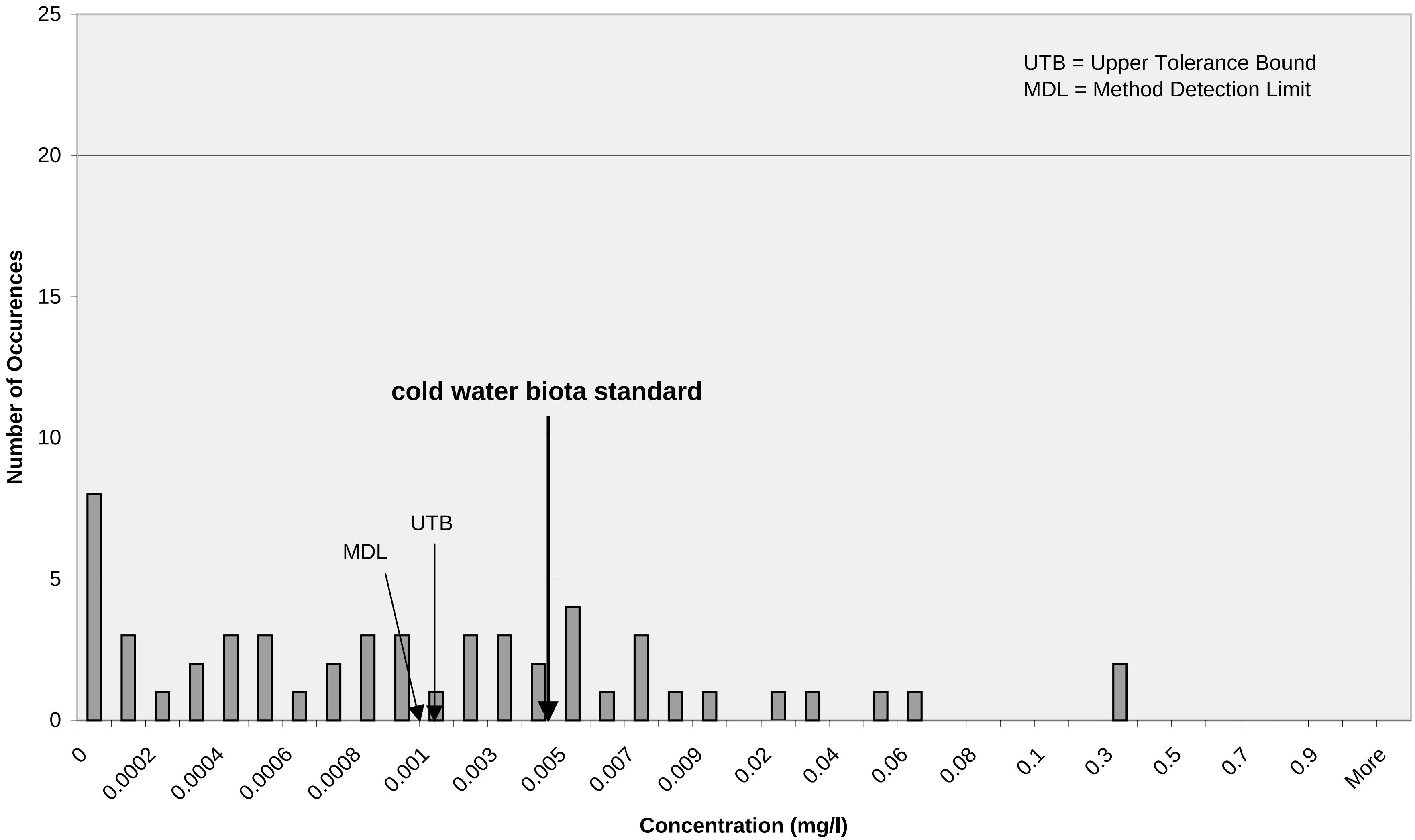


FIGURE G.2
Spring 1998 Mine Facility Surface Water Selenium Frequency Data

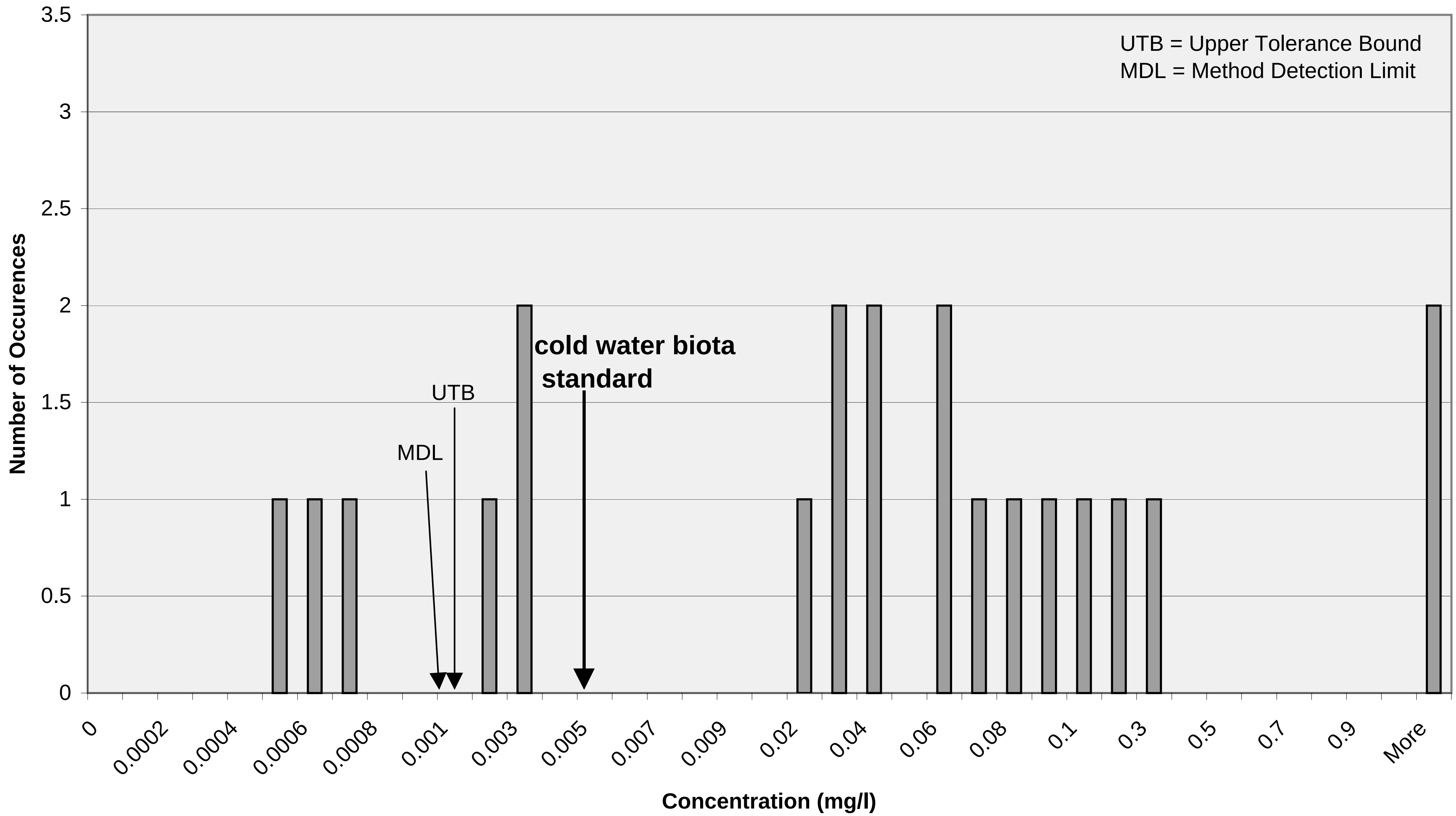


FIGURE G.3
Fall 1998 Stream Selenium Frequency Data

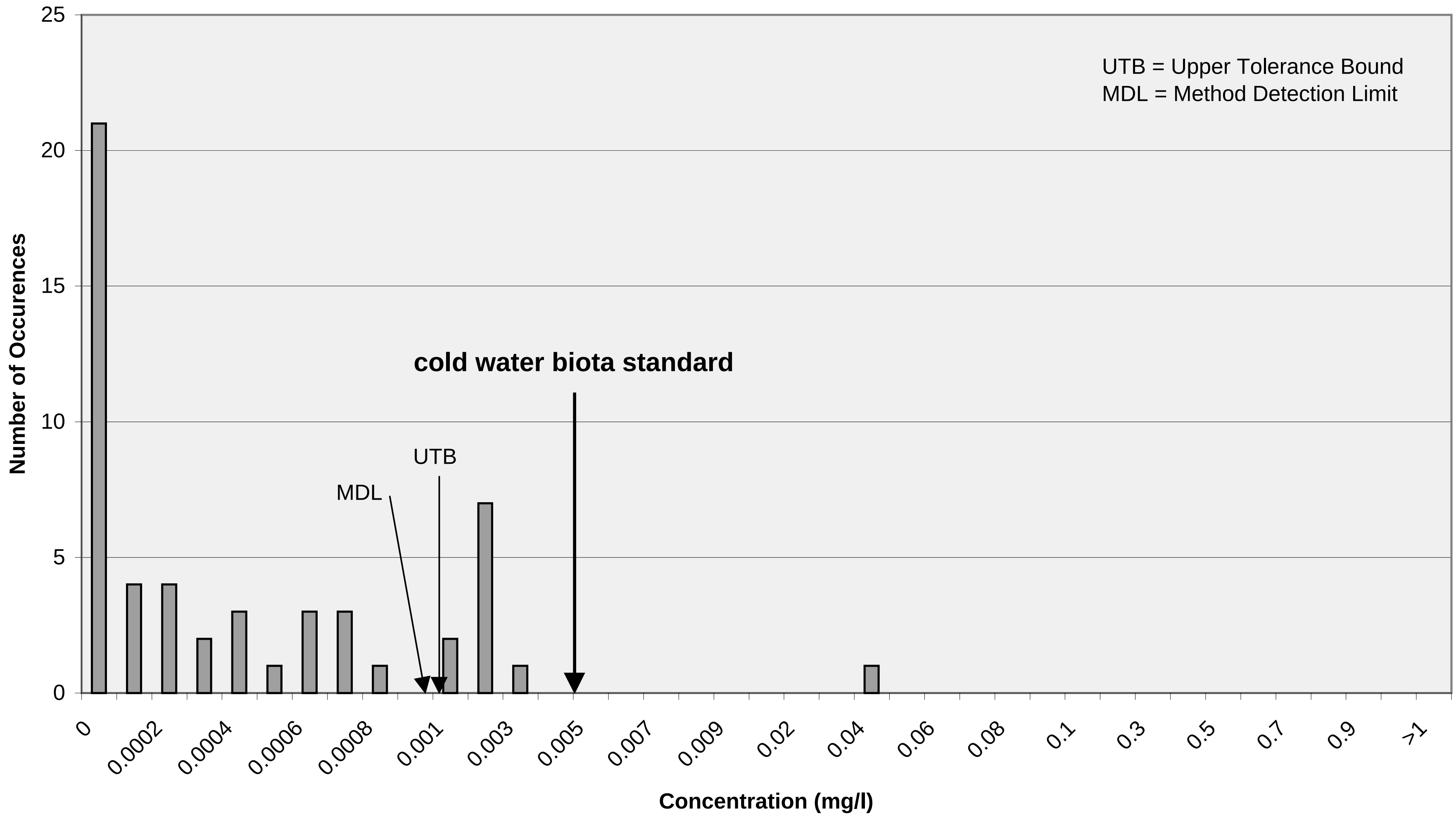


FIGURE G.4
Fall 1998 Mine Facility Surface Water Selenium Frequency Data

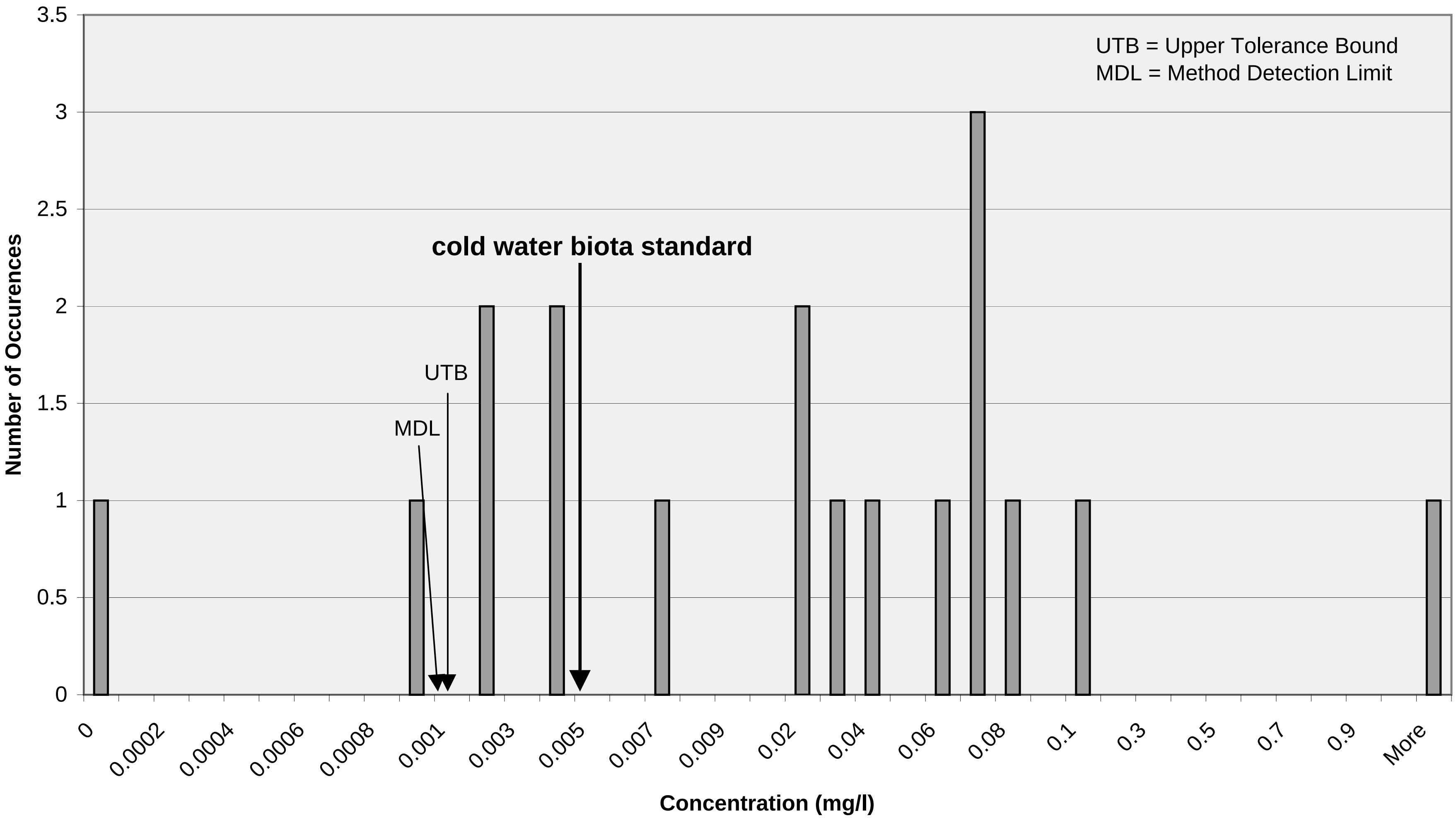
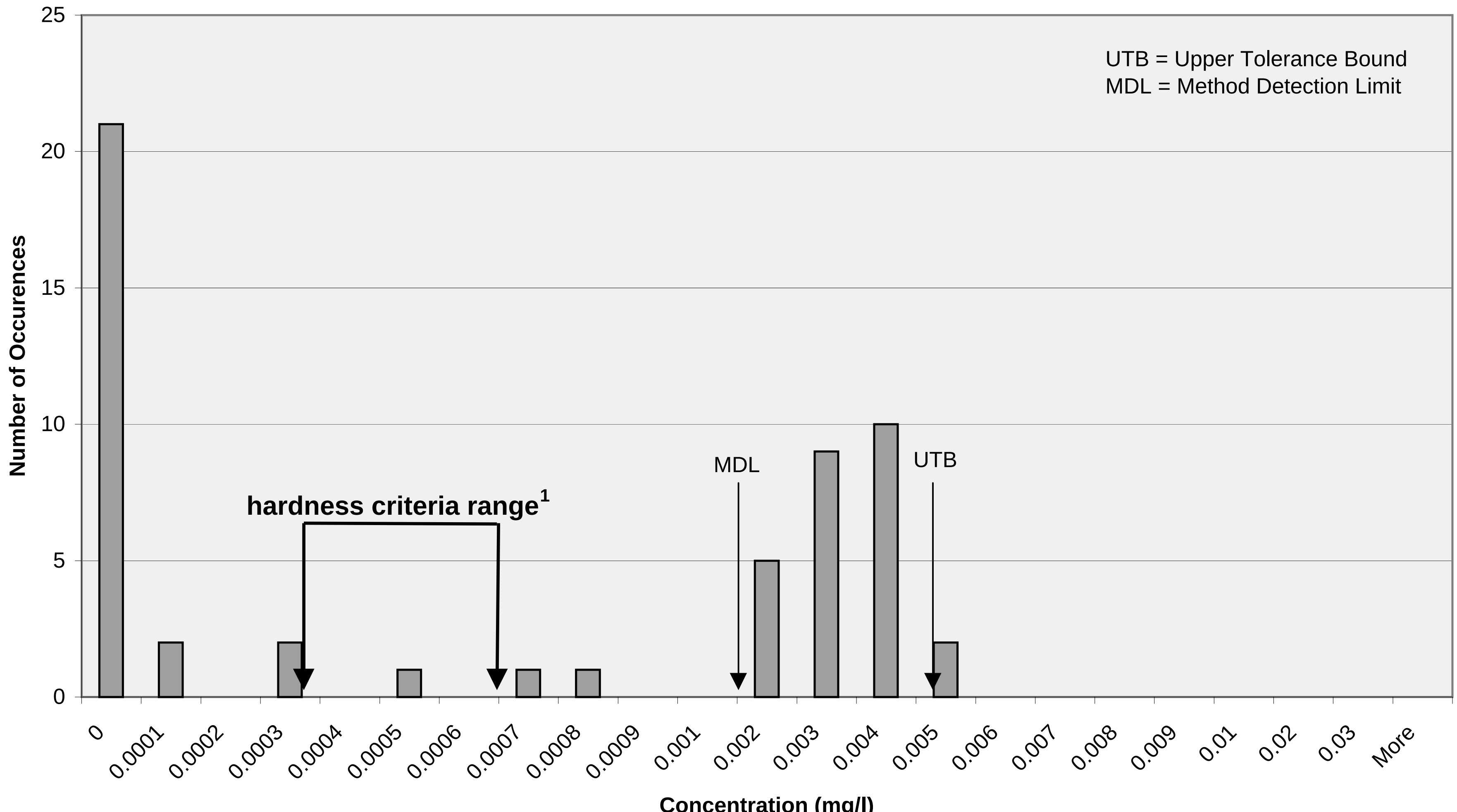
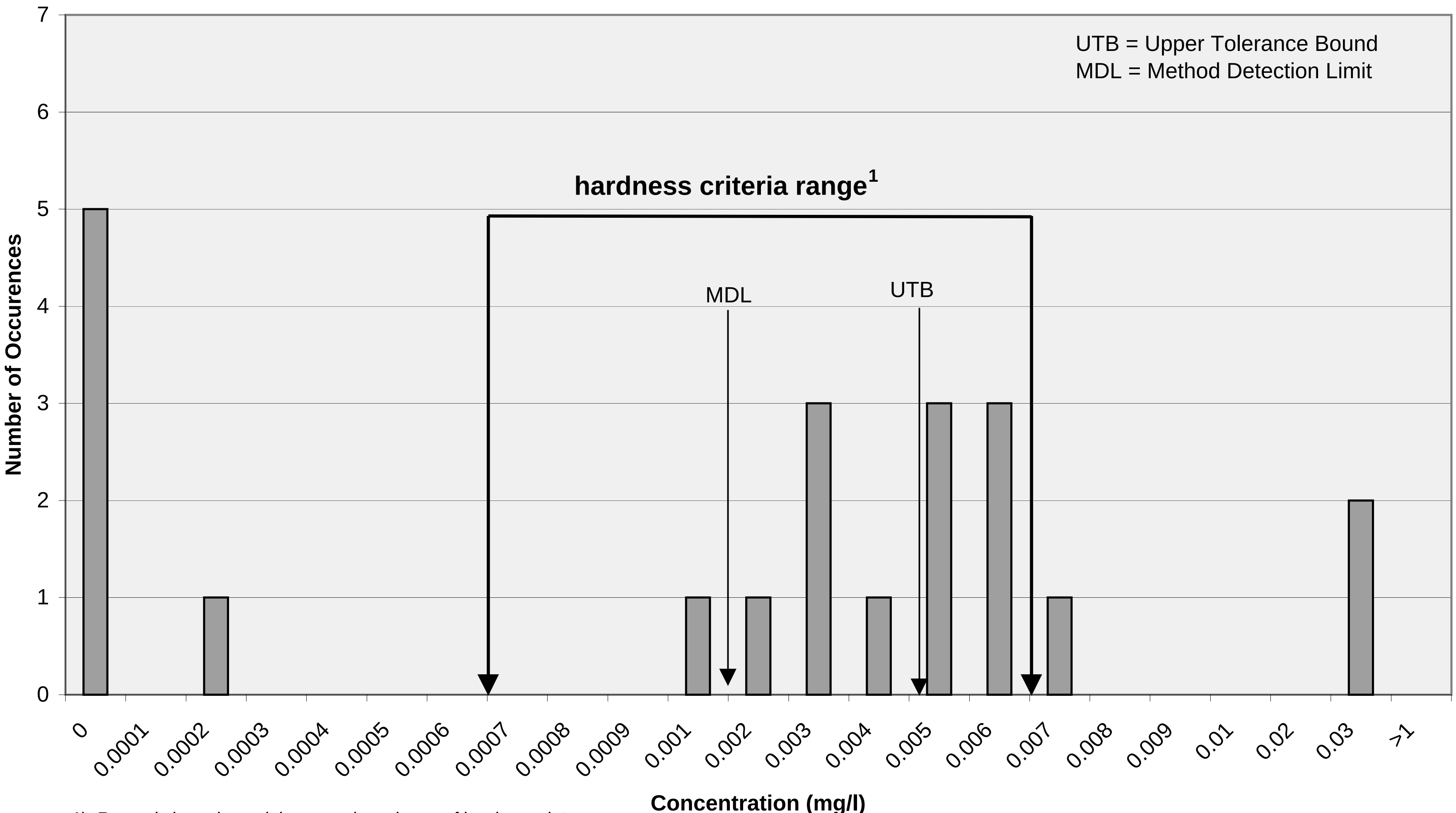


FIGURE G.5
Spring 1998 Stream Cadmium Frequency Data



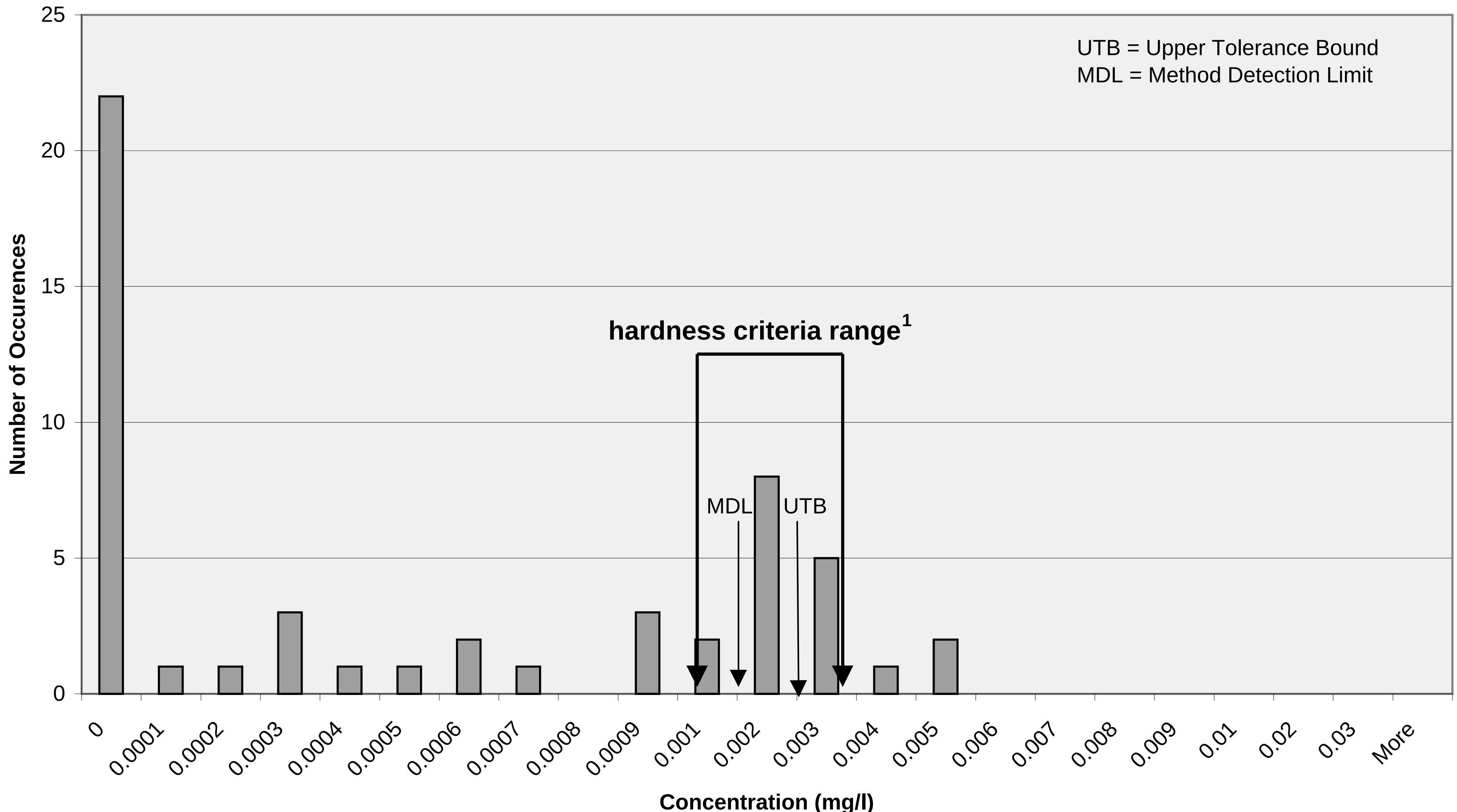
1) Range is based on minimum and maximum of hardness data.

FIGURE G.6
Spring 1998 Mine Facility Surface Water Cadmium Frequency Data



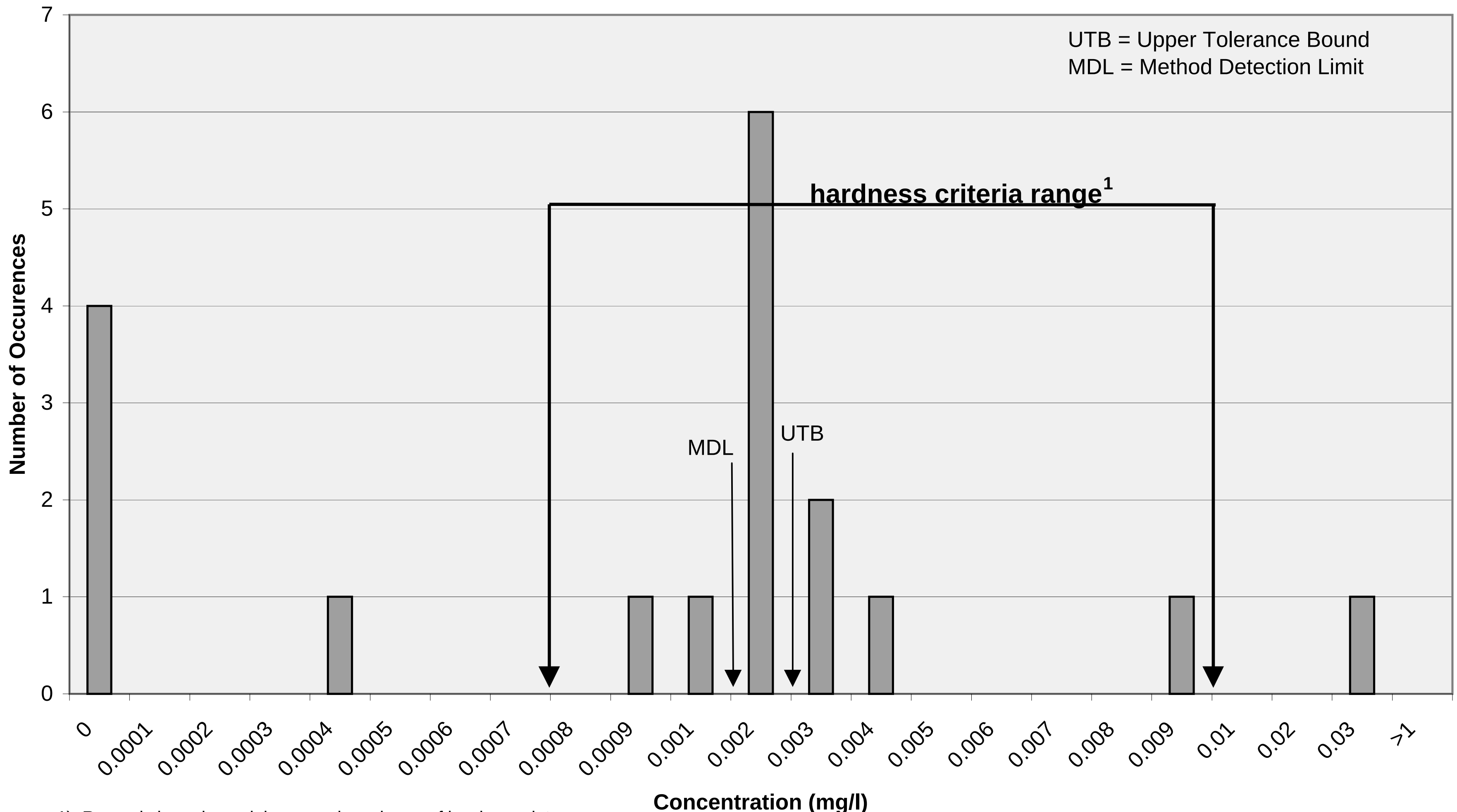
1) Range is based on minimum and maximum of hardness data.

FIGURE G.7
Fall 1998 Stream Cadmium Frequency Data



1) Range is based on minimum and maximum of hardness data.

FIGURE G.8
FALL 1998 Mine Facility Surface Water Cadmium Frequency Data



1) Range is based on minimum and maximum of hardness data.

FIGURE G.9
Spring 1998 Groundwater Well Selenium Frequency Data

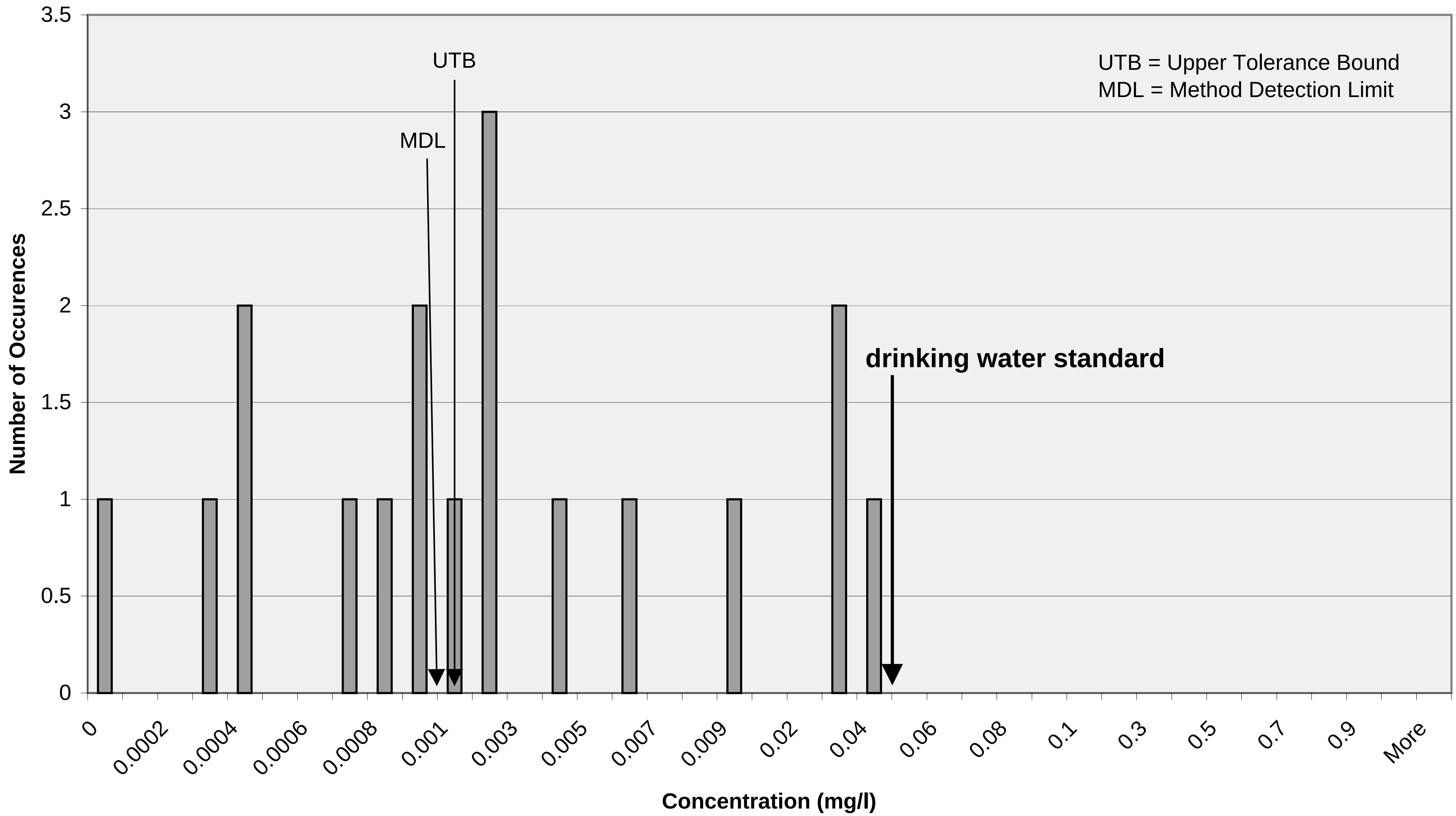


FIGURE G.10
Fall 1998 Groundwater Well Selenium Frequency Data

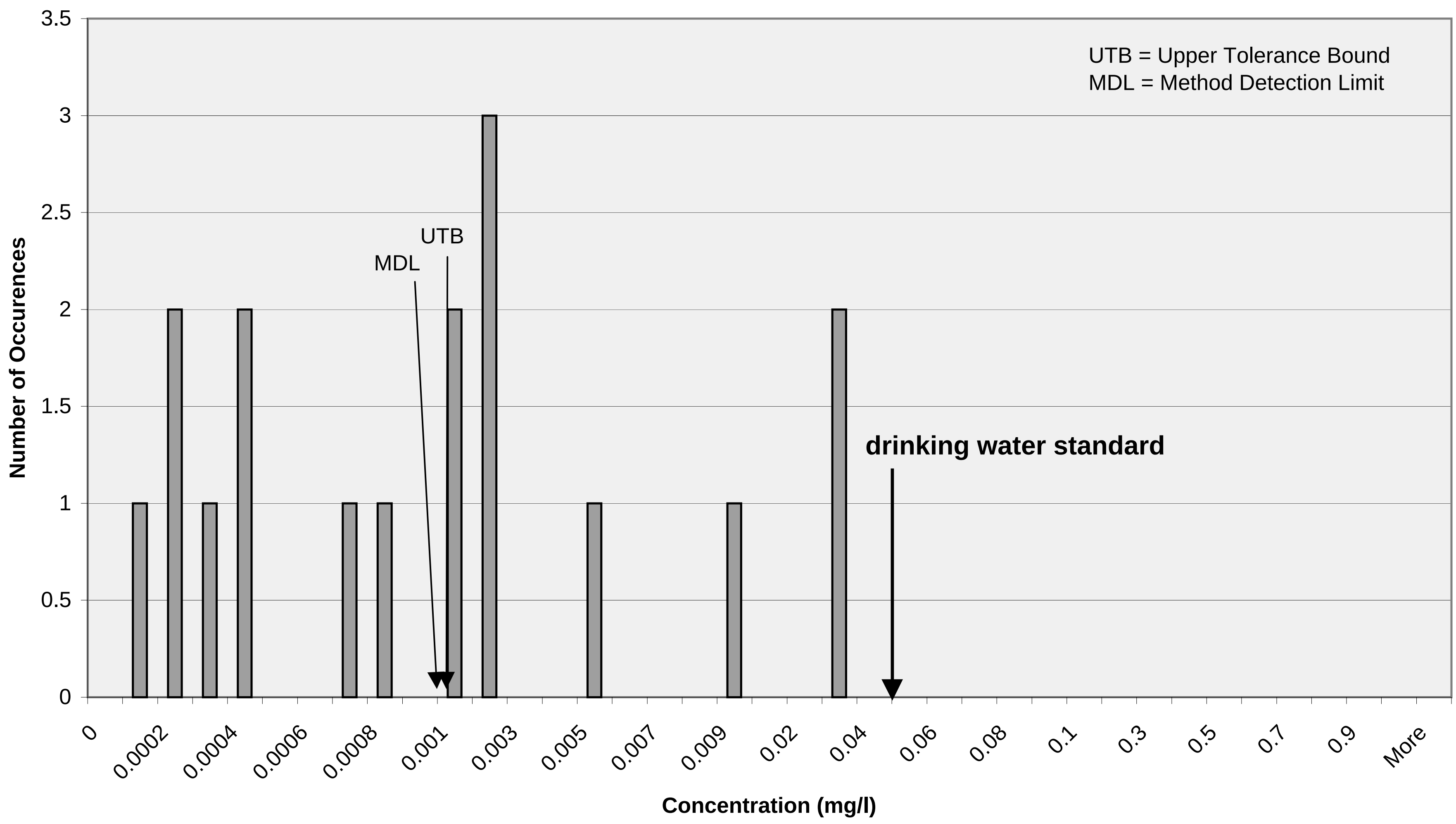


FIGURE G.11
Fall 1998 Groundwater Well Cadmium Frequency Data

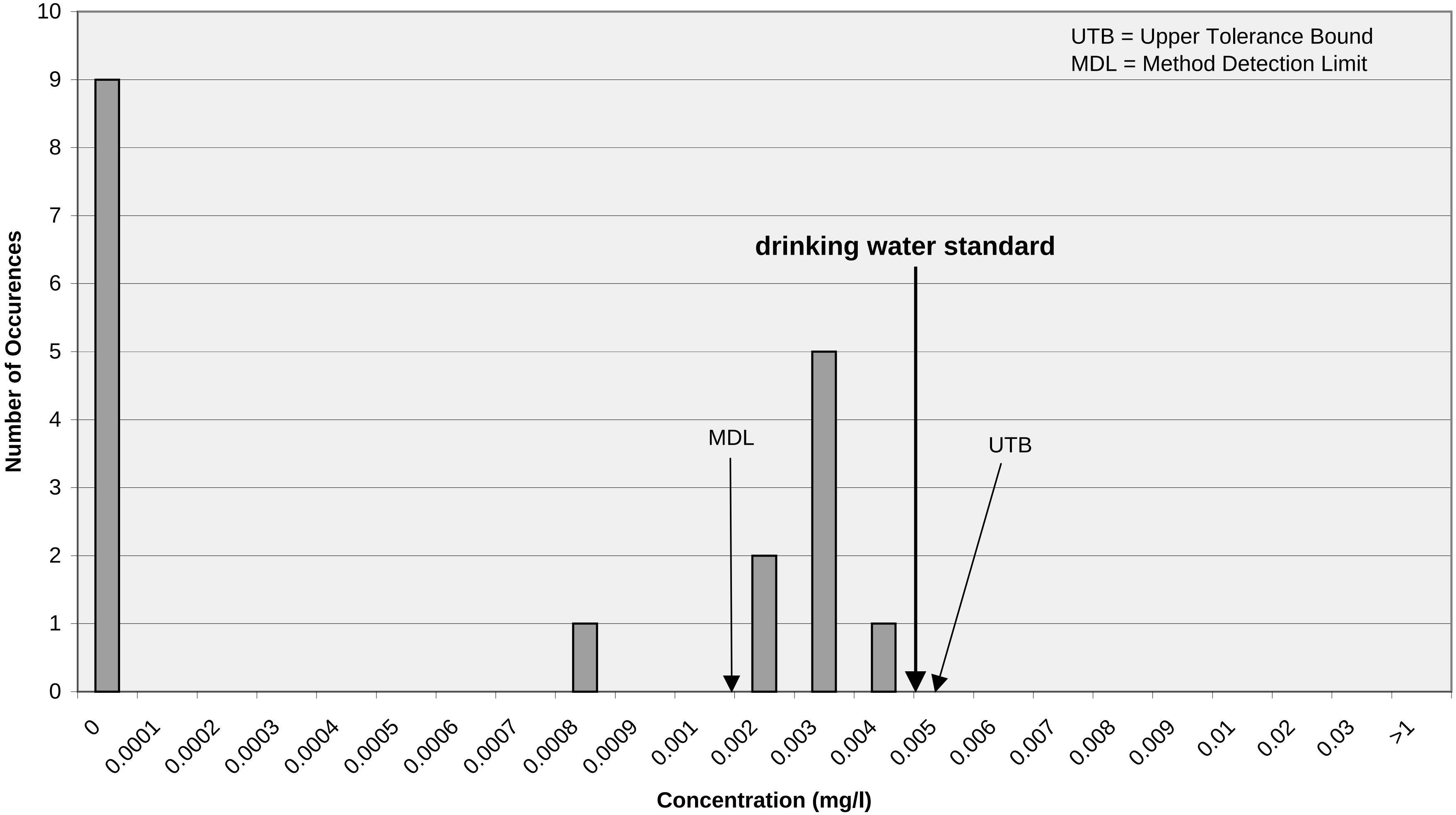
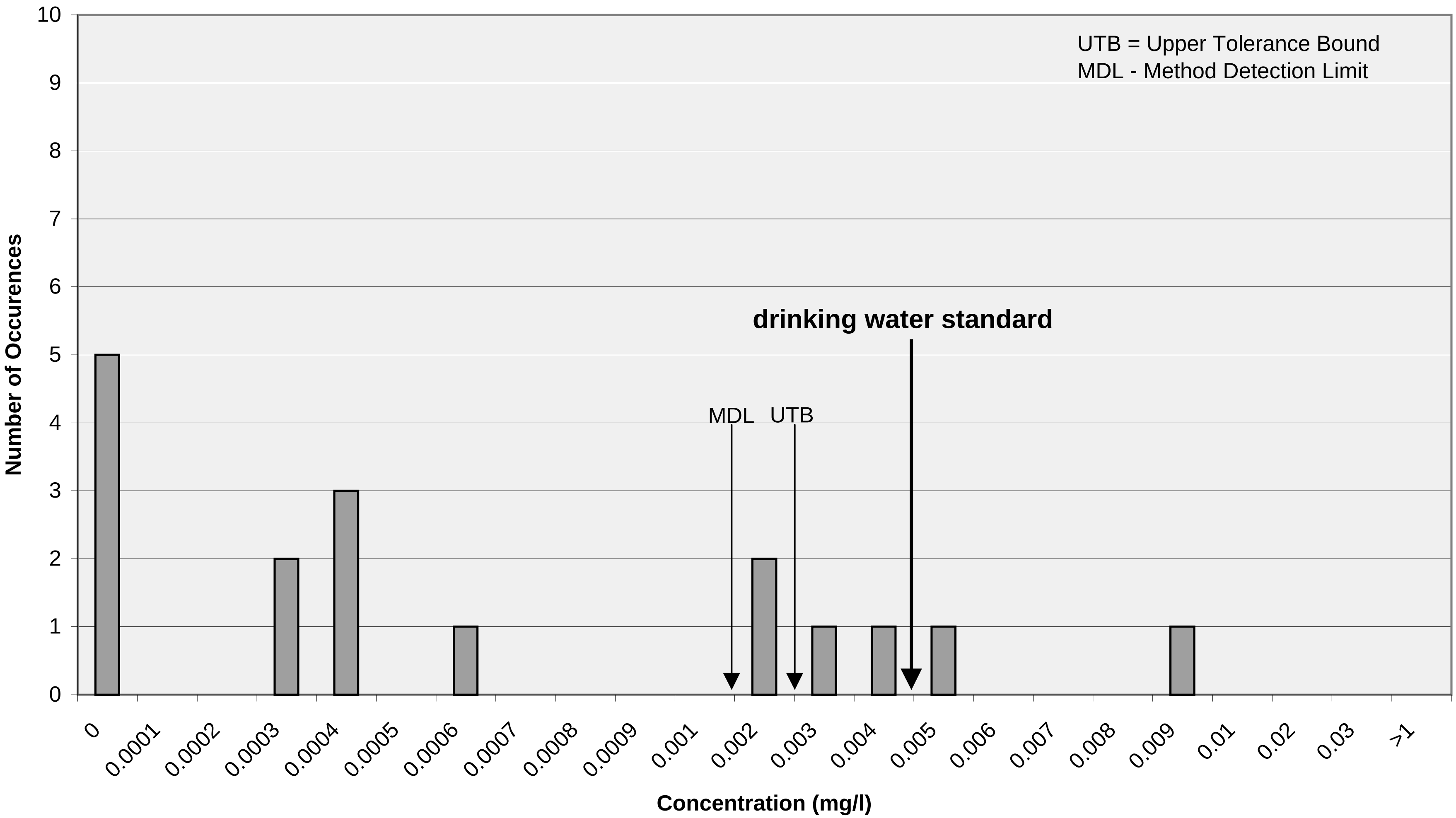


FIGURE G.12
Fall 1998 Groundwater Well Cadmium Frequency Data



Appendix H

APPENDIX H – PRELIMINARY RISK ASSESSMENT

This appendix provides preliminary human and ecological health risk assessments for the Idaho Mining Association (IMA) Selenium Subcommittee's Selenium Project. The preliminary risk assessments were developed using information collected in 1998. The draft version of the preliminary risk assessments were provided to the Interagency/Phosphate Industry Selenium Working Group (Selenium Working Group) in June 1999. Selenium Working Group comments on the draft version have been incorporated into the final version of the preliminary risk assessments that are presented below. The preliminary assessments will be further refined by incorporating data generated during the interim 1999 investigation and the 1999-2000 regional investigation.

The 1998 Sampling and Analysis Plan (1998 SAP [MW, 1998b]) presented a risk-based screening process that was used to identify the contaminants of potential concern (COPC). The screening process identified the following six constituents as the Selenium Project COPCs.

- cadmium
- manganese
- nickel
- selenium
- vanadium
- zinc

Table H.1 compares maximum observed concentrations of the six targeted trace elements in surface water and soil to preliminary remediation goal concentrations (PRGs). The PRGs were tabulated by Environmental Protection Agency (EPA) Region 9 and are derived from very conservative exposure assumptions commonly used throughout the nation by EPA in first-cut assessments.

Screening maximum observed concentrations against PRGs is extremely conservative. Especially with a large set of data such as was generated for this project (n = 146 per targeted trace element for surface water in 1998; n = 65 for soil). It would be more appropriate to compare the PRGs against the 95th percentiles of the average concentrations. However, much can be learned from the extremely conservative screen presented in Table H.1.

TABLE H.1
Comparison of Observed Water and Soil Concentrations to EPA Preliminary Remediation Goals

Targeted Trace Element	Maximum Observed Concentration		Preliminary Remediation Goal	
	Surface Water (mg/l)	Soil (mg/kg, dry)	Tap Water (mg/l)	Industrial Soil (mg/kg, dry)
Se	2.0	330	0.18	8,500
Cd	0.030	110	0.018	850
Mn	1.5	5,500	1.7	43,000
Ni	0.48	4,000	0.73	34,000
V	0.18	640	0.26	12,400
Zn	1.5	2,100	11	100,000

As shown in Table H.1, there were no observed soil concentrations of any of the targeted trace elements that were greater than their respective soil PRGs. The maximum observed concentrations are all well below their respective benchmarks. Thus, we believe that the exposure to soil is not a potential pathway and can be eliminated from further evaluation.

The 1998 data indicate that only two of the targeted trace elements, selenium and cadmium, have maximum observed concentrations in surface water that exceed their respective tap water PRGs. The degree of exceedence for selenium is much greater than that for cadmium. This suggests that selenium could have a higher potential to threaten environmental receptors than does cadmium.

The preliminary human health risk assessment is in subsection H.1. The preliminary ecological health risk assessment is presented in subsection H.2.

H.1 PRELIMINARY HUMAN HEALTH RISK ASSESSMENT

The preliminary human health risk assessment was developed using the following three phases.

- Problem formulation
- Analysis
- Risk characterization

The three phases of the preliminary assessment are presented in subsections H.1.1 through H.1.3, respectively. Subsection H.1.4 summarizes the preliminary human health risk assessment.

The draft preliminary human health risk assessment was submitted to the Selenium Working Group in June 1999. Participating agencies provided comments on the draft version that were incorporated into this final version of the preliminary human health risk assessment. A human health risk assessment workshop was held in November 1999. The workshop provided an opportunity for the Selenium Working Group to review the final version of the preliminary human health risk assessment and to kick off development of the next generation of the human health risk assessment. The results of the next generation of the human health risk assessment will be included in the 1999-2000 investigation report.

H.1.1 Problem Formulation

The initial phase in the risk assessment process was problem formulation. This potentially iterative phase, which included conceptual modeling, was undertaken to identify substances, receptors, and exposure routes of potential concern. Work plans developed to guide the 1998 sampling and analyses efforts did not originally include a human health risk assessment. The Selenium Working Group originally assumed that any potential risk associated with phosphate mining activities in the project area was an ecological risk.

The Selenium Working Group did initially consider one potential exposure route to human receptors. This route was groundwater ingestion. Most of the water-supply wells in the project area are industrial wells. Water from these wells is typically used for dust abatement and beneficiation. However, to assure that there was no problem with groundwater in the area, samples were collected and analyzed. The 1998 data generally indicated that none of the water-supply wells sampled exceeded drinking water standards. The exceptions were GW013 which had a May 1998 cadmium concentration of 0.0085 mg/l and GW020 which had nickel concentrations of 0.18 mg/l and 0.13 mg/l in May and September 1998, respectively. However, these are both industrial wells and are not utilized for potable water. Therefore, we believe that the groundwater ingestion pathway is not operative.

The Selenium Subcommittee modified the scope of the 1998 regional investigation during the summer of 1998 and added a human health risk assessment component. This risk assessment was added to address the question: "Are fish inhabiting streams in the southeast Idaho Phosphate Resource Area safe for human consumption?" The scope of the investigation was amended to include the sampling and chemical analysis of salmonids and to conduct a risk assessment for a fish ingestion exposure scenario.

Analysis of salmonid fillet samples indicated that selenium was the only targeted trace element elevated above the range of background concentrations. The elevated concentration is probably linked to the geochemical similarity between selenium and sulfur. There is a basic set of twenty amino acids used as building blocks of various proteins. Two of these amino acids, cysteine and methionine, contain a sulfur atom. Because the chemistry of selenium is so similar to sulfur, selenium can be preferentially taken up in biological tissue.

Following the identification of salmonid tissue as a potential risk pathway, the Selenium Working Group concluded that the ingestion of beef or elk that grazed reclaimed water rock dumps was another potential human health risk. Consequently, a risk assessment for a beef ingestion exposure scenario was initiated under the assumption that cattle at Henry Mine would provide a conservative surrogate for free- and wide-ranging elk. The Henry Mine cattle were selected because they were pastured on a seleniferous waste rock dump for nine continuous weeks. It was assumed that the cattle would serve as a conservative surrogate for free- and wide-ranging elk.

In summary, the 1998 regional investigation evolved to include two human exposure scenarios.

Fish Ingestion Scenario

- Substance of interest: selenium
- Receptor of interest: randomly selected adult resident of the region
- Exposure pathway of interest: ingestion of skin-on salmonid fillets

Beef Ingestion Scenario

- Substance of interest: selenium
- Receptor of interest: randomly selected adult resident of the region
- Exposure pathway of interest; ingestion of beef skeletal muscle

These two scenarios were evaluated and presented separately in the draft version of preliminary human health assessment. For the final version of the preliminary human health assessment, the two scenarios have been combined to allow for an overall evaluation. Combining the two prevents double counting background contributions of selenium in the diet. The overall preliminary conceptual model for the Selenium Project is summarized below.

- Substance of interest: selenium
- Receptor of interest: a randomly selected adult resident of the region who is (1) a recreational fisherman who fishes downstream of phosphate mines and consumes his catch; (2) someone who consumes beef grazed on phosphate mine waste rock dumps; and, (3) is sensitive to selenium
- Exposure pathways of interest: background dietary ingestion, multi-vitamin or mineral supplement ingestion, seleniferous fish ingestion, and seleniferous beef ingestion.

The assessment of this preliminary scenario is subject to refinement based upon new data generated by the interim 1999 and 1999-2000 regional investigation activities and upon comments received from Selenium Working Group participants. Therefore, one should be cautious about drawing any conclusions based upon the results of this initial and preliminary effort. The preliminary human health assessment focuses on selenium. Cadmium was not included in the preliminary assessment because the 1998 salmonid fillet cadmium concentrations were not elevated. However, cadmium has not been eliminated a COPC. Additional fish tissue sampling is being conducted as part of the 1999-2000 investigation. In addition, the 1999 – 2000 investigation includes beef and elk skeletal muscle and internal organ tissue sampling and analyses. If elevated levels of cadmium are observed in any of these tissues, then cadmium may be added as an additional constituent of interest in the final assessment.

H.1.2 Analysis

The analysis phase of a risk assessment consists of two steps, a toxicity assessment and an exposure assessment. Subsection H.1.2.1 illustrates the toxicity assessment while subsection H.1.2.2 presents the exposure assessment.

The following equation summarizes the risk model:

$$HQ = \frac{D}{T}$$

Equation H.1-1

where:

- HQ is the hazard quotient (unitless) associated with exposure to selenium
- T is the toxicity component of the model, a reference dose (RfD, mg/[kg·d])
- D is the dose resulting from the relevant exposure (mg/[kg·d])

A model was developed for each of the two exposure scenarios, which, in turn, were comprised of two submodels characterizing toxicity and dose. If the dose, D, exceeded the toxicity, T, then the resulting hazard quotient (HQ) is greater than 1.0 which indicates that the potential for toxic effects exists.

H.1.2.1Toxicity Assessment

Selenium was the only substance of interest identified for this preliminary assessment. Nutritional and toxicity aspects of selenium are discussed below, followed by documentation and development of the toxicity sub-model.

Selenium Nutrition

Selenium is an essential dietary nutrient for humans and other animals (Agency for Toxic Substances Disease Registry [ATSDR], 1994; EPA, 1999). The recommended daily allowance (RDA) for selenium in humans is 0.055 to 0.07 mg/d, or a daily dose of about 0.001 mg/(kg·d) (assuming a median adult body weight of 70 kg (National Research Council [NRC], 1989). The average daily intake (ADI) in humans is 0.071 to 0.152 mg/d (daily doses of about 0.001 to 0.002 mg/[kg·d]), and this is primarily obtained through diet (ATSDR, 1994). Over-the-counter selenium dietary supplements are available in doses of 0.05 and 0.20 mg/d. The use of supplements can potentially increase the daily intake range from 0.121 to 0.35 mg/d (daily doses of about 0.0017 to 0.005 mg/[kg·d]).

Selenium deficiency is associated with at least two chronic, metabolic diseases: Keshan disease, and Kashin-Beck disease (Yang et al., 1988). Keshan disease manifests its symptoms by increased necrosis of the myocardial muscle, while Kashin-Beck disease results in degeneration, atrophy, and necrosis of cartilage. Low selenium intake in other instances may result in increased cardiomyopathy and has caused human cardiovascular deaths (Oster et al., 1983; Salonen et al., 1982). Daily selenium intakes below 0.007 to 0.019 mg/d (daily doses of about 0.0001 to 0.0003 mg/[kg·d]) are associated with Keshan disease.

Selenium Toxicity

Three types of selenium toxicity have been clinically described: acute selenosis, subacute selenosis, and chronic selenosis. Acute selenosis is caused by consuming high amounts of selenium over a short period of time. Following the onset of this condition walking becomes unsteady, cyanosis of the mucous membranes occurs, labored breathing becomes common, and it occasionally results in death (EPA, 1999).

Subacute selenosis occurs from exposure to lesser (relative to those associated with acute selenosis) doses of selenium over a longer period of time which results in neurological dysfunction (i.e., impaired vision, ataxia, and disorientation), and respiratory distress. It is most frequently observed in grazing livestock feeding upon selenium-accumulating plants and has been referred to as blind staggers (EPA, 1999).

Prolonged exposure to more moderate levels of selenium is characterized by chronic effects including garlic breath, alopecia, dental carie increase, brittle and discolored nails, hair loss, gastroenteritis, and increased nervous system disorders. Pathological signs include hepatic degeneration, enlarged spleen, and accumulation of selenium in the hair and nails (EPA, 1999).

The nature of selenium effects do not appear to correlate with the oxidation state of the element. However, absorption and bio-availability are dependent on whether the form of selenium is organic or inorganic.

There have been no investigations that have demonstrated that selenium induces developmental anomalies in humans (ASTDR, 1989). Recent investigations in lower primates indicate that selenium does not induce fetal malformations under continuous dosing prior to conception through parturition. Similarly, developmental malformations in rodents have not been demonstrated under very stringent selenium exposure conditions (Barlow and Sullivan, 1982). However, avian species appear to be highly susceptible to selenium-induced malformations (Palmer et al., 1973). In rodents, selenium ingestion impairs fertility and conception rates, and elicits decreased fetal body weights (Chowdhury and Venkatakrishna-Ghatt, 1983).

Selenium has not been shown to be mutagenic in bacterial or mammalian cell mutagenesis assays (ASTDR, 1989). In fact, selenium has been shown to protect mammalian cells from oxidative damage that may lead to mutagenesis and carcinogenesis. Finally, the International Agency For Research on Cancer has concluded that selenium in the forms of selenite, selenate, and organic species are not carcinogenic to humans (EPA, 1999).

Selenium Toxicity Submodel

Because selenium is not considered to be carcinogenic to humans, the toxicity or dose-response assessment for selenium is limited to potential noncarcinogenic adverse health impacts. For such noncarcinogenic systemic toxicants, it is assumed that a threshold dose exists below which no adverse health effects are seen.

The potential for a substance to produce systemic toxic effects is used in a quantitative estimate of hazard. The chronic reference does (cRfD) is the toxicity value used to quantitatively express the potential for a chemical to produce noncarcinogenic effects. The cRfD is expressed in units of mg/(kg·d) and represents a daily intake of contaminant per mass of body weight that is not sufficient to cause the threshold effect of concern for the substance. Doses that are above the cRfD, or the threshold dose for the systemic toxicant, could potentially cause adverse health effects. The toxicity sub-model for this preliminary assessment consists of a simple equation used to estimate the chronic oral reference does for selenium ($cRfD_{Se}$). The equation is a function of the chronic no0sbserved-adverse-effects level ($cNOAEL_{Se}$) and the intraspecific uncertainty factor ($UF_{H,Se}$):

$$cRfD_{Se} = \frac{cNOAEL_{Se}}{UF_{H,Se}}.$$

Equation H.1-2

This sub-model is documented in Attachment H.1.

H.1.2.2 Exposure Assessment

The stage of the analysis phase mathematically defines the equations, variables, and parameters in the exposure sub-models for the two scenarios under evaluation. The fish ingestion component of the model is presented first, followed by the beef ingestion. Included is an assessment of selenium ingestion in background sources.

Fish Ingestion

The incremental daily selenium dose attributable to ingestion of recreationally-caught fish within the study area, $\Delta Dose_{Se,fish}$, is calculated as follows:

$$\Delta Dose_{Se,fish} = \frac{\left(C_{Se,fish,site,mean} - C_{Se,fish,background,mean}\right) \times IR_{fish} \times F_{fish,site} \times EF}{UCF_t \times BW}$$

Equation H.1-3

where:

- $C_{Se,fish,site,mean}$ is the average concentration of selenium (on a wet-weight basis) in salmonid fillets obtained from the study area, mg/kg;
- $C_{Se,fish,background,mean}$ is the average concentration of selenium (on a wet-weight basis) in edible fish tissue obtained from everywhere outside of the study area, mg/kg;
- IR_{fish} is the ingestion rate of fish, kg/d (wet weight);
- $F_{fish,site}$ is the fraction of fish biomass ingested that is obtained from the seleniferous waters within the study area;
- EF is the exposure frequency, d/yr;
- UCF_t is a time unit conversion factor, d/yr; and,
- BW is body weight of the individual consuming the fish, kg.

Each of these variables is defined in Attachment H-1. The dose is an incremental one because the model assumes that each kg of seleniferous fish consumed replaces a kg of non-seleniferous fish accounted for in the background component of the model.

Beef Ingestion

The incremental daily selenium dose attributable to ingestion of beef obtained from cattle grazed on seleniferous waste rock dumps within the study area, $\Delta Dose_{Se,beef}$, is calculated as follows:

$$\Delta Dose_{Se,beef} = \frac{\left\langle \left\{ \left[\frac{\left(C_{Se,beef,site,pasture,mean} - C_{Se,beef,background,mean}\right)}{2^{DT/BHL_{Se}}} \right] + C_{Se,beef,background,mean} \right\} - C_{Se,beef,background,mean} \right\rangle \times IR_{beef} \times F_{beef,site} \times EF}{UCF_t \times BW}.$$

Equation H.1-4

where EF, UCF_t, and BW are as defined above for Equation H.1-3, and where:

- $C_{Se,beef,site,pasture,mean}$ is the average concentration of selenium (on a wet-weight basis) in the skeletal muscle of beef at the time the cattle are removed from seleniferous pasture, mg/kg;
- $C_{Se,beef,background,mean}$ is the average concentration of selenium (on a wet-weight basis) in beef skeletal muscle obtained anywhere outside of the seleniferous portions of the study area, mg/kg;
- DT is the depuration time, or the time span from removal from seleniferous pasture until slaughter, during which selenium depletes from the tissues, d;
- BHL_{Se} is the biological half life of selenium in the muscle, d;
- IR_{beef} is the ingestion rate of beef, kg/d (wet weight); and,
- $F_{beef,site}$ is the fraction of beef biomass ingested that is obtained from seleniferous portions of the study area.

All variables are defined in Attachment H-1. As with fish, the beef ingestion dose is incremental because it is assumed that every kg of seleniferous beef replaces a kg of non-seleniferous beef already accounted for in the background component of the model.

Ingestion of Selenium from Background Sources

The daily selenium dose attributable to background sources, everyday diet and multi-vitamin or mineral supplements, is denoted $Dose_{Se,background}$ and is calculated as follows:

$$Dose_{Se,background} = \frac{ADI_{Se,diet} + ADI_{Se,supplements}}{BW}$$

Equation H.1-5

where BW is as defined above for Equation H.1-3, and where:

- $ADI_{Se,diet}$ is the average daily intake of selenium attributable to a normal, non-seleniferous diet, mg/d; and,
- $ADI_{Se,supplements}$ is the average daily intake of selenium attributable to the ingestion of multi-vitamins or mineral supplements, mg/d.

These two variables are defined in Attachment H-1. The inclusion of the background dose is necessary because of the threshold nature of selenium toxicity. With the threshold nature of the toxicity all significant sources of selenium exposure must be accounted for. The deterministic spreadsheet model is presented in Attachment H-2 and the deterministic demonstration is provided in Attachment H-3.

H.1.3 Risk Characterization

The risk characterization phase of a risk assessment consists of two steps, risk estimation and risk description. Risk estimation is the integration of the toxicity and exposure sub-models and an analysis of uncertainty. Risk description is a summary and interpretation of the estimated risk. Subsection H.1.3.1 documents the risk estimation; Subsection H.1.3.2 documents the risk description.

H.1.3.1 Risk Estimation

<u>**Integration of Toxicity and Exposure Assessments**</u>

The risk model is a measure of hazard called the site hazard quotient, denoted here as $HQ_{Se,site}$. The equation for the risk model, canceling out variables where possible for simplification, is as follows:

$$HQ_{Se,site} = \frac{ADI_{Se,diet} + ADI_{Se,supplements} + \dfrac{\left\langle \left\{ \left[\dfrac{\left(C_{Se,beef,site,pasture,mean} - C_{Se,beef,background,mean} \right)}{2^{DT/BHL_{Se}}} \right] \times IR_{beef} \times F_{beef,site} \right\} + \left\{ \left(C_{Se,fish,site,mean} - C_{Se,fish,background,mean} \right) \times IR_{fish} \times F_{fish,site} \right\} \right\rangle \times EF}{UCF_t}}{BW \times \dfrac{cNOAEL_{Se}}{UF_{H,Se}}}.$$

Equation H.1-6

Each variable in the above model is defined in Section H.1.2 above. $HQ_{Se,site}$ represents an estimate of risk to a randomly selected member of the target receptor population within the study area. Another hazard quotient can be defined as a subset of the above model:

$$HQ_{Se,background} = \frac{Dose_{Se,background}}{cRfD_{Se}}.$$

Equation H.1-7

The $HQ_{Se,background}$ the hazard quotient attributable to background selenium exposures are those that would occur in the target receptor population in the absence of any impacts from phosphate mining. This background risk estimate provides a check of model validity, as one would expect to be highly confident (e.g., > 99% confident) that background exposures would not harm members of the target receptor population. If the background risk estimate predicts otherwise, it would be an indication of the model being overly conservative.

The spreadsheet model used to evaluate the risk is presented as Attachment H-2. Each of the cells in the spreadsheet contains the deterministic or point-estimate values. Shaded numeric cells denote those that contain probability distributions. Light shading represent input assumptions and the darker shading indicate output forecasts, either intermediate or ultimate. Included in Attachment H-2 is a spreadsheet in formula format. Probabilistically, the model was evaluated by means of a 10,000-trial Monte Carlo simulation. A Monte Carlo simulation trial is a what-if evaluation where the computer randomly selects a value from each of the input distributions calculates the results deterministically, and records the results. The selected inputs are within the constraints of how a distribution is defined and the correlations with other input variables that have been imposed upon it. When a large number of random, what-if trials are performed and recorded, the results represent a probability distribution of the desired but uncertain output.

The deterministic solution to $HQ_{Se,site}$, $HQ_{Se,site,det}$, is 1.71. This value is presented in Attachment H-2. (Note: Health risk estimates are typically reported to one significant digit in deference to their uncertainty. However, the risk estimates in this assessment were reported to two significant digits to discern subtle differences between background and site risks.) The probabilistic solution to $HQ_{Se,site}$ is documented in the forecast portion of Attachment H-3. Some of the statistics included in the $HQ_{Se,site}$ distribution are presented in Table H.2 below.

TABLE H.2
$HQ_{Se,site}$ Distribution Statistics

Statistic	Value	Notes
μ	0.23	
σ	0.183	
$p_{0.50}$	0.178	
$p_{0.90}$	0.42	
$p_{0.95}$	0.53	
$p_{0.98}$	0.75	
	0.80	$HQ_{Se,site,semisto}$
$p_{0.989}$	1.00	Toxicity threshold
$p_{0.99}$	1.02	
$p_{0.999}$	1.55	
$p_{0.9998}$	1.71	$HQ_{Se,site,det}$
C_V	0.80	Coefficient of variation; i.e., σ/μ
$p_{0.95}/p_{0.050}$	8.3	inter-icosatile ratio

Where μ is the mean, σ is the standard deviation, p_q is a specified percentile (e.g., $p_{0.50}$ is the percentile corresponding to the 0.050 quantile, which is the 50th percentile or median), and $HQ_{Se,site,semisto}$ is the semi-stochastic result (i.e., the 95th percentile of the dose estimate divided by EPA's point estimate of the $cRfD_{Se}$). The results indicate that there is approximately 98.9% confidence that no member of the target receptor population will be harmed by the combination of study area related and background selenium exposures. They also indicate that the deterministic risk estimate is an invalid bounding estimate.

For comparison, $HQ_{Se,background,det}$ is 0.98 as seen from Attachment H-2. The results of the probabilistic analysis for $HQ_{Se,background}$ are fully documented in the forecast portion of Attachment H-3 and are summarized in Table H.3.

The preliminary assessment model indicates that the confidence level of no harm for background exposure is only slightly higher than that for the combination of site and background exposures. 99.1% for background alone vs. 98.9% for background and site combined. The degree of confidence for background exposure is sufficiently high so as to conclude that the model is not grossly over-conservative. A sensitivity analysis using another risk estimate was performed to validate the results. The second risk estimate examined the hazard quotient for background dietary selenium exposure independently. This is defined as $HQ_{Se,diet}$. The results of this estimate are presented as a deterministic estimate in Attachment H.2 and as a probabilistic estimate in the forecast portion of Attachment H-3. The confidence level for no harm from background diet independently is extremely high at > 99.99%, which validates the model.

TABLE H.3 $HQ_{Se,background}$ Distribution Statistics		
Statistic	**Value**	**Notes**
μ	0.21	
σ	0.171	
$p_{0.50}$	0.169	
$p_{0.90}$	0.39	
$p_{0.95}$	0.49	
$p_{0.98}$	0.70	
	0.76	$HQ_{Se,bckgrnd,semisto}$
$p_{0.99}$	0.91	
$p_{0.991}$	0.98	$HQ_{Se,background,det}$
$p_{0.991}$	1.00	Toxicity threshold
$p_{0.999}$	1.44	
$p_{0.9998}$	1.71	
C_V	0.81	Coefficient of variation; i.e., σ/μ
$p_{0.95}/p_{0.050}$	7.9	inter-icosatile ratio

Uncertainty Analysis

The deterministic model indicates that thereis a fair amount of uncertainty in $HQ_{Se,site}$. The C_V value of 0.80 is moderately high and the inter-icosatile ratio, which quantifies the range within which 90 percent of the risk estimate lies, is 8.3. This indicates that the ratio nearly spans an order of magnitude. These values indicate a marked improvement in the reduction of the uncertainiy from the draft version of the model. The draft version had a C_V value of 1.0 and inter-icosatile ratio of 20 for fish ingestion, and corresponding values of 1.3 and 30 for beef ingestion. The values in the final version represent an average reduction of 30% as measured by C_V, and an average reduction of 67% as measured by the inter-icosatile ratio.

The sensitivity analysis portion of Attachment H.3 includes tables of rank correlation sensitivity analyses for the three HQs discussed above. For all three HQs, only two variables, $UF_{H,Se}$ and $ADI_{Se,diet}$, account for well over 80% of the uncertainty in the risk estimates. The variable $UF_{H,Se}$, which is the only uncertain input variable in the toxicity sub-model, accounting for nearly two-thirds of the uncertainty.

The evaluation of the types of uncertainty, reducible or irreducible, that are associated with dominant variables in a probabilistic model constitutes an informal value-of-information analysis. This value-of-information analysis evaluates the benefits of further efforts to refine input variables and, consequently, the model output. Ignorance, or lack of knowledge, is the form of uncertainty that can be reduced through further experimentation or investigation. Natural stochastic, or random, variability is the form of uncertainty that can not be reduced. Stochastic variability exists and can only be described, further experimentation or investigation will do nothing reduce this type of variability.

The dominant form of uncertainty in the two model input variables, $UF_{H,Se}$ and $ADI_{Se,diet}$, for the site risk estimate that account for most of the overall model uncertainty is different. For $UF_{H,Se}$, the uncertainty is entirely in the form of lack of knowledge. There is only one true value of $UF_{H,Se}$ that, when applied to the $cNOAEL_{Se}$, provides the one true value of $cRfD_{Se}$, which is the 0^{th} percentile of the dose-response curve. We, however, do not know the true value, but it can be bound with a fair degree of certainty. While there is undoubtedly lack of knowledge in $ADI_{Se,diet}$, the dominant form of uncertainty in this variable is most likely natural stochastic variability. Each person in the target receptor population has a different average daily intake of selenium in his background diet and it can be assumed that the differences can be rather substantial.

To refine this model further, the refinement would target $UF_{H,Se}$ and $ADI_{Se,diet}$ on the basis of their contributions to the uncertainty in the model predictions. Refinement of the first variable would likely require an extensive human toxicological study. It is expected that this would be very time consuming and expensive. Refinement of the second variable would require an extensive behavioral study. This would also be very time consuming and expensive and very time consuming. Because the dominant form of uncertainty is probably natural stochastic variability the refinement woul not provide an significant information.

Interesting, it appears that the model is not sensitive to the site selenium concentration variables, $C_{Se,fish,site}$ and $C_{Se,beef,site,pasture}$. This indicates that the existing tissue sampling and analysis methods and procedures is adequate. However, additional refinement of the selenium concentration variables is ongoing as part of the interim 1999 and 1999-2000 investigation efforts to assure that the model adequately portrays spatial and temporal variation.

A contribution analysis was performed to evaluate the relative magnitudes of the ingestion of background diet, supplements, seleniferous fish, and seleniferous beef to the site risk estimate. The results are documented in the forecast portion of Attachment H-3. Table H.4, Summary of the Ingestion Contribution Aanlysis, presents the results of the analysis.

TABLE H.4
Summary of the Ingestion Contribution Aanlysis

Source of Selenium Ingested	Contribution (percent)
Background diet	88
Supplements	7
Seleniferous fish	3
Seleniferous beef	2

Because the fish and beef ingestion pathways were identified as being of most concern, these results indicate that the omission of less significant pathways in no way compromises the model's integrity.

H.1.3.2 Risk Description

Risk Interpretation

Within a regulatory context, an HQ in excess of 1.0 provides a possible basis for requiring site remediation within the framework of Comprehensive Environmental Response Compensation Liability Act (40 CFR § 300). Because most risk assessments for systemic toxicants are done within a deterministic framework, and because the deterministic framework is generally extremely conservative, an HQ is excess of 1.0 is not typically regarded as a hard threshold for remedial action.

Within a probabilistic framework, EPA's (1992) final exposure assessment guidelines suggest that risk managers base remedial action decisions on high-end estimates of risk. These guidelines define a high-end risk estimate to be one that lies within the range of the 90^{th} to 99.9^{th} percentile of the risk estimate. More specifically, the guidelines suggest that the range of reasonable maximum estimates is from the 90^{th} percentile to the 98^{th} percentile, and that any estimate exceeding the 99.9^{th} percentile is to be regarded as a bounding estimate. The guidelines indicate that it is inappropriate to base a site remedy on a bounding estimate. However, a no-action decision can be appropriate in instances where a bounding estimate lies below a level of concern; i.e., bounding estimates have screening utility. More recent guidance (EPA, 1995) indicates that the 95^{th} or 90^{th} percentile can be regarded as reasonable maximum estimates versus the 95^{th} percentile that is usually chosen.

The deterministic estimate represented by $HQ_{Se,site,det}$ is 1.71, which is above the action threshold of 1.0. However, the probabilistic assessment demonstrates that $HQ_{Se,site,det}$ is at the 99.98^{th} percentile.

As indicated above, a value at this percentile is above the range of a reasonable maximum estimate and that it is an invalid bounding estimate. The more realistic probabilistic estimate represented by $HQ_{Se,site,0.95}$ is 0.53. This value is significantly less than the action threshold. The semi-stochastic estimate represented by $HQ_{Se,site,semisto}$, is 0.80. This estimate is also well below the action threshold.

None of the other five target trace elements has the same toxicological endpoint as does selenium. The exclusion of the other elements from the model does not compromise the integrity of the analysis in any way because any risk estimates associated with the other trace elements would not be additive with the selenium risk estimate.

H.1.4 Risk Summary

The deterministic estimate of risk represented by $HQ_{Se,site,det}$ is 1.71. This estimate suggests that is may be appropriate to initiate remedial action to avert human exposure to selenium associated with fish and beef ingestion. However, the assessment demonstrates that this estimate is an invalid bounding estimate that lies at the 99.98th percentile of the underlying distribution of valid risk estimates. The 95th percentile of the probabilistic estimate represented by $HQ_{Se,site,0.95}$ is 0.53. This value is significantly less than the human health action threshold of 1.0..

The uncertainty analysis shows that some refinement of the toxicity variable, $UF_{H,Se}$, and especially the exposure variable $ADI_{Se,diet}$ could contribute to refinement of the overall model. However, substantial reductions in uncertainty have already been achieved relative to the draft version of the model and it is probable that additional reductions of any significance would be difficult. The model results indicate that fish and beef tissue sampling and analysis methods and procedures are adequate, but that additional spatial and temporal data may eliminate some the possibility of existing concentration biases.

The addition of other trace elements would not affect the risk estimates presented in the preliminary assessment because of the non-additive nature of the constituents. Selenium is a systemic toxin and the other five constituents are carcinogenic. In addition, it is believed that the addition of other selenium exposure pathways would not significantly alter the results of the final version of the preliminary assessment.

H.2 PRELIMINARY ECOLOGICAL HEALTH RISK ASSESSMENT

This section presents the methods and results of a preliminary ecological health risk assessment conducted for ecological habitats and receptors potentially impacted by phosphate mining operations in southeastern Idaho. This assessment was recommended by the Selenium Working Group based on a finding of elevated levels of selenium measured in surface water and vegetation during interim surveys conducted in 1997. This preliminary assessment was intended to evaluate potential ecological impacts associated with phosphate mining on the basis of data collected during the 1998 Regional Investigation. The results of this preliminary assessment will assist in the identification of potential data gaps in the 1998 regional investigation, and help to focus the 1999-2000 regional investigation on any critical data needs. Consequently, additional data collected as part of the 1999-2000 Regional Investigation will be used in the development of a refined assessment of potential impacts of phosphate-mining operations on ecological habitats and receptors.

H.2.1 Introduction

(EPA, 1998a) describes the following major steps in the screening ecological risk assessment process:

- Problem formulation
- Exposure assessment

- Ecological effects evaluation
- Risk estimation

The problem formulation step includes information on the following:

- descriptions of the biological resources present or potentially present

- identification of COPCs)

- identification of indicator receptors for evaluating the assessment and measurement endpoints

- the assessment and measurement endpoints selected for evaluation.

The exposure assessment includes the development of exposure parameters for use in calculating exposure doses. The ecological effects evaluation includes the establishment of ecotoxicity values for use in evaluating exposures to site COPCs. Finally, the risk estimation step involves a calculation of ecological hazard based on comparison of the exposure doses and ecotoxicity values for each receptor-COPC combination.

Each step in EPA's guidance is included in this preliminary assessment as follows:

- **Section H.2.1 - Introduction.**
  This subsection presents a brief introduction, and identifies the purpose and scope of the preliminary ecological assessment.

- **Section H.2.2 - Problem Formulation.**
  This subsection describes the ecological habitats and biological resources potentially present, identification of COPCs, identification of the assessment and measurement endpoints selected for evaluation, and identification of the indicator receptors selected for evaluating the assessment and measurement endpoints.

- **Section H.2.3 - Ecological Exposure Assessment.**
  This subsection describes the ecological conceptual site model, and the methods and assumptions used in ecological exposure modeling.

- **Section H.2.4 - Ecological Effects Assessment.**
  The toxicity (i.e., effects) criteria used in the ecological risk characterization are described in this subsection.

- **Section H.2.5 - Ecological Risk Characterization.**
  This subsection describes the methods used in the ecological risk characterization and presents the results of this preliminary assessment.

- **Section H.2.6 - Uncertainty Analysis.**
  The uncertainties involved in the preliminary assessment are discussed in this subsection.

- **Section H.2.7 - Data Gaps and Recommendations.**
  This subsection presents a discussion of data gaps and recommendations for further study.

H.2.2 Problem Formulation

This subsection includes a description of the ecological habitats and biological resources that are present in the investigation area, identification of COPCs, identification of the assessment and measurement endpoints that were selected for evaluation, and identification of the indicator receptors that serve to evaluate the assessment and measurement endpoints.

H.2.2.1 Biological Resources

The Resource Area lies in a vegetative transition zone and contains a large variety of plant and animal communities.

Vegetation

A detailed list of plants occurring within the investigation area is presented in Appendix A, Table A.1, *List of Plants Potentially Occurring Within the Study Area*. The plant associations present have been grouped into six categories as follows (USGS and USFS, 1977):

- Coniferous-aspen
- Mountain-brush
- Sagebrush-grass
- Riparian
- Marshland
- Agricultural land

The coniferous-aspen communities are dominated by Douglas fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmanii*), lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), and quaking aspen (*Populus tremuloides*). Shrubs present in this association include big whortleberry (*Vaccinium membranaceum*), Greene's mountain ash (*Sorbus scopulina*), mountain big sagebrush (*Artemisia tridentata*), and Redosier dogwood (*Cornus stolonifera*). Forbs include cutleaf balsam root (*Balsamorhiza macrophylla*), fendler meadowrue (*Thalictrum fedleri*), horsetail (*Equisetum spp.*), lupine (*Lupinus spp.*), and sweet anise (*Osmorhiza occidentalis*). Grasses present in this association include mountain brome (*Bromus carinatus*), oniongrass (*Melica bulbosa*), and pinegrass (*Calamagrostis rubescens*).

The mountain-brush community is dominated by Douglas fir (*Pseudotsuga menziesii*), rocky mountain juniper (*Juniperus scopulorum*), and Utah juniper (*Juniperus utahensis*). Shrubs present in this community include antelope bitterbrush (*Purshia tridentata*), mountain big sagebrush (*Artemisia tridentata*), and snowberry (*Symphoricarpos oreophilous*). Forbs include aster (*Aster* spp.), eriogonum (*Eriogonum spp.*), and thistle (*Cirsium spp.*). Grasses present in this association include bluebunch wheatgrass (*Agrophyron spicatum*) and prairie junegrass (*Koeleria cristata*).

Sagebrush-grass communities are dominated by antelope bitterbrush (*Purshia tridentata*), big sagebrush (*Artemisia tridentata var. tridentata*), chokecherry (*Prunus virginiana*), rabbitbrush (*Chrysothamnus viscidiflorus*), silver sagebrush (*Artemisia cana*), big mountain brome (*Bromus carinatus*), cheatgrass (*Bromus tectorum*), Idaho fescue (*Fescuca idahoensis*), and prairie junegrass (*Koeleria cristata*). Forbs present in this association include aster (*Aster* spp.), horsemint (*Agastache urtricifolia*), scarlet paintbrush (*Castilleja chromosa*), and western yarrow (*Achillea millefolium*).

Riparian communities are comprised of silver sagebrush (*Artemisia cana*), wax currant (*Ribes cereum*), willows (*Salix* spp.), aster (*Aster* spp.), fendler meadowrue (*Thalictrum fedleri*), and western yarrow (*Achillea millefolium*). Grasses present include Kentucky bluegrass (*Poa pratensis*), sedge (*Carex* spp.), and tufted hairgrass (*Deschampsia caespitosa*).

Marshland associations include Redosier dogwood (*Cornus stolonifera*), willows (*Salix* spp.), arrowhead (*Sagittaria* spp.), duckweed (*Lemna* spp.), pondweed (*Potamogeton* spp.), and mosses. Grasses include cattail (*Typha* spp.), rushes (*Juncus* spp.), sedges (*Carex* spp.), and spikerush (*Eleocharis* spp.).

Wildlife

Wildlife habitats are typically described by the vegetation types that occur within a particular area. The diverse plant associations previously described support a variety of wildlife, as indicated in Appendix A, Table A.2, *List of Mammalian Species Potentially Occurring Within the Study Area*, Table A.3, *List of Avian Species Potentially Occurring Within the Study Area,* Table A.5, *List of Fish Species Potentially Occurring Within the Study Area* , (USGS and USFS, 1977; National Audubon Society, 1996; Idaho Conservation Data Center, 1999). Additionally, the wildlife species present reflect human influences of urbanization, agriculture, mining activities, and hunting/trapping. For example, the grizzly bear (*Ursus arctos*) and gray wolf (*Canis lupus*) once inhabited southeastern Idaho but have since been extirpated from the region. The gray wolf has since been reintroduced to the region and there are reported sightings within the Study Area.

Conifer-aspen and mountain-brush communities support black bear (*Ursus americanus*), mountain lion (*Felis concolor*), snowshoe hare (*Lepus americanus*), yellow pine chipmunk (*Eutamias amoenus*), great horned owl (*Buba virginianus*), downy woodpecker (*Dendrocopos pubescens*), and western bluebird (*Sialia mexicana*).

Sagebrush-grass communities support coyote (*Canis latrans*), bobcat (*Lynx rufous*), deer mouse (*Peromyscus maniculatus*), prairie falcon (*Falco mexicanus*), sage grouse (*Centrocercus urophasianus)*, and mourning dove (*Zenaidura macroura*).

Riparian and marsh communities support moose (*Alces alces*), beaver (*Castor cawadensis*), muskrat (*Ondatra zibethica*), belted kingfisher (*Megacergle alcyon*), mallard duck (*Anas platyrhynchas)*, great blue heron (*Ardea heroidias*), and common snipe (*Capella gallinago*).

Fish associated with the streams, Blackfoot River, Blackfoot Reservoir, and various ponds within the area include cutthroat trout (*Onchorhynchus clarki*), rainbow trout (*Onchorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), mountain sucker (*Catostomus platyrhynchus*), longnose dace (*Rhinichthys catatactae*), red shiner (*Notropis lutrensis*), and Utah chub (*Gila atraria*).

Sensitive Species

The investigation area provides habitat for certain sensitive plant and animal species, as indicated in Table H.5, *List of Special Status Plant and Animal Species Potentially Occurring Within the Study Area*. Sensitive plant and wildlife species include: all listed federal and state sensitive (S), threatened (T), and endangered (E) species; species that are candidates for such listing (C); and, species of special concern (SC).

Plants

There are no federally listed plant species present in the investigation area. State-listed plant species potentially occurring within the investigation area include hoary willow (*Salix candita)*, green needlegrass (*Stipa viridula*), and red glasswort (*Salicornia rubra*). Additional state-listed plant species are included in Table H.5.

Wildlife

Sensitive avian species currently listed by state and federal agencies include the bald eagle (*Haliaeetus leucocephalus*), Columbian sharp-tailed grouse (*Tympanchus phasianellus columbianus*), long-billed curlew

(*Numenius americanus*), and white-faced ibis (*Plegadis chihi*). Mammals identified as sensitive by state or federal agencies include the gray wolf *(Canis lupus),* North American wolverine (*Gulo gulo luscus*), and pygmy rabbit (*Brachylagus idahoensis*). Listed fish species include the Bear Lake cutthroat trout *(Oncorhynchus clarki pop 3),* Bear Lake sculpin *(Cottus extensus),* Bear Lake whitefish *(Prosopium abyssicola),* Bonneville cisco *(Prosopium gemmifer),* Bonneville cutthroat trout *(Oncorhynchus clarki Utah),* Bonneville whitefish *(Prosopium spilonotus),* leatherside chub *(Gila copei),* and the Yellowstone cutthroat trout *(Oncorhynchus clarki bouvieri).* Additional sensitive wildlife species are included in Table H.5.

H.2.2.2 Identification of Chemicals of Potential Ecological Concern

The basic criteria for selection of COPCs for the ecological assessment were:

- Comparison with laboratory and field blanks
- Comparison with background concentrations
- Essential nutrient status

Based on these criteria, the chemicals that were selected as COPCs for evaluation in this assessment are selenium and cadmium. These chemicals, two of the six targeted trace elements in the 1998 Regional Investigation, demonstrated consistently elevated concentrations in surface water, sediments, surficial soil, and terrestrial vegetation as shown in Table H.6, *Cadmium and Selenium Exposure Point Concentrations in Surface Water,* Table H.7, *Cadmium and Selenium Exposure Point Concentrations in Sediment,* Table H.8, *Cadmium and Selenium Exposure Point Concentrations in Surficial Soil,* and Table H.9, *Cadmium and Selenium Exposure Point Concentrations in Terrestrial Vegetation.*

H.2.2.3 Assessment and Measurement Endpoints

As defined in by EPA (1998a) an assessment endpoint is an explicit expression of the environmental value that is to be protected (e.g., a decline in a specific species population). A measurement endpoint is defined as a quantitative expression of an observed or measured effect of the hazard; i.e., a measurable response to a stressor that is related to the ecological characteristic chosen as the assessment endpoint (EPA, 1998a).

Appropriate assessment endpoints may be broad and general, or very specific. The objectives of this preliminary ecological assessment are reflected in the assessment endpoints that were selected for evaluation. Specific assessment endpoints identified include protection of the growth and survival of aquatic/riparian organisms (i.e., fish, waterfowl, shore birds, marsh-dwelling passerines, omnivorous mammals, and herbivorous mammals) and large terrestrial herbivores. These organisms are represented by specific indicator receptors that were selected for quantitative evaluation in this preliminary assessment (see subsection H.2.2.4 below).

The measurement endpoints that were selected for evaluation of the assessment endpoints are receptor-specific hazard indices, HIs, for indicator receptors. The HIs are the sum of the hazard quotients, HQs. HQs are calculated by estimating the exposure dose received by the receptor and dividing it by a reference dose that is anticipated not to cause adverse effects.

H.2.2.4 Indicator Receptors

As described in subsection H.2.2.1, numerous plant and wildlife species are present, or potentially occurring, within the investigation area. It is not feasible to quantitatively evaluate potential impacts

Insert Table H.5, *List of Special Status Plant and Animal Species Potentially Occurring within the Study Area*

TABLE H.5 LIST OF SPECIAL STATUS PLANT AND ANIMAL SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA			
Common Name	LATIN BINOMIAL	Status	
		FEDERAL[1]	State[2]
Plants			
Foothill Sedge	*Carex tumulicola*		S
Slick Spot Peppergrass	*Lepidium papilliferum*	SC	GP2
Green Spleenwort	*Asplenium viride*		1
Starveling Milkvetch	*Astragalus jejunus var jejunus*		GP3
Vinta Basin Cryptantha	*Cryptantha breviflora*		2
Tufted Cryptantha	*Cryptantha caespitosa*		GP3
Varying Buckwheat	*Erigonum brevicaule var laxifolium*		
Rydberg's Musineon	*Musineon lineare*	SC	GP2
Cache Penstemon	*Penstemon compactus*	SC	GP2
Ute Ladies' Tresses	*Spiranthes diluvialis*	LT	GP2
Idaho Sedge	*Carex Parryana Idahoa*		GP2
Hoary Willow	*Salix candida*		S
Kelsey's Phlox	*Phlox kelseyi var kelseyi*		
Green Muhly	*Muhlenbergia racemosa*		1
Green Needlegrass	*Stipa viridula*		2
Red Glasswort	*Salicornia rubra*		S
Birds			
American White Pelican	*Pelecanus erythrorhynchos*		SC
Bald Eagle	*Haliaeetus leucocephalus*	LT	E
Black Tern	*Chlidonias niger*		SC
Black-Crowned Night-Heron l	*Nycticorax nycticorax*		P
Boreal Owl	*Aegolius funereus*	W	SC
California Gull	*Larus californicus*		P
Caspian Tern	*Sterna Caspia*		P
Cattle Egret	*Bubulcus ibis*		P
Columbian Sharp-Tailed Grouse	*Tympanchus phasianellus columbianus*	SC	GSC
Common Grackle	*Quiscalus quiscula*		P
Double-Crested Cormorant	*Phalacrocorax auritus*		P
Eared Grebe	*Podiceps nigricollis*		P
Forster's Tern	*Sterna forsteri*		P
Franklin's Gull	*Larus pipixcan*		P
Great Gray Owl	*Strix nebulosa*	W	SC
Lark Bunting	*Calamospiza melanocorys*		P
Long-Billed Curlew	*Numenius americanus*	SC	P
Northern Goshawk	*Accipiter gentilis*	W	SC
Peregrine Falcon	*Falco peregrinus anatum*	LE	E
Ring-Billed Gull	*Larus delawarensis*		P
Snowy Egret	*Egretta Thula*		P
Trumpeter Swan	*Cygnus buccinator*	SC	SC
Western Grebe	*Aechmophorus occidentalis*		P
White-Faced Ibis	*Plegadis chihi*	SC	P
Whooping Crane	*Grus americana*	XN	E
Mammals			
Gray Wolf	*Canis lupus*	E	XN
Rock Squirrel	*Spermophilus variegatus*	W	SC
Uinta Chipmunk	*Tamius umbrinus*	W	SC
Western Small-Footed Myotis	*Myotis ciliolabrum*	W	
Yuma Myotis	*Myotis yumanenisis*	W	
North American Wolverine	*Gulo gulo luscus*	W	SC
Pygmy Rabbit	*Brachylagus idahoensis*	W	GSC
Fish			
Bear Lake cutthroat trout	*Oncorhynchus clarki pop 3*	W	GSC
Bear Lake Sculpin	*Cottus extensus*	W	SC
Bear Lake whitefish	*Prosopium abyssicola*	W	GSC
Bonneville cisco	*Prosopium gemmifer*	W	GSC
Bonneville cutthroat trout	*Oncorhynchus clarki Utah*	SC	GE
Bonneville whitefish	*Prosopium spilonotus*	W	GSC
Leatherside Chub	*Gila copei*	W	SC
Yellowstone Cutthroat Trout	*Oncorhynchus clarki Bouvieri*	SC	GSC

TABLE H.5
LIST OF SPECIAL STATUS PLANT AND ANIMAL SPECIES
POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Source: Idaho Conservation Data Center (1999)

Notes: 1. Federal special status species, as follows:

C = (Candidate Species) Taxa for which the USFWS has on file sufficient information on biological vulnerability and threats to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.

LE = (Listed Endangered) Taxa in danger of Extinction throughout all or a significant portion of their range.

LT = LT=(Listed Threatened) Taxa likely to be classified as Endangered within the foreseeable future throughout all or a significant portion of their range.

PE = (Proposed Endangered) Taxa proposed to be listed as Endangered (formal rulemaking in progress).

PT = (Proposed Threatened) Taxa proposed to be listed as Threatened (formal rulemaking in progress).

[2]State special status species, as follows:

SC = (Species of Special Concern) Native Species which are either low in numbers, limited in distribution, or have suffered significant habitat losses.

T = (Threatened) Any species likely to be classified as endangered within the foreseeable future throughout all or a significant portion of its Idaho range.

E = (Endangered) Any species in danger of extinction throughout all or a significant portion of its Idaho range.

P = Protected species.

G = Game Species

W = (Watch) Species that are poorly understood, or may have unique habitats and population habits.

Blank spaces in the status column indicate that the species has not been identified as a "special status" species.

TABLE H.6 CADMIUM AND SELENIUM EXPOSURE POINT CONCENTRATIONS IN SURFACE WATER						
SOURCE/COPC	Water Concentration (mg/l)				NUMBER OF Samples[5]	DETECTION Frequency[6]
	Maximum[1]	Minimum[2]	Mean[3]	95% UCL[4]		
Stock Ponds						
Cadmium	0.0052	0.00084	0.0028	0.0049	13	100%
Selenium	0.12	0.00052	0.061	0.63	13	100%
Tailings Ponds						
Cadmium	0.0083	0.00019	0.003	0.009	10	100%
Selenium	0.03	0.00047	0.01	0.05	10	100%
Blackfoot River						
Cadmium	0.0041	0.001	0.003	0.0046	14	100%
Selenium	0.012	0.00046	0.0042	0.015	14	100%
State Land Creek						
Cadmium	0.0035	0.0021	0.0031	0.0041	2	100%
Selenium	0.029	0.000067	0.015	0.048	2	100%
East Mill Creek						
Cadmium	0.00084	0.00014	0.00043	0.0032	3	100%
Selenium	0.26	0.032	0.17	0.36	3	100%

Notes:
1. Maximum detected concentration of original or duplicate water samples.
2. Minimum concentration of original or duplicate water samples.
3. The arithmetic mean of detected concentrations for water samples collected.
4. The 95 percent upper confidence limit (95%UCL) on the mean concentration detected.
5. Total number of water samples collected (excludes duplicate samples).
6. Number of samples collected divided by number of detections, times one hundred.

mg/l = milligrams per liter

TABLE H.7 CADMIUM AND SELENIUM EXPOSURE POINT CONCENTRATIONS IN SEDIMENT						
	Sediment Concentration (mg/kg)				Number of Samples[5]	Detection Frequency[6]
Source/COPC	**Maximum[1]**	**Minimum[2]**	**Mean[3]**	**95% UCL[4]**		
Stock Ponds						
Cadmium	130	6.4	49	180	7	100%
Selenium	69	1.2	26	140	7	100%
Blackfoot River						
Cadmium	4.8	2.8	3.5	4.6	7	100%
Selenium	1.4	0.49	1.0	1.7	7	100%
State Land Creek						
Cadmium	10	10	10	30	1	100%
Selenium	9.4	9.4	9.4	28	1	100%
East Mill Creek						
Cadmium	9.3	9.3	9.3	28	1	100%
Selenium	2.9	2.9	2.9	8.7		100%

Notes:
1. Maximum detected concentration of original or duplicate water samples.
7. Minimum concentration of original or duplicate water samples.
8. The arithmetic mean of detected concentrations for water samples collected.
9. The 95 percent upper confidence limit (95%UCL) on the mean concentration detected.
10. Total number of water samples collected (excludes duplicate samples).
11. Number of samples collected divided by number of detections, times one hundred.

mg/kg = milligrams per kilograms

TABLE H.8
CADMIUM AND SELENIUM EXPOSURE POINT CONCENTRATIONS IN SURFICIAL SOIL

	Soil Concentration (mg/kg)				Number of Samples[5]	Detection Frequency[6]
Source/COPC	**Maximum[1]**	**Minimum[2]**	**Mean[3]**	**95% UCL[4]**		
Waste Rock Dumps						
Cadmium	110	4.9	41	100	50	100%
Selenium	330	0.69	43	160	50	100%
Phosphoria Formation						
Cadmium	28	4.7	11	23	15	100%
Selenium	16	0.61	2.9	8	15	100%

Notes:
1. Maximum detected concentration of original or duplicate water samples.
12. Minimum concentration of original or duplicate water samples.
13. The arithmetic mean of detected concentrations for water samples collected.
14. The 95 percent upper confidence limit (95%UCL) on the mean concentration detected.
15. Total number of water samples collected (excludes duplicate samples).
16. Number of samples collected divided by number of detections, times one hundred.

mg/kg = milligrams per kilograms

TABLE H.9 CADMIUM AND SELENIUM EXPOSURE POINT CONCENTRATIONS IN TERRESTRIAL VEGETATION						
	Vegetation Concentration (mg/kg)				Number of Samples[5]	Detection Frequency[6]
Source/COPC	**Maximum[1]**	**Minimum[2]**	**Mean[3]**	**95% UCL[4]**		
Waste Rock Dumps						
Cadmium\	8.4	0.093	1.9	5.2	50	100%
Selenium	84	0.16	16	97	50	100%
Phosphoria Formation						
Cadmium	2.1	0.1	0.8	2.5	15	100%
Selenium	0.78	0.0015	0.15	0.85	15	100%

Notes:

1. Maximum detected concentration of original or duplicate water samples.
17. Minimum concentration of original or duplicate water samples.
18. The arithmetic mean of detected concentrations for water samples collected.
19. The 95 percent upper confidence limit (95%UCL) on the mean concentration detected.
20. Total number of water samples collected (excludes duplicate samples).
21. Number of samples collected divided by number of detections, times one hundred.

mg/kg = milligrams per kilograms

to all receptors inhabiting this ecosystem. Therefore, representative indicator species were selected for quantitative evaluation in this preliminary assessment. The specific indicator receptors that were chosen, and the basis for their selection, are provided below.

Cutthroat Trout

Cutthroat trout (*Onchorhynchus clarki*) occupy inshore marine and estuarine waters, lakes, coastal, inland, and alpine streams. These trout are distinguished by basibranchial teeth and bright red-orange slash marks on each side of the throat. They have reached up to 41 pounds in weight, and 30 inches in length, but rarely exceed 15 inches today. There are more than ten subspecies of cutthroat trout, locally called native trout, that vary in coloration and size. Inland, cutthroat trout live in an area ranging from Southern British Columbia and Alberta to New Mexico, Colorado, and eastern California (National Audubon Society, 1983).

Within the investigation area, native cutthroat trout occupy the Blackfoot River, its tributaries, and the Blackfoot Reservoir. This fish species was selected as an indicator receptor because:

- It is an upper-trophic-level aquatic vertebrate and therefore would be expected to receive relatively higher exposures to bioaccumulating chemicals such as selenomethionine.
- It affects the abundance, reproduction, and recruitment of higher-trophic-level receptors (i.e., it is a keystone species).
- It is of social and economic importance, in large part because of its status as a game fish.

Red-Winged Blackbird

The red-winged blackbird (*Agelaius phoeniceus*) is an omnivorous bird present in the riparian food web. Red-winged blackbirds are diurnal and occupy wetland habitats, roosting in fresh and saline emergent wetlands of cattails and tules, or in moist open habitats with thickets of sedges, willows, dense forbs, and grasses. Nests and roosts are near or over water roost sites may be occupied by thousands in winter. Red-winged blackbirds feed on seeds and cultivated grains such as rice, oats, and corn. Plant material constitutes up to 90 percent of their diet in fall and winter. Insects and spiders are consumed in the breeding season, serving as the entire diet of nestlings and much of the adult diet in certain areas. Red-winged blackbirds normally breed between early March and late July. Nests are sometimes solitary, but more often are semicolonial, with each male mating with several females simultaneously. Clutch size ranges from two to six eggs, with an incubation period of ten to twelve days. Altricial young are tended by the female alone or by both parents. Young leave the nest at eleven to fourteen days, become independent at two weeks, and breed at one year. Each female may raise two or three broods yearly. Nest predators include grackles, snakes, raccoons, skunks, minks, and other small mammals. The red-winged blackbird occasionally causes extensive crop damage and subsequent economic losses (Zeiner et al., 1990).

The red-winged blackbird was selected as a representative indicator receptor because:

- It represents a marsh-dwelling passerine.
- It is important in energy transfer between lower trophic levels (e.g., producers) and upper trophic levels (i.e., carnivores). However, it does not have social importance or provide economic gain.

Common Snipe

The common snipe (*Capella gallinago*) is an omnivorous bird present in the riparian food web. Common snipes are diurnal and occupy wetland habitats, roosting in fresh emergent wetlands, coastal meadows, wet pastures, rice fields, sloughs, canals, ditches, or other wetlands with fresh, rich, decomposed organic matter. Common snipes average 10.5 to 11.5 inches in length, and feed on insects, earthworms, freshwater crustaceans, mollusks, and occasionally fish. It feeds by probing in water-saturated soils, and seizing prey from the surface. It also takes in grass, sedge seeds, and grit during the feeding process. Common snipes normally breed between mid April and August. Nests are sometimes solitary, but nesting pairs may aggregate where suitable habitat exists. Clutch size is four eggs, with only one brood being raised per season. The female incubates the eggs for a period of seventeen to twenty days. Precocial young are cared for by both parents until they fledge at nineteen to twenty days after hatching (Zeiner, 1990).

The common snipe was selected as an indicator receptor because:

- It represents a riparian and marsh-dwelling shore bird.
- It is anticipated to receive relatively high exposures to targeted trace elements in sediment due to its probing foraging behavior.
- It is important in energy transfer between lower trophic levels and upper trophic levels. Additionally, the common snipe is one of the few shorebirds that is taken as a harvest species.

Mallard

The mallard (*Anas platyrhynchos*) is an omnivorous bird present in the riparian food web. Mallards are diurnal and occupy fresh emergent wetlands, estuarine, lacustrine, and riverine habitats, ponds, pastures, croplands, and urban parks. The home range depends upon population density and habitat. In winter, mallards may fly 30 to 40 miles from winter resting sites to forage. Mallards average 20.5-28.0 inches in length, and feed on grains, seeds, leaves of aquatic plants, grasses, and other green vegetation. Their diet also includes snails, small crustaceans, earthworms, tadpoles, and small fish. Plant material constitutes up to 90 percent of their diet, with animal foods being most important during breeding season. Mates pair up as early as August, and breed between March and July. Nesting pairs are monogamous and nest singly, or close to other pairs. Clutch size usually ranges from six to twelve eggs, with an incubation period of 23 to 26 days. Precocial young are tended by the hen only. Young fly 40 to 60 days after hatching and breed late in the first year. Nest predators include striped skunks, rats, coyotes, raccoons, opossums, gulls, crows, and magpies (Zeiner et al., 1990).

The mallard was selected as an indicator receptor because:

- It represents riparian and marsh-dwelling waterfowl.
- It is important in energy transfer between lower trophic levels and upper trophic levels.
- It has social and economic importance, in large part because it is a game bird.

Muskrat

The muskrat (*Ondatra zibethicus*) is mainly an herbivorous mammal present in the riparian food web, with opportunistic feeding on aquatic vertebrates and invertebrates. Muskrats are both diurnal and nocturnal, occupying fresh emergent wetland habitats, valley foothill and montane riparian habitats, aspen and lacustrine, riverine, and estuarine habitats. They will also occupy human-made habitats such as roadside and irrigation ditches (Zeiner et al., 1990). They average 1.25 to 4 pounds in weight, and feed on aquatic plants such as cattails, sedges, rushes, and water lilies, preferring roots and basal stems (Zeiner, 1990; National Audubon Society, 1996). Muskrats normally breed year-round, weather permitting in the south, spring and summer in the north, and may have two to three litters per year, with four to eight young per litter. The gestation period is 25 to 30 days. Sexual maturity occurs the spring after birth (Zeiner et al., 1990). They are prey for minks, raccoons and other large bird and mammal predators (Zeiner et al., 1990).

The muskrat was selected as an indicator receptor because:

- It represents an aquatic/riparian, omnivorous mammal.
- It has a relatively small home range and therefore may spend considerable time within a potentially affected area.
- It is important in energy transfer between lower trophic levels and upper trophic levels.
- It is of potential social and economic importance in the fur trade.

Moose

The moose (*Alces alces*) is an herbivorous mammal present in the riparian food web. Moose are diurnal and occupy spruce forests, swamps, and aspen and willow thickets. They range from 700 to 1,400 pounds in weight, and feed on willows and aquatic vegetation in the summer, and woody plants such as willow, balsam, aspen, dogwood, birch, cherry, maple, and viburnum in the winter. Moose are excellent swimmers and runners. They will move through the water at six miles per hour, for stretches of two hours and will run at speeds of 35 miles per hour. Moose normally breed mid September through late October, bearing one or two calves in late May through early June. The calf can swim within a couple of weeks, and is weaned at six months, and is finally driven off just before the birth of new calves. Wolves are the main predator of moose, but are largely extirpated from the moose's range (National Audubon Society, 1996).

The moose was selected as an indicator receptor because:

- It represents a riparian, herbivorous mammal.
- It is important in recruitment of energy from lower trophic levels.
- It has social and economic importance, in large part because it is a game species.

Livestock (Sheep, Horses, and Cattle)

Domesticated sheep, horses, and cattle are permitted to graze the reclaimed waste rock dumps during the summer months. Sheep are typically herded from one grazing site to the next and typically spend less than two months on any one site. Horses and cattle are not herded and may spend relatively more time grazing a particular waste rock dump. The limiting factors in grazing duration are the winter freeze, and the non-irrigated nature of the waste rock dumps. Because of these factors, the waste rock dumps only sustain ample vegetation for grazing from about June through August or September. This provides a maximum grazing duration of three to four months, after which the livestock are removed from the sites.

Sheep, horses, and cattle were selected as indicator receptors because:

- They represent large, terrestrial, herbivorous mammals.

- They most likely have higher exposures relative to free-ranging terrestrial ungulates such as elk and mule deer.

- They are important in energy recruitment from lower trophic levels (i.e., plants).

- They have obvious social and economic importance.

H.2.3 Ecological Exposure Assessment

This section describes the ecological conceptual site model, and the methods and assumptions that were used in ecological exposure modeling for this preliminary assessment. The development of an ecological conceptual site model (CSM) serves to identify all potentially exposed receptors and potentially complete exposure pathways. Exposure modeling allows quantification of the potential co-occurrence of receptors and COPCs. Potential exposures are evaluated by estimating COPC exposure point concentrations in abiotic and biotic media, and subsequent uptake by indicator receptors. The results of the exposure assessment are considered in relation to the results of the toxicity assessment to characterize ecological risk.

H.2.3.1 Ecological Conceptual Site Model

An ecological CSM was prepared for the investigation area, consistent with EPA guidelines (1998a). The ecological CSM is a graphic representation of the potential contaminant sources, migration and transport pathways, exposure pathways, and exposed populations.

As described in subsection H.2.2.3, the assessment endpoints identified for this preliminary assessment include protection of the growth and survival of aquatic/riparian organisms (i.e., fish, waterfowl, shore birds, marsh-dwelling passerines, omnivorous mammals, and herbivorous mammals) and large terrestrial herbivores. Specific indicator receptors were selected to represent these organisms for quantitative evaluation in this assessment (see subsection H.2.2.4 above). Simplified exposure models for aquatic/riparian and terrestrial habitats are presented in Figure H-1, *Exposure Model for Aquatic/Riparian Receptors,* and Figure H-2, *Exposure Model for Terrestrial Receptors.* Based on the relationship of the various indicator receptors to their habitats and the nature of the COPCs evaluated in this preliminary assessment, a general CSM was developed for the investigation area and is presented in Figure H-3, *Ecological Conceptual Site Model.*

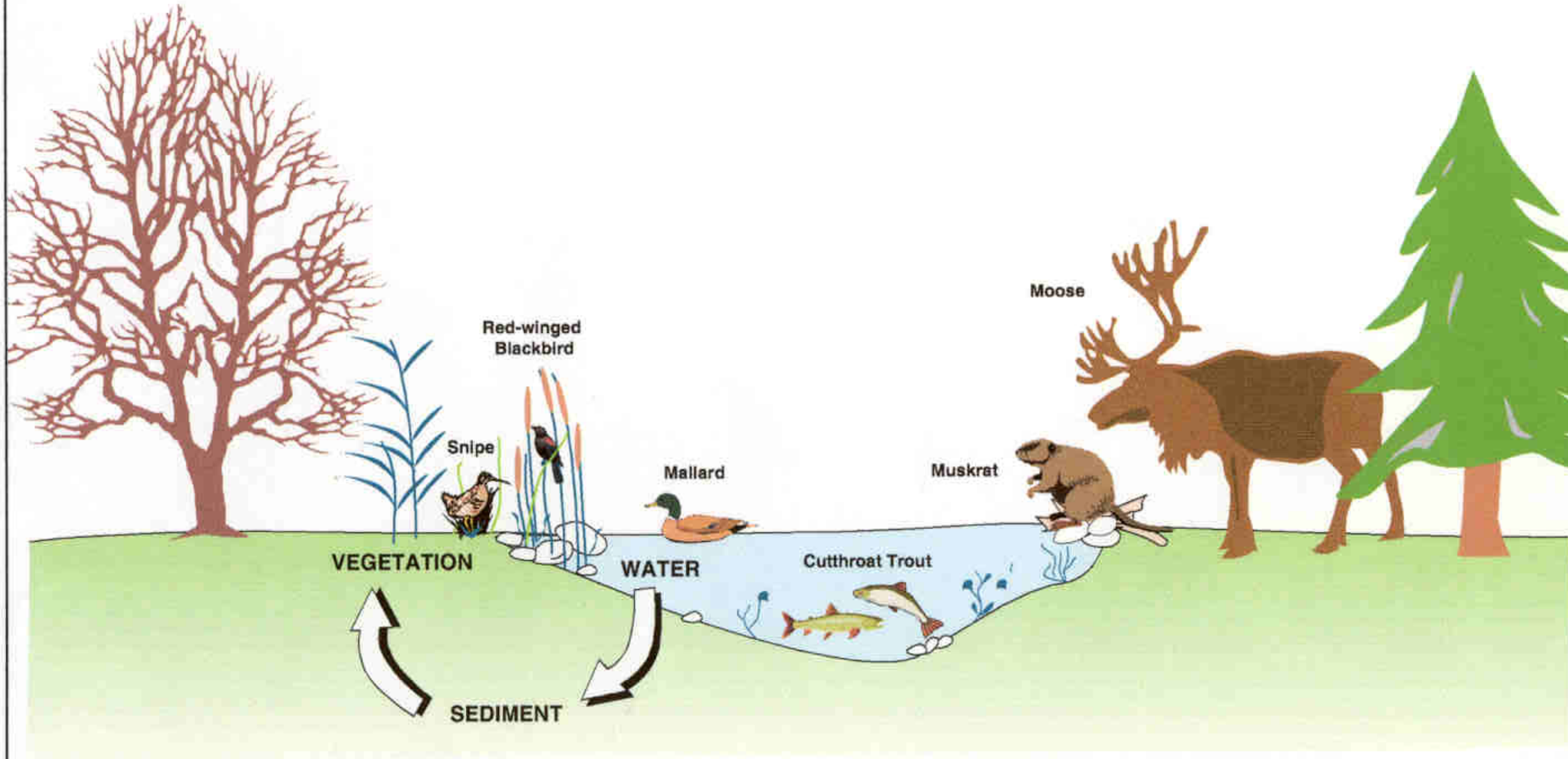
Evaluation of the potentially complete exposure pathways identified in Figure H-3 for inclusion in quantitative exposure modeling is described in the following subsection.

H.2.3.2 Ecological Pathway and Exposure Route Analysis

All potential exposure pathways for indicator receptors were evaluated, and the potentially complete pathways were identified. Wind erosion of particulates in soil and subsequent inhalation was considered to be a potentially complete pathway. However, this pathway was not quantitatively evaluated in this preliminary assessment due to the lack of available methodologies to quantitatively assess this pathway. Furthermore, the ingestion route typically dominates ecological exposures (Maughan, 1993). Deposition of airborne particulates onto plants was considered to be a potentially complete exposure pathway for terrestrial receptors. This pathway was quantitatively evaluated by modeling the uptake of COPCs through incidental ingestion of soil. Assimilation of soil COPCs into plants and subsequent dietary uptake was considered to be a complete pathway for terrestrial receptors, and was quantitatively evaluated in this preliminary assessment. Similarly, uptake of

COPCs from soil via ingestion and dermal contact, and exposure to COPCs in surface water, were modeled for terrestrial receptors.

For aquatic/riparian habitats, assimilation of surface water and sediment COPCs by aquatic plants and invertebrates and subsequent dietary uptake by omnivores was considered to be a significant pathway and was quantitatively evaluated. For the moose (an obligate herbivore) uptake of COPCs through ingestion of plants, but not aquatic invertebrates, was evaluated. Similarly, exposures to COPCs in sediment and surface water via ingestion and dermal contact were modeled for aquatic/riparian receptors.



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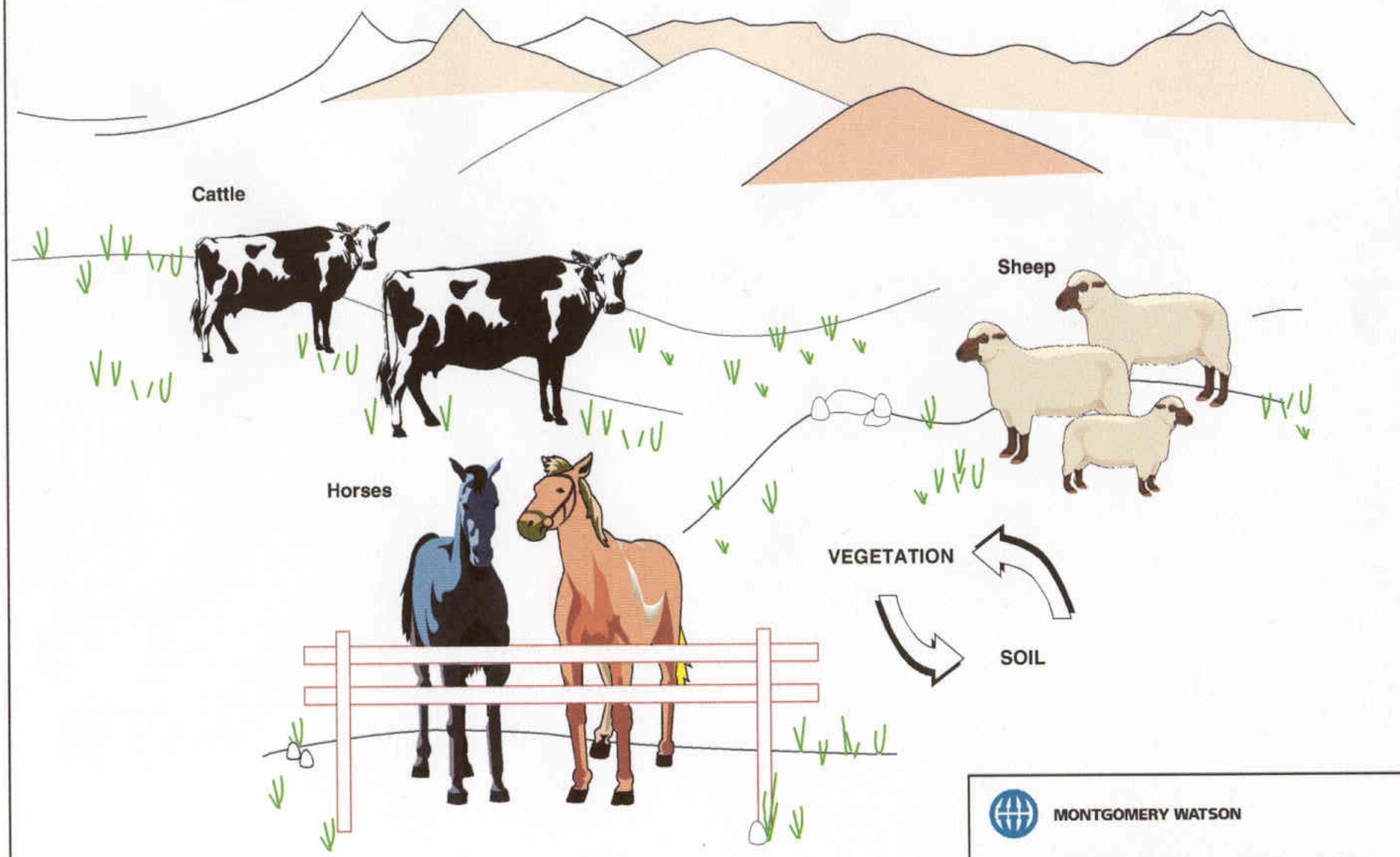
EXPOSURE MODEL FOR AQUATIC/RIPARIAN RECEPTORS

FIGURE H-1

05-99.IMA



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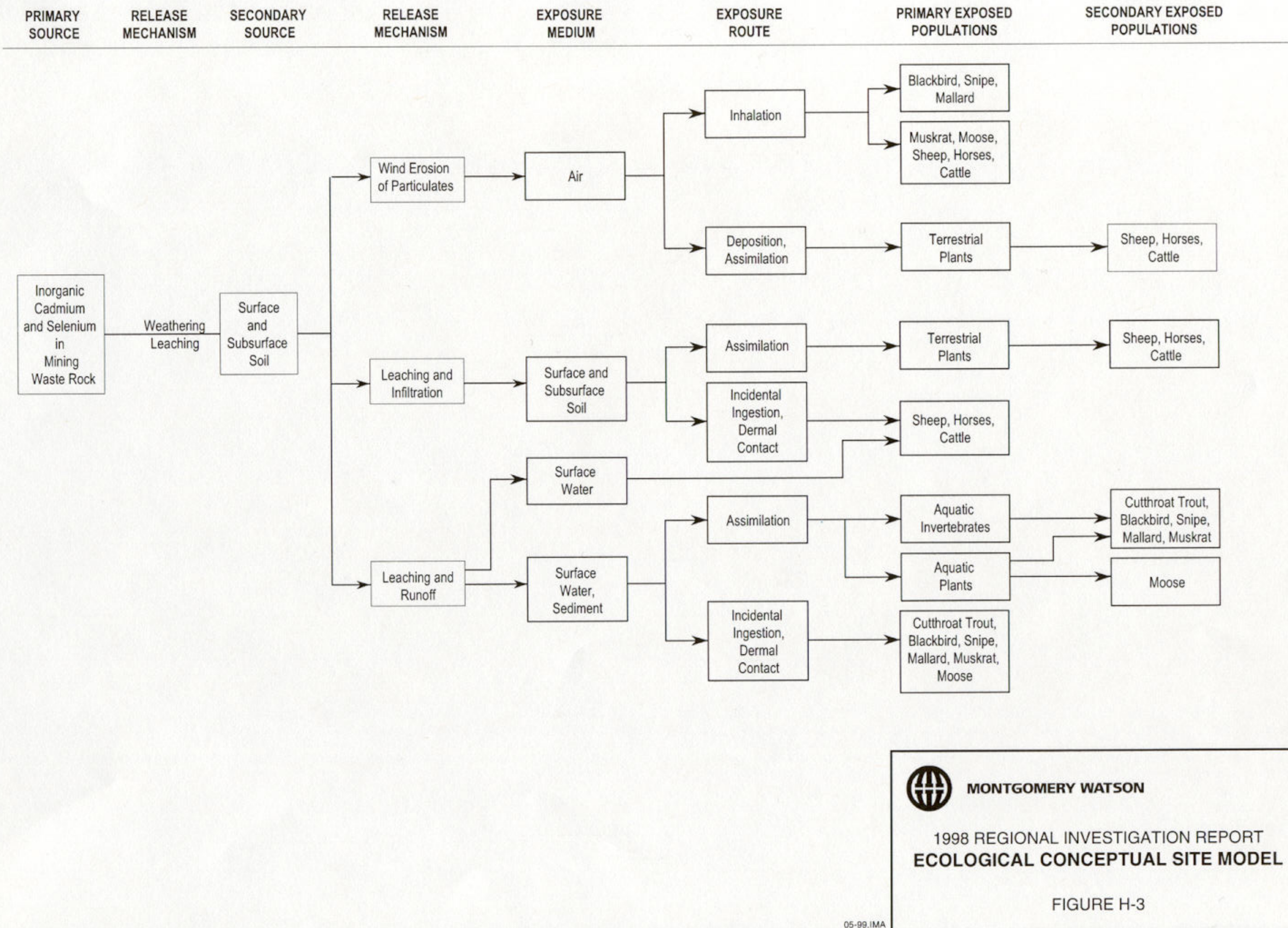
EXPOSURE MODEL FOR TERRESTRIAL RECEPTORS

FIGURE H-2

05-99.IMA



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ECOLOGICAL CONCEPTUAL SITE MODEL

FIGURE H-3

H.2.3.3 Exposure Point Concentrations

It was not possible to perform quantitative exposure modeling for all of the surface water, sediment, soil, and vegetation sampling locations that were included in the 1998 Regional Investigation. Therefore data were grouped, where appropriate, or locations of highest COPC concentrations were selected for modeling. Surface water and sediment data that were selected for evaluation include stock ponds, tailings ponds, Blackfoot River, State Land Creek, and East Mill Creek (see Tables H.6 and H.7). These locations represent areas of highest COPC concentrations that are also associated with potential habitat. Soil and vegetation data were combined into an aggregate data set for all waste rock dumps (see Tables H.8 and H.9).

Consistent with EPA (1998a), an upper bound estimate of exposure was derived from the maximum or 95 percent upper confidence limit on the mean (95% UCL) concentration of each COPC in site media. Because of the limited sampling data available for most locations evaluated in this preliminary assessment, the estimated 95% UCL generally exceeded the maximum observed concentration. Pursuant to EPA guidance the maximum concentration of each COPC in each medium was generally assumed as the exposure point concentration(see Tables H.6 through H.9). Because it is not reasonable to assume that organisms are exposed to maximum concentrations of COPCs in site media all of the time, mean concentrations of COPCs in site media were also evaluated to provide an estimate of central tendency, or more typical, exposures.

For modeling exposures for terrestrial indicator receptors, upper bound (maximum or 95% UCL) and mean concentrations of COPCs measured in surface water, soil, and vegetation were used. Because the aquatic/riparian indicator receptors forage on aquatic plants and invertebrates, and these media were not sampled, concentrations of COPCs in aquatic plants and invertebrates had to be estimated based on the use of transfer coefficients.

Transfer coefficients were used to estimate exposure point concentrations in aquatic flora (plants) and aquatic invertebrates for modeling exposures to aquatic/riparian indicator receptors. Transfer coefficients for water-to-aquatic flora, sediment-to-aquatic flora, water-to-aquatic invertebrates, and sediment-to-aquatic invertebrates were identified. All transfer coefficients were obtained from the *Draft Protocol for Screening Level Ecological Risk Assessments at Hazardous Waste Combustion Facilities* (EPA, 1998b). Based on the upper bound (maximum or 95% UCL) and mean concentrations of COPCs measured in surface water and sediment, exposure point concentrations in aquatic flora and aquatic invertebrates were then estimated.

The transfer coefficients used in the estimation of dietary exposure point concentrations for aquatic/riparian indicator receptors are presented in Table H.10, *Transfer Coefficients for Ecological Food Chain Modeling*. The dietary (i.e., aquatic flora and invertebrate) exposure point concentrations are included in the ecological hazard calculation tables presented in Attachment H-4, *Ecological Risk Assessment Calculations*.

H.2.3.4 Exposure Parameters

Exposure parameters for each indicator receptor were required to estimate the exposure dose. Exposure parameters were obtained from EPA's (1993) *Wildlife Exposure Factors Handbook*, the National Audubon Society's (1977) *Field Guide to North American Birds* and (1996) *Field Guide to North American Mammals*, and *California's Wildlife* (Zeiner et al., 1990). The exposure parameters required for the quantitative dose estimate include the receptor's:

- Body weight
- Ingestion rate of biotic and abiotic media

TABLE H.10
TRANSFER COEFFICIENTS FOR ECOLOGICAL FOOD CHAIN MODELING [1]

COPC	Water to Aquatic Flora [2] (L water/ kg tissue-wet)	Sediment to Aquatic Flora [2] (kg dry sediment/ kg tissue-wet)	Water to Aquatic Invertebrate [2] (L water/ kg tissue-wet)	Sediment to Aquatic Invertebrate [2] (kg dry sediment/ kg tissue-wet)	Plant to Animal [3] (kg dry soil/ kg tissue-wet)
Cadmium	782	0.364	3,461	3.4	0.00065
Selenium	1,845	0.016	1,261	0.9	0.015

Notes:
1. Refer to Section H.2.3.3.1 for an explanation of transfer coefficients and their use in ecological food chain modeling.
2. Source: *Draft Protocol for Screening Level Ecological Risk Assessments at Hazardous Waste Combustion Facilities* (EPA, 1998b).
3. Source: *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture* (Baes et al., 1984).

- Dermal contact rates with abiotic media (e.g., soil)
- Site utilization factor (the area of contamination in relation to the receptor's home range)
- Exposure duration (time in a year that a receptor is exposed to site COPCs)
- Skin surface area
- Chemical-specific dermal absorption factors
- Soil adherence factors

The exposure parameters and assumptions for indicator receptors are presented in Table H.11, *Site Utilization Factors for Aquatic/Riparian Indicator Receptors*, Table H.12, *Exposure Assumptions for Aquatic/Riparian Indicator Receptors*, Table H.13, *Exposure Assumptions for Terrestrial Indicator Receptors*, and Table H.14, *Toxicity Reference Values for Aquatic/Riparian Indicator Receptors,* and Table H.15, *Toxicity Reference Values for Terrestrial Indicator Receptors* are described in more detail below.

Body Weight

Body weights for aquatic/riparian indicator receptors were obtained from the National Audubon Society's (1977) *Field Guide to North American Birds* and (1996) *Field Guide to North American Mammals*. The average body weights reported for both males and females were used for each indicator receptor. Body weights for terrestrial indicator receptors (sheep, horses, and cattle) were obtained from Lewis (1992).

Food Ingestion Rates

Food ingestion rates for each indicator receptor were calculated using allometric equations provided in EPA's (1993) *Wildlife Exposure Factors Handbook* that are based on established relationships between body size and metabolic requirements. Food ingestion rates expressed in kg/d were calculated based on the handbook's Equation 3-3 for avians, and Equation 3-9 for herbivorous mammals.

Abiotic Ingestion Rates

Surface water ingestion rates in L/d were calculated based on Equation 3-15 for avians, and Equation 3-17 for mammals from EPA (1993). Incidental soil and sediment ingestion rates (as a percent of dry matter food consumption) were obtained from Beyer et al., (1994). Ingestion rates on a percent basis were converted to ingestion rates in kg/d on a wet-weight basis.

Skin Surface Area

The skin surface area is an exposure parameter used to estimate dermal exposure of indicator receptors to COPCs. Total skin surface areas in square centimeters (cm^2) were calculated based on Equation 3-21 for avians, and Equation 3-22 for mammals EPA (1993). Exposed skin surface areas corresponding to the areas of the feet and beak or muzzle were assumed to represent approximately 9.0 percent of the total skin surface area.

TABLE H.11
SITE UTILIZATION FACTORS FOR AQUATIC/RIPARIAN INDICATOR RECEPTORS

	Site Utilization Factor (Unitless)[1]				
Source Area	**Red-Winged Blackbird**	**Common Snipe**	**Mallard**	**Muskrat**	**Moose**
East Mill Creek[2]	1.0	1.0	0.007	1.0	0.002
Stock Ponds[3]	1.0	0.8	0.004	1.0	0.001
Tailings Ponds[4]	1.0	1.0	0.02	1.0	0.006
State Land Creek[5]	1.0	1.0	0.005	1.0	0.002
Blackfoot River[6]	1.0	1.0	0.05	1.0	0.02

Notes:
1. The site utilization factor (SUF) is a unitless value that is calculated as follows: SUF = Exposure area (acres)/Home range (acres).
2. The surface area of East Mill Creek was calculated as 13 acres, based on an assumed length of 5200m and a width of 10m.
3. Based on an average surface area for all stock ponds of 8 acres.
4. Based on an average surface area for all tailings ponds of 39 acres.
5. The surface area of State Land Creek was calculated as 10 acres, based on an assumed length of 4000m and a width of 10m.
6. The surface area of the Blackfoot River was calculated as 98 acres, based on an assumed length of 39,790m and a width of 10m.

TABLE H.12 EXPOSURE ASSUMPTIONS FOR AQUATIC/RIPARIAN INDICATOR RECEPTORS					
	Avians			**Mammals**	
Exposure Parameter	**Red-Winged Blackbird**	**Common Snipe**	**Mallard**	**Muskrat**	**Moose**
Body Weight (kg)[1]	0.064	0.107	1.134	0.873	475
Diet Composition (%)[2]					
Plant Matter	83	7	90	95	100
Animal Matter	17	93	10	5	0
Total	100	100	100	100	100
Food Ingestion Rate (kg/d)[3]	0.044	0.062	0.287	0.360	35.1
Water Ingestion Rate (L/d)[4]	0.009	0.013	0.064	0.088	25
Soil/Sediment Ingestion Rate					
(%)[5]	2	18	3.3	9.4	2
(kg/d)[6]	0.000194	0.00245	0.00208	0.0075	0.155
Skin Surface Area (cm2)					
Total[7]	160	226	1,090	915	61,144
Exposed[8]	14	20	98	82	5,503
Home Range (acres)[9]	0.19	10.3	1,828	0.27	6,533
Exposure Area (acres)[10]	Site-specific	Site-specific	Site-specific	Site-specific	Site-specific
Site Utilization Factor (unitless)[11]	Site-specific	Site-specific	Site-specific	Site-specific	Site-specific
Exposure Duration (year)[12]	0.5	0.5	0.5	1	1

TABLE H.12

EXPOSURE ASSUMPTIONS FOR AQUATIC/RIPARIAN INDICATOR RECEPTORS

Notes:

1. Obtained from EPA's *Wildlife Exposure Factors Handbook* (USEPA, 1993), Zeiner et al. (1990), and National Audubon Society (1996).
2. Derived from EPA (1993) and Zeiner et al. (1990).
3. Calculated using the methods described in EPA (1993) for avians (Equation 3-3) and herbivorous mammals (Equation 3-9).The corresponding food ingestion rates are presented on a wet weight basis.
4. Calculated using the methods described in EPA (1993) for avians (Equation 3-15) and mammals (Equation 3-17).
5. Soil/sediment ingestion rates are derived from Beyer et al. (1994) and are based on dry weights. The value for the blackbird is based on the ring-necked duck; that for the snipe is based on the average of four values for different sandpiper species; the value for the muskrat is based on that for the raccoon.
6. Calculated as fraction of the diet comprised of soil or sediment (on a wet weight basis assuming diet is 78% moisture) multiplied by the food ingestion rate in kg/d (wet weight).
7. Total skin surface area is calculated using Equations 3-21 (avians) and 3-22 (mammals) in EPA (1993).
8. Exposed skin surface area is calculated assuming the area of the feet and beak or muzzle is equal to 9% of total skin surface area.
9. Home ranges were derived from EPA (1993), Zeiner et al. (1990), and National Audubon Society (1996).
10. Exposure areas are site-specific.
11. Site utilization factors are typically calculated as the exposure area divided by the home range. Refer to Table H-10 for the receptor- and site-specific SUFs that were used in this preliminary ERA.
12. Exposure durations are based on the following: 1) the avian indicator receptors evaluated are migratory and the watersheds are inaccessible 4 to 6 months of the year; and 2) the mammalian indicator receptors selected are not migratory and may remain active throughout the year (EPA, 1993; Zeiner et al., 1990; and National Audubon Society, 1996).

TABLE H.13 EXPOSURE ASSUMPTIONS FOR TERRESTRIAL INDICATOR RECEPTORS			
	Exposure Assumptions		
Exposure Parameter	**Sheep**	**Horses**	**Cattle**
Body Weight (kg)[1]	60	500	500
Diet Composition (%)[2]			
Plant Matter	100	100	100
Animal Matter	0	0	0
Total	100	100	100
Food Ingestion Rate (kg/d)[3]	7.8	36	36
Water Ingestion Rate (L/d)[4]	3.9	27	27
Soil/Sediment Ingestion Rate			
(%)[5]	2	2	2
(kg/d)[6]	0.0343	0.160	0.160
Skin Surface Area (cm2)	15,382	63,272	63,272
Total[7]	1384	5,694	5,694
Exposed[8]			
Foraging Range (acres)[9]	Site-specific	Site-specific	Site-specific
Exposure Area (acres)[10]	Site-specific	Site-specific	Site-specific
Site Utilization Factor (unitless)[11]	1	1	1
Exposure Duration (year)[12]	0.17	0.25	0.25

Notes:
1. Obtained from Sax's Dangerous Properties of Industrial Materials (Lewis, 1992).
2. Derived from Lewis (1992).
3. Calculated using the methods described in EPA's Wildlife Exposure Factors Handbook (EPA, 1993) for herbivorous mammals (Equation 3-9). The corresponding food ingestion rates are presented on a wet weight basis.
4. Calculated using the methods described in EPA (1993) for mammals (Equation 3-17).
5. Soil/sediment ingestion rates are derived from Beyer et al. (1994) and are based on dry weights. The value for horses is based on cattle and sheep.
6. Calculated as fraction of the diet comprised of soil or sediment (on a wet weight basis assuming diet is 78% moisture) multiplied by the food ingestion rate in kg/d (wet weight).
7. Total skin surface area is calculated using Equation 3-22 (mammals) in EPA (1993).
8. Exposed skin surface area is calculated assuming the area of the feet and muzzle is equal to 9% of total skin surface area.
9. Foraging ranges are site-specific; for purposes of this preliminary ERA, they were assumed to equal the exposure area.
10. Exposure areas are site-specific; for purposes of this preliminary ERA, they were assumed to equal the foraging range.
11. Site utilization factors are typically calculated as the exposure area divided by the foraging range; for purposes of this screening ERA the SUFs were assumed to be 1.
12. Exposure durations are based on the following: because the waste rock dumps are not irrigated, they provide a sustainable pasture for a maximum of 3 months duration per year; the exposure duration for sheep was assumed to be 2 months because they tend to be herded.

TABLE H.14 TOXICITY REFERENCE VALUES FOR AQUATIC/RIPARIAN INDICATOR RECEPTORS				
COPC/Receptor	**Toxicity Benchmark[1] (mg/kg-d)**	**Benchmark Species[2]**	**Benchmark Species Body Weight[3] (kg)**	**Allometric TRV[4] (mg/kg-d)**
Cadmium				
Red-winged blackbird	1.45	Mallard	1.153	3.0E+00
Common snipe	1.45	Mallard	1.153	2.6E+00
Mallard	1.45	Mallard	1.153	1.5E+00
Muskrat	1	Rat	0.303	7.7E+01
Moose	1	Rat	0.303	1.6E+01
Selenium				
Red-winged blackbird	0.4	Mallard	1	8.0E-01
Common snipe	0.4	Mallard	1	7.0E-01
Mallard	0.4	Mallard	1	3.9E-01
Muskrat	0.2	Rat	0.35	1.6E-01
Moose	0.2	Rat	0.35	3.3E-02

Notes:

1. Toxicity benchmarks were obtained from *Toxicological Benchmarks for Wildlife: 1996 Revision* (Opresko et al., 1996). For selenium the avian benchmark is based on selenomethionine; and the mammalian benchmark is based on potassium selenate. For cadmium, both the avian and mammalian benchmarks are based on studies using cadmium chloride.
2. Benchmark species is the test species in which the toxicity benchmark was derived.
3. Body weight of the test species used to derive the toxicity benchmark.
4. Receptor-specific toxicity reference values are derived from body weight-based allometric conversion of the toxicity benchmark value (refer to Section H.2.4).

COPC: Constituent of potential concern
kg: Kilograms
mg/kg-d: milligrams per kilogram body weight per day
TRV: Toxicity reference value

TABLE H.15
TOXICITY REFERENCE VALUES FOR TERRESTRIAL INDICATOR RECEPTORS

COPC/Receptor	Toxicity Benchmark [1] (mg/kg-d)	Benchmark Species [2]	Benchmak Species Body Weight [3] (kg)	Allometric TRV [4] (mg/kg-d)
Cadmium				
Sheep	1	Rat	0.303	2.7E-01
Horse	1	Rat	0.303	1.6E-01
Cattle	1	Rat	0.303	1.6E-01
Selenium				
Sheep	0.2	Rat	0.35	5.5E-02
Horse	0.2	Rat	0.35	3.3E-02
Cattle	0.2	Rat	0.35	3.3E-02

Notes:
1. Toxicity benchmarks were obtained from *Toxicological Benchmarks for Wildlife: 1996 Revision* (Opresko et al., 1996). For selenium the benchmark is based on potassium selenate. For cadmium the benchmark is based on studies using cadmium chloride.
2. Benchmark species is the test species in which the toxicity benchmark was derived.
3. Body weight of the test species used to derive the toxicity benchmark.
4. Receptor-specific toxicity reference values are derived from body weight-based allometric conversion of the toxicity benchmark value (refer to Section H.2.4).

COPC Constituent of potential concern
kg kilograms
mg/kg-d milligrams per kilogram body weight per day
TRV Toxicity reference value

Site Utilization Factor

The site utilization factor, SUF, describes the area of contamination that a receptor potentially contacts relative to its home range. Home range is the area of habitat required by an ecological receptor to meet its dietary needs. Home ranges vary between species depending upon differences in dietary requirements, and within a species depending upon the relative abundance of food items in a particular area in which the receptor feeds. Home range values were obtained from the National Audubon Society's (1977) *Field Guide to North American Birds* and (1996) *Field Guide to North American Mammals*. Comparison of a receptor's home range to the areal extent of contamination of a site is used to determine the relative amount of potentially contaminated diet the receptor is exposed to. The SUF is calculated as the ratio of the area of contamination to a receptor's home range. When the receptor's home range is greater than the affected area, the SUF is less than 1.00. When a receptor's home range is less than or equal to the affected area the SUF is equal to 1.00. The SUF values for aquatic/riparian receptors were calculated based on estimated areas for each surface water body and are provided in Table H.9. SUF values for livestock, which are not free ranging, were assumed to equal 1.00.

Exposure Duration

The exposure duration, ED, refers to the fraction of the year that a receptor is likely to spend utilizing a site. This is frequently a function of migration and/or hibernation potential. For the red-winged blackbird, snipe, and mallard, which are migratory, the exposure duration was assumed to be equal to one-half of the year or 0.50. For the muskrat and moose, which may remain in the area for the entire year, the exposure duration was assumed to be 1.00. For livestock, exposure durations were based on the grazing practices described in subsection H.2.2.4. An exposure duration of two months or 0.167 was assumed for sheep, and four months or 0.333 was assumed for horses and cattle.

Chemical-Specific Dermal Absorption Fraction

The chemical-specific dermal absorption fraction is used to estimate dermal exposures from contaminants in abiotic media. The dermal absorption fraction represents the ratio of the absorbed dose to the applied dose of a chemical (EPA, 1992b). An average dermal absorption fraction of 0.0100 (i.e., 1 percent) for inorganic chemicals has been published by EPA (1992b) for use in human health risk assessment, and was used in this preliminary ecological assessment.

Soil Adherence Factor

The dermal adherence factor is also used in the estimation of dermal exposure to contaminants in soil or sediment. This parameter depends in part on chemical properties and in part on soil characteristics, such as total organic carbon and particle size. A dermal adherence factor of 1.00 mg/cm^2 (EPA, 1992b) was assumed for modeling dermal exposures to COPCs in soil and sediment.

H.2.3.5 Exposure Dose Calculation

The final phase of the exposure assessment consolidates the exposure pathways and exposure routes, exposure point concentrations, and exposure parameters into an equation that provides an exposure dose estimate in units of milligrams of COPC per kilogram body weight per day (mg/[kg·d]). Ingestion dose estimates are calculated using the following general equation derived from EPA's (1993) *Wildlife Exposure Factors Handbook*:

$$Dose_{Ingestion} = \frac{[(IR_{Biotic} \times EPC_{Biotic}) + (IR_{Abiotic} \times EPC_{Abiotic})] \times ED \times SUF}{BW}$$

Equation H.2-1

where:

- $Dose_{Ingestion}$ is the estimated exposure dose from ingestion of food and ingestion of abiotic media, mg/(kg·d)
- IR_{Biotic} is the food ingestion rate, kg/d
- $IR_{Abiotic}$ is the abiotic medium ingestion rate, kg/d or L/d
- EPC_{Biotic} is the concentration of COPC in food item, mg/kg (wet weight)
- $EPC_{Abiotic}$ is the concentration of COPC in abiotic medium, mg/kg (wet weight) or mg/l
- ED is the exposure duration (fraction of year), unitless
- SUF is the site utilization factor, unitless
- BW is the body weight of the receptor, kg

Dermal exposure estimates were calculated for indicator receptors using the following general equation:

$$Dose_{Dermal} = \frac{EPC_{Abiotic} \times SSA \times AF \times ABS \times ED \times SUF \times UC}{BW}$$

Equation H.2-2

where:

- $Dose_{Dermal}$ is the estimated dose from dermal contact with soil, mg/(kg·d)
- $EPC_{Abiotic}$ is the exposure point concentration in soil or sediment, mg/kg
- SSA is the skin surface area, cm^2
- AF is the soil adherence factor, mg/cm^2
- ABS is the chemical-specific dermal absorption fraction, unitless
- ED is the exposure duration (fraction of year), unitless
- SUF is the site utilization factor, unitless
- UC is the mass unit conversion factor, 10^{-6} kg/mg, for soil or sediment
- BW is the receptor's body weight, kg

H.2.4 Ecological Effects Assessment

The potential for ecological effects due to exposures of indicator receptors to COPCs detected in site media was evaluated by comparing calculated exposure doses with toxicity reference values, TRVs, for each COPC-receptor combination. The TRVs used in the evaluation of potential risks to indicator receptors are expressed in terms of mg/(kg·d). Toxicity reference values used in the evaluation of aquatic/riparian and terrestrial indicator receptors were derived from ecological toxicity benchmarks published in *Toxicological Benchmarks for Wildlife–1996 Revision* (Sample et al., 1996).

Toxicity benchmarks were based on experimentally derived NOAELs. Emphasis was placed on studies in which reproductive and developmental endpoints were considered. The selenium toxicity benchmark for avian species was derived from a NOAEL for selenomethionine in mallards. The selenium toxicity benchmark for mammals was derived from a NOAEL for potassium selenate in rats. For cadmium, the avian and mammalian toxicity benchmarks were based on studies using cadmium chloride in mallards and rats, respectively.

Toxicity benchmarks provided for a test species were allometrically converted to a toxicity reference value for each indicator species using the following equation described in Sample et al., (1996):

$$\text{Dose}_I = \text{Dose}_T \times \left(\frac{BW_T}{BW_I}\right)^{0.25}$$

Equation H.2-3

where:

- Dose_I is the TRV for the indicator receptor, mg/(kg·d)
- Dose_T is the benchmark NOAEL dose for the test species, mg/(kg·d)
- BW_T is the body weight for the test species, kg
- BW_I is the body weight for the indicator species, kg

The TRVs for evaluating aquatic/riparian and terrestrial indicator receptors are presented in Tables H.14 and H.15, respectively.

For evaluating potential impacts of chemicals on aquatic organisms (e.g., fish and aquatic invertebrates), aquatic toxicity benchmarks for surface water or sediment are generally used. Consistent with this, freshwater aquatic toxicity benchmarks were compared to upper bounds or mean surface water concentrations to evaluate potential impacts of COPCs on cutthroat trout. The aquatic toxicity benchmark selected for evaluation of cadmium was the freshwater chronic National Ambient Water Quality Criterion (NAWQC) of $_e\{0.7852$ [ln (hardness)] - 3.49} x {1.101672- [ln(hardness)] x 0.041838} The actual criterion is hardness-dependent, and a value of 0.0011 mg/l is equivalent to a water hardness of 100 mg/l as calcium carbonate. The NAWQC for cadmium was derived by EPA based on chronic toxicity data using a variety of warm-water and cold-water species. This criterion was deemed appropriate for use in this preliminary assessment to evaluate potential impacts to cutthroat trout, because chronic values in a related salmonid (i.e., brook trout) occur at concentrations as low as 0.0017 mg/l (EPA, 1985). Hardness- specific values were calculated for cadmium depending upon site-specific surface water hardness concentrations (see Tables H.16

through H.18).

A freshwater chronic NAWQC of 0.005 mg/l currently exists for selenium. This criterion is based on studies in Belews Lake, North Carolina, demonstrating impacts to warm-water fish species at concentrations as low as 0.010 mg/l (Lemly, 1985). In setting the NAWQC at 0.005 mg/l, EPA (1987) stated that a freshwater criterion continuous concentration (CCC; i.e., chronic criterion) for selenium should be between 0.010 mg/l and the concentration in the unaffected portion of Belews Lake, which was near or below 0.005 mg/l. The EPA chose the lower end of this range (i.e., 0.005 mg/l) as the CCC for selenium. It should be noted, however, that significant differences have been observed in the sensitivities of warm-water versus cold-water fish to the effects of selenium.

In acute studies, salmonids including rainbow trout have been shown to be relatively resistant to the toxic effects of selenium. In addition, a lowest chronic value of 0.047 mg/l was observed for rainbow trout exposed under controlled conditions to sodium selenite (EPA, 1987). In a field study of selenite-treated lakes in Sweden (Lindqvist et al., 1991; Paulsson and Lundbergh, 1991), significant differences in responses and tissue levels were observed between perch and pike inhabiting the same water bodies. Selenite treatments, resulting in lake water concentrations that ranged 0.003 to 0.035 mg/l, were associated with drastic reductions in perch populations while pike populations were relatively unaffected. After one year of exposure, perch fry muscle concentrations ranged 6 to 36 mg/kg, while concentrations in pike muscle ranged 0.9 to 2.3 mg/kg. These observed differences in tissue levels and toxicity may potentially be explained based on species differences in bioaccumulation potential. Measured bioconcentration factors, BCFs, for freshwater species ranged from 2 for rainbow trout to 452 for bluegill (EPA, 1987).

Based on the above considerations, the freshwater CCC of 0.005 mg/l was not selected as the aquatic toxicity benchmark for selenium. Instead, freshwater Final Chronic Values, FCVs, derived by EPA for selenite and selenate in a variety of warm-water and cold-water species were evaluated. For selenite, the EPA (1987) derived a freshwater FCV of 0.0276 mg/l that was intended to be protection of freshwater aquatic species including rainbow trout. A freshwater FCV of 0.0097 mg/l was derived for selenate, based on chronic values for three species including rainbow trout. Because surface water samples collected during the 1998 Regional Investigation were not speciated for the different forms of selenium, potential impacts to cutthroat trout should be evaluated based on the more protective of the two freshwater FCVs. For purposes of this preliminary assessment, therefore, the freshwater FCV for selenate (0.0097 rounded to 0.0100 mg/l) was used to evaluate potential impacts of selenium on cutthroat trout. This value is consistent with the upper end of the range of values (0.005 to 0.010 mg/l) used by EPA in deriving the freshwater CCC for selenium.

H.2.5 Ecological Risk Characterization

The methods and results of the risk characterization performed for the 1998 regional investigation are presented in this section.

H.2.5.1 Methods

The ecological risk characterization uses the information that was previously gathered to determine the potential ecological risks resulting from the presence of COPCs in environmental media. Information regarding the presence and attributes of site receptors as well as the chemistry, toxicology, and distribution of site chemicals was synthesized in an evaluation of the potential for adverse effects to ecological indicator receptors.

The overall goal of this preliminary assessment is to evaluate whether COPC concentrations identified in surface water, sediment, soil, and vegetation potentially impacted by phosphate mining-derived wastes are sufficiently protective of ecological receptors or whether the concentrations are elevated and suggest potential risks to the ecosystem. Attainment of this goal is not directly measurable. To provide an indication of whether the ecosystem is protected, specific assessment endpoints were identified (see subsection H.2.2.3). Measurement endpoints were also selected (see subsection H.2.2.3) as tools for evaluating the assessment endpoints.

The measurement endpoints evaluated in this preliminary assessment include comparison of modeled exposure doses with toxicity reference values for aquatic/riparian and terrestrial indicator receptors.

The comparison with toxicity reference values yields chemical-specific HQs as follows:

$$HQ = \frac{Dose}{TRV}$$

Equation H.2-4

where:

- HQ is the element-specific hazard quotient for a given indicator species, unitless
- Dose is the modeled element-specific exposure dose for a given indicator species, mg/(kg·d)
- TRV is the element-specific toxicity reference value for a given indicator species, mg/(kg·d)

Additionally, to estimate the cumulative effects of COPCs, a hazard index, HI, was calculated for each indicator receptor. This HI was determined by adding the HQs obtained from food chain modeling for all COPCs identified at the site for each indicator receptor. HQ or HI values that exceed 1.0 are generally considered to be indicative of potential biological or ecological effects on representative receptors. These values do not necessarily indicate that a biological or ecological effect will occur, but only that a lower threshold has been exceeded (Menzie, et al., 1992). In general, the evaluation of the significance of the HQ and HI values was conducted in a manner consistent with Menzie, et al., (1992), as follows:

- *HQ or HI less than 1.0* - no adverse effects on representative receptors are anticipated
- *HQ or HI between 1.0 and 10* - there is a limited potential for adverse effects on representative receptors
- *HQ or HI between 10 and 100* - there is potential for adverse effects on representative receptors
- *HQ or HI exceeds 100* - there is significant potential for adverse effects on representative receptors

Note that the above are only guidelines. Site-specific factors such as spatial distribution and frequency of detection of COPCs, uncertainty of assumptions used in exposure determination, and endpoint of the study used to determine the toxicity benchmarks need to be considered when reviewing specific HQs and HIs. The above guidelines are in wide use, however, because of the inherently conservative nature of screening ecological risk assessments - i.e., assessments such as this one tend to overestimate risk substantially (as demonstrated in subsection H.1 above). To acknowledge this fact, all estimates of hazard presented below are qualified by presenting them in the form of < HQ, indicating that a more accurate assessment would be highly likely to show a 95^{th} percentile estimate of HQ to be lower than the one deterministically derived through the preliminary screening procedures used herein.

For evaluating potential impacts of COPCs on cutthroat trout, comparison of measured concentrations of COPCs in surface water with freshwater aquatic toxicity benchmarks yield chemical specific HQs as follows:

$$HQ = \frac{C - water}{TRV}$$

Equation H.2-5

where:

- HQ is the hazard quotient, unitless
- C-water is the measured concentration in surface water, mg/l
- TRV is the freshwater toxicity benchmark, mg/l

H.2.5.2 Results

The results of the ecological risk characterizations for aquatic/riparian and terrestrial indicator receptors are presented in the following subsections.

Aquatic/Riparian Indicator Receptors

Cutthroat Trout

A compliance assessment (i.e. comparison of maximum concentrations of selenium in surface waters to the CWBS) for cutthroat trout is presented in Table H.16, *Compliance Assessment for Cutthroat Trout.* Based on this compliance assessment, HQ values for selenium ranged from 2.4 (Blackfoot River) to 52 (East Mill Creek). However, the CWBS is not believed to be an appropriate toxicity benchmark for cutthroat trout, and related salmonids, based on the rationale presented in Section H.2. More appropriate hazard estimates for cutthroat trout are presented in Table H.17, *Upper Bound Hazard Estimates for Cutthroat Trout,* and Table H.18, *Mean Hazard Estimates for Cutthroat Trout.* The upper bound HQ estimate for cutthroat trout exposed to selenium in East Mill Creek is < 26 (Table H.16). This upper bound estimate was based on the maximum measured concentration of selenium (range 0.032 – 0.26 mg/l). The central tendency HQ estimate for cutthroat trout exposed to selenium in East Mill Creek is < 17 (Table H.17). Based on the hazard classification system of Menzie et al., (1992), there is a potential for impacts on cutthroat trout exposed to either the maximum or mean concentrations of selenium measured in East Mill Creek.

The upper bound HQ for selenium for the stock ponds was slightly greater than 10, while the mean HQ estimate is less than 10 (Tables H.17 and H.18). These results suggest that there is a slight potential to a potential for impacts to cutthroat trout based on measured concentrations of selenium in the stock ponds. It should be noted that none of the stock ponds within the Study Area is known to support fish of any kind.

For the tailings ponds and State Land Creek, both upper bound and mean HQ estimates for selenium were less than 10 (Tables H.17 and H.18). Based on the hazard classification system of Menzie et al., (1992), these results represent a 'slight potential' for impacts on cutthroat trout exposed to either the maximum or mean concentrations of selenium measured in these surface water sources.

For the Blackfoot River, the upper bound HQ estimate for selenium was only slightly greater than 1.0 (Table H.17), suggesting a 'slight potential' for adverse effects on cutthroat trout exposed to the maximum concentration of selenium measured in the Blackfoot River. However, based on mean concentrations of selenium in the Blackfoot River, no adverse impacts to cutthroat trout are anticipated.

The highest hazard estimates for the Blackfoot River, tailings ponds, and State Land Creek were associated with cadmium concentrations (Tables H.17 and H.18). The upper bound and mean HQ estimates for cadmium in these sources were between 1.0 and 10, indicating a slight potential for

TABLE H.16
COMPLIANCE ASSESSMENT FOR CUTTHROAT TROUT

Source/COPC	Maximum Surface Water Concentration[1] (mg/l)	Aquatic Toxicity Benchmark[2] (mg/l)	Hazard Quotient
ZStock Ponds			
Cadmium	0.0052	0.0032	1.6
Selenium	0.12	0.005	24
Tailings Ponds			
Cadmium	0.0083	0.0016	5.2
Selenium	0.03	0.005	6.0
Blackfoot River			
Cadmium	0.0041	0.0017	2.4
Selenium	0.012	0.005	2.4
State Land Creek			
Cadmium	0.0035	0.0017	2.1
Selenium	0.029	0.005	5.8
East Mill Creek			
Cadmium	0.00084	0.0017	0.5
Selenium	0.26	0.005	52

Notes:
1. Maximum detected concentration of original or duplicate water samples.
2. Refer to Section H.2.4 for sources of aquatic toxicity benchmarks.

mg/l - milligrams per liter

TABLE H.17 UPPER BOUND HAZARD ESTIMATES FOR CUTTHROAT TROUT			
Source/COPC	**Maximum Surface Water Concentration[1] (mg/l)**	**Aquatic Toxicity Benchmark[2] (mg/l)**	**Hazard Quotient**
Stock Ponds			
Cadmium	0.0052	0.0032	1.6
Selenium	0.12	0.010	12
Tailings Ponds			
Cadmium	0.0083	0.0016	5.2
Selenium	0.03	0.010	3.0
Blackfoot River			
Cadmium	0.0041	0.0017	2.4
Selenium	0.012	0.0010	1.2
State Land Creek			
Cadmium	0.0035	0.0017	2.1
Selenium	0.029	0.010	2.9
East Mill Creek			
Cadmium	0.00084	0.0011	0.5
Selenium	0.26	0.010	26

Notes:
1. Maximum detected concentration of original or duplicate water samples.
2. Refer to Section H.2.4 for sources of aquatic toxicity benchmarks.

mg/l - milligrams per liter

TABLE H.18
MEAN HAZARD ESTIMATES FOR CUTTHROAT TROUT

Source/COPC	Mean Surface Water Concentration[1] (mg/l)	Aquatic Toxicity Benchmark[2] (mg/l)	Hazard Quotient
Stock Ponds			
Cadmium	0.0028	0.0011	2.5
Selenium	0.061	0.010	6.1
Tailings Ponds			
Cadmium	0.003	0.0011	2.3
Selenium	0.01	0.010	1.1
Blackfoot River			
Cadmium	0.003	0.0011	2.3
Selenium	0.0042	0.010	0.4
State Land Creek			
Cadmium	0.0031	0.0011	2.8
Selenium	0.015	0.010	1.5
East Mill Creek			
Cadmium	0.00043	0.0011	0.4
Selenium	0.17	0.010	17

Notes: 1. Mean of detected concentrations in original or duplicate water samples.
2. Refer to Section H.2.4 for sources of aquatic toxicity benchmarks.

mg/l - milligrams per liter

impacts to cutthroat trout exposed to cadmium. However, there is substantial evidence to indicate that cadmium concentrations and associated hazard estimates are associated with regional ambient conditions. The 95% UCL on the 95th percentile of the background distribution for cadmium measured in surface water during the May 1998 sampling event was about 0.006 mg/l. Of the surface water sources evaluated in this preliminary assessment, only the maximum concentration detected in the tailings ponds exceeded this background upper tolerance bound, and by less than a factor of two. Additionally, the State of Idaho's Cold Water Biota Standard (CWBS) for cadmium is hardness dependent, and ranges from 0.00072 – 0.036 mg/l for the surface water stations that were sampled in the 1998 Regional Investigation. When evaluated on a station-specific basis (i.e., comparison of the maximum cadmium concentration measured at a specific station with its corresponding hardness-dependent CWBS), approximately 52% of the surface water stations assumed to be impacted by phosphate mining activities were associated with an exceedence of the cadmium CWBS. However, 28% of control sampling stations (defined as district background or located upstream of phosphate mining activities) also exceeded the CWBS for cadmium. Based on the above, at least a portion of the excess hazard estimates for cutthroat trout exposed to cadmium in surface water are likely attributable to ambient conditions.

Red-Winged Blackbird

Hazard estimates for aquatic/riparian receptors are presented in Table H.19, *Upper Bound Hazard Estimates for Aquatic/Riparian Indicator Receptors* and H.20, *Mean Hazard Estimates for Aquatic/Riparian Indicator Receptors*. The highest hazard estimates for the red-winged blackbird were also associated with East Mill Creek. The upper bound and mean HQ estimates for the red-winged blackbird for East Mill Creek were <24 and <16, respectively (Tables H.19 and H.20). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a potential for impacts on red-winged blackbirds exposed to either the maximum or mean concentrations of selenium measured in East Mill Creek. The upper bound HQ estimate for the Stock Ponds also exceeded 10 (Table H.19), but was less than 10 based on mean exposure point concentrations (Table H.20).

For the tailings ponds, State Land Creek, and the Blackfoot River, both upper bound and mean HQ estimates were less than 10 (Tables H.19 and H.20). These results suggest a slight potential for impacts on red-winged blackbirds exposed to maximum concentrations of selenium measured in these surface water sources. Mean HQ estimates for the Blackfoot River are less than 1.0 (Table H.20), suggesting that no adverse impacts to red-winged blackbirds are anticipated from mean concentrations of cadmium and selenium measured in surface water and sediment associated with the Blackfoot River.

Common Snipe

The upper bound HQ estimate for the snipe in East Mill Creek was <130 (Table H.19), suggesting a significant potential for impacts on snipe exposed to maximum concentrations of selenium measured in East Mill Creek. However, the mean HQ estimate for East Mill Creek was less than 100 (Table H.20), suggesting a potential for impacts on snipe under anticipated exposed conditions.

For the stock ponds, upper bound and mean HQ estimates for the snipe were <50 and <25, respectively (Tables H.19 and H.20). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a potential for impacts on snipe exposed to either the maximum or mean concentrations of selenium measured in the stock ponds.

For the tailings ponds and State Land Creek, upper bound HQ estimates were greater than 10 (Table H.19), while mean HQ estimates were less than 10 (Table H.20). These results suggest a slight potential to potential for impacts on snipe exposed to surface water and sediments associated with these sources.

TABLE H.19
UPPER BOUND HAZARD ESTIMATES FOR AQUATIC/RIPARIAN INDICATOR RECEPTORS[1]

Source Area	Red-Winged Blackbird	Common Snipe	Mallard	Muskrat	Moose
	Estimated Hazard Index (HI)				
East Mill Creek	24	127	0.1	45	0.004
Stock Ponds	16	50	0.04	52	0.03
Tailings Ponds	3.4	18	0.03	6.8	0.004
State Land Creek	3.3	16	0.008	7.9	0.004
Blackfoot River	1.6	7.4	0.04	3.4	0.02

Notes: 1. Refer to Attachment 4 for receptor-specific ecological hazard calculations.

TABLE H.20
MEAN HAZARD ESTIMATES FOR AQUATIC/RIPARIAN INDICATOR RECEPTORS[1]

Source Area	Red-Winged Blackbird	Common Snipe	Mallard	Muskrat	Moose
	ESTIMATED HAZARD INDEX (hi)				
East Mill Creek	16	83	0.1	30	0.004
Stock Ponds	7.7	25	0.02	22	0.01
Tailings Ponds	1.2	6	0.01	2.3	0.001
State Land Creek	2.0	8.6	0.005	5.6	0.004
Blackfoot River	0.7	3.2	0.02	1.7	0.013

Notes: 1. Refer to Attachment 4 for receptor-specific ecological hazard calculations.

For the Blackfoot River, both upper bound and mean HQ estimates were less than 10 (Tables H.19 and H.20). These results suggest a slight potential for impacts on snipe exposed to measured concentrations of selenium in the Blackfoot River.

Mallard

The upper bound and mean HQ estimates for the mallard for all surface water sources evaluated were less than 1.0 (Tables H.19 and H.20). Based on the hazard classification system of Menzie et al., (1992) these results suggest that no adverse impacts to mallards are anticipated from exposures to surface water or sediment associated with any of these surface water sources. The low HQ estimates for the mallard are attributable to significantly lower anticipated exposures for this avian receptor relative to those anticipated for the red-winged blackbird or the snipe. The primary factor contributing to low exposures for the mallard is its large home range.

Muskrat

Similar to the results for avian receptors, the highest hazard estimates for the muskrat were associated with East Mill Creek. The upper bound and mean HQ estimates for the muskrat for East Mill Creek were <45 and <30, respectively (Tables H.19 and H.20). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a potential for impacts on muskrats exposed to either the maximum or mean concentrations of selenium measured in East Mill Creek. The upper bound and mean HQ estimate for the stock ponds also exceeded 10 (Table H.19), and suggest a potential for impacts on muskrats exposed to this surface water source.

For the tailings ponds, State Land Creek, and the Blackfoot River, both upper bound and mean HQ estimates were less than 10 (Tables H.19 and H.20). These results suggest a slight potential for impacts on muskrats exposed to surface water and sediments associated with these sources.

Moose

The upper bound and mean HQ estimates for the moose for all surface water sources evaluated were less than 1.0 (Tables H.19 and H.20). Based on the hazard classification system of Menzie et al., (1992), these results suggest that no adverse impacts to moose are anticipated from exposures to surface water or sediment associated with any of these surface water sources. The low HQ estimates for the moose are attributable to significantly lower anticipated exposures for this receptor; the primary contributing factor being its large home range.

Terrestrial Indicator Receptors

Sheep

Hazard estimates for terrestrial indicator receptors are presented in Table H.21, *Upper Bound Hazard Estimates for Terrestrial Indicator Receptors* and Table H.22, *Mean Hazard Estimates for Terrestrial Indicator Receptors*. The upper bound HQ estimate for sheep potentially grazing the waste rock dumps was <35 (Table H.21). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a potential for impacts on sheep exposed to waste rock dump soils, vegetation, and water. It should be noted, however, that selenium exposure point concentrations in waste rock dump soils and vegetation were based on the 95% UCL or maximum concentrations for soil and vegetation samples collected from all of the waste rock dumps combined. However, only one waste rock dump (Ballard Mine Pit 1 Overburden Dump 1) was associated with soil concentrations at, or above, the upper bound exposure point concentration; all other waste rock dumps contained selenium concentrations well below that used in the upper bound HQ estimate for sheep. Similarly, the selenium exposure point concentration in vegetation was based on the maximum concentration measured in vegetation samples collected from Smoky Canyon Mine Pole Canyon Waste Dump.

TABLE H.21 UPPER BOUND HAZARD ESTIMATES FOR TERRESTRIAL INDICATOR RECEPTORSa			
	Estimated Hazard Index (HI)		
Source Area	**Sheep**	**Horses**	**Cattle**
Cadmium:	0.5	0.6	0.6
Selenium:	34.1	46.3	46.3
Total HI:	35	47	47
Notes: 1. Refer to Attachment 4 for receptor-specific ecological hazard calculations.			

TABLE H.22 MEAN HAZARD ESTIMATES FOR TERRESTRIAL INDICATOR RECEPTORS			
	Estimated Hazard Index (HI)		
Source Area	**Sheep**	**Horses**	**Cattle**
Cadmium:	0.2	0.2	0.2
Selenium:	6.5	8.9	8.9
Total HI:	6.7	9.1	9.1
Notes: 1. Refer to Attachment 4 for receptor-specific ecological hazard calculations.			

Only two sites (Smoky Canyon Mine Pole Canyon Waste Dump, and Ballard Mine Pit 1 Overburden Dump 1) were associated with vegetation concentrations that are within the range of the maximum level that was used as the vegetation exposure point concentration for sheep. Finally, the water exposure point concentration that was used to estimate upper bound hazards to sheep was based on the maximum selenium concentration measured in stock pond samples (from Enoch Valley Mine North Pond).

Based on the above discussion, it is apparent that the upper bound HQ estimate for sheep represents a worst-case analysis of hazard that is geographically isolated. The mean HQ estimate is more representative of regional hazards associated with sheep grazing on the waste rock dumps. The mean HQ for sheep was estimated as < 7 (Table H.22). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a slight potential for impacts on sheep grazing the waste rock dumps.

Horses

The upper bound HQ estimate for horses potentially grazing the waste rock dumps was <50 (Table H.21). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a potential for impacts on horses exposed to waste rock dump soils, vegetation, and water. Similar to the hazard estimate for sheep, however, selenium exposure point concentrations in waste rock dump soils and vegetation were based on the 95% UCL or maximum concentrations for soil and vegetation samples collected from all of the waste rock dumps combined. However, only one waste rock dump (Ballard Mine Pit 1 Overburden Dump 1) was associated with soil concentrations at, or above, the upper bound exposure point concentration; all other waste rock dumps contained selenium concentrations well below that used in the upper bound HQ estimate for horses. Similarly, the selenium exposure point concentration in vegetation was based on the maximum concentration measured in vegetation samples collected from Smoky Canyon Mine Pole Canyon Waste Dump. Only two sites (Smoky Canyon Mine Pole Canyon Waste Dump, and Ballard Mine Pit 1 Overburden Dump 1) were associated with vegetation concentrations that are within the range of the maximum level that was used as the vegetation exposure point concentration for horses. Finally, the water exposure point concentration that was used to estimate upper bound hazards to horses was based on the maximum selenium concentration measured in stock pond samples (from Enoch Valley Mine North Pond).

Based on the above discussion, it is apparent that the upper bound HQ estimate for horses represents a worst-case analysis of hazard that is geographically isolated. The mean HQ estimate is more representative of regional hazards associated with horses grazing on the waste rock dumps. The mean HQ for horses was estimated as <10 (Table H.22). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a slight potential for impacts on horses grazing the waste rock dumps.

Cattle

The upper bound HQ estimate for cattle potentially grazing the waste rock dumps was <50 (Table H.21). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a potential for impacts on cattle exposed to waste rock dump soils, vegetation, and water. Similar to the hazard estimates for sheep and horses, however, selenium exposure point concentrations in waste rock dump soils and vegetation were based on the 95% UCL or maximum concentrations for soil and vegetation samples collected from all of the waste rock dumps combined. However, only one waste rock dump (Ballard Mine Pit 1 Overburden Dump 1) was associated with soil concentrations at, or above, the upper bound exposure point concentration; all other waste rock dumps contained selenium concentrations well below that used in the upper bound HQ estimate for cattle. Similarly, the selenium exposure point concentration in vegetation was based on the maximum concentration measured in vegetation samples collected from Smoky Canyon Mine Pole Canyon Waste Dump. Only two sites (Smoky Canyon Mine Pole Canyon Waste Dump, and Ballard Mine Pit 1 Overburden Dump 1) were associated with vegetation concentrations that are within the range of the maximum level that was used as the vegetation exposure point concentration for horses. Finally, the water exposure point concentration that was used to estimate upper bound hazards to cattle was based on the maximum selenium concentration measured in stock pond samples (from Enoch Valley Mine North Pond).

Based on the above discussion, it is apparent that the upper bound HQ estimate for cattle represents a worst-case analysis of hazard that is geographically isolated. The mean HQ estimate is more representative of regional hazards associate with cattle grazing on the waste rock dumps. The mean HQ for cattle was estimated as <10 (Table H.22). Based on the hazard classification system of Menzie et al., (1992), these results suggest that there is a slight potential for impacts on cattle grazing the waste rock dumps.

H.2.6 Uncertainty Analysis

The presence of uncertainty is inherent in the ecological risk assessment process. Uncertainties may be associated with each of the steps evaluated in this preliminary assessment, namely:

- Problem formulation
- Ecological exposure assessment
- Ecological effects assessment
- Ecological risk characterization

The uncertainties associated with each of these steps as they relate to the preliminary assessment for the 1998 Regional Investigation are described below.

H.2.6.1 Problem Formulation

The primary contributions to uncertainty in the problem formulation phase include the following:

- Characterization of elevated concentrations of targeted trace elements
- Identification of COPCs
- Identification of indicator receptors

The potential uncertainties in each of these steps are described below.

Characterization of Regional Contamination

There is a degree of uncertainty in the characterization of elevated trace element because it is not possible to sample an entire region or site. The 1998 regional investigation used an outside-in sampling approach to characterizing area streams that included sampling the first streams downstream of historic or existing phosphate mining operations that are known to support fish, as well as background (i.e., unimpacted) areas. This sampling investigation included the collection of surface water and sediment samples from a total of 78 sampling stations located throughout the region. However, the selection of sampling stations was heavily biased towards those locations reasonably anticipated to have been impacted by phosphate mining discharges, and included waste rock dump seeps, french drains, stock ponds, tailings ponds, and streams located downstream of phosphate mining operations. Surface water stations were sampled in both May and September of 1998.

The 1998 regional investigation soil and vegetation sampling program was even more biased towards impacted areas than was the surface water sampling program. Soil and vegetation samples were collected from 65 locations, including waste rock dumps, waste rock dump seeps, and, for characterization of background, undisturbed Phosphoria Formation outcrops.

Fish sample collection during the 1998 Regional Investigation was limited to three sampling stations - the Blackfoot River above Wooley Range Ridge Creek (ST026), East Mill Creek (ST227), and, for background characterization, South Fork of Sage Creek (ST228).

Based on the above, the 1998 regional investigation included an extensive evaluation of regional impacts, and was heavily biased towards the detection of elevated concentrations of trace elements. Only limited sampling of non-vegetative biota was performed.

Identification of COPCs

The basis for the selection of COPCs evaluated in the assessment included the following:

- Comparison with laboratory and field blanks
- Comparison with background concentrations
- Essential nutrient status

Based on the above criteria, the targeted trace elements that were selected as COPCs for evaluation in this preliminary assessment were selenium and cadmium.

Selenium demonstrated consistently elevated concentrations in surface water, sediments, soil, and terrestrial vegetation during the 1998 regional investigation. As described in subsection H.2.5.2.1, however, there is evidence that, at least, a portion of the cadmium concentrations in surface water, and associated hazard estimates for cutthroat trout, may be associated with regional ambient conditions. This line of evidence includes the following facts: (1) only the maximum concentration of cadmium detected in the tailings ponds exceeded the background upper tolerance bound, and by less than a factor of two; and, (2) more than 25 percent of control sampling stations exceeded the CWBS for cadmium. Therefore, it is highly probable that a substantial portion of the measured cadmium concentrations, and associated hazards, represent a natural phenomenon associated with ambient conditions in a mineralized region.

Identification of Indicator Receptors

The 1998 regional investigation focused on the sampling of surface water sources and waste rock dumps, because these are the areas of highest suspected impacts associated with selenium releases from phosphate mining operations. Consistent with this sampling approach, the assessment focused on aquatic/riparian receptors, as well as terrestrial receptors potentially grazing the waste rock dumps.

As described in subsection H.2.2.4, it is not feasible to quantitatively evaluate potential impacts to all receptors inhabiting these ecosystems. Therefore, representative indicator species were selected for quantitative evaluation in this preliminary assessment. The specific indicator receptors that were selected to evaluate potential impacts to aquatic/riparian species included the cutthroat trout, red-winged blackbird, snipe, mallard, muskrat, and moose. As described in subsections H.2.2 and H.2.3, these receptors were selected because they are anticipated to receive high exposures to COPCs in surface water and sediment, and because they represent a variety of food guilds. Other aquatic/riparian receptors (e.g., benthic invertebrates and emergent vegetation) could potentially be impacted by selenium releases. This assessment made the assumption that upper trophic level species, including those selected as indicator receptors, would receive higher exposures to selenium than would lower trophic level receptors and, thus, provide a measure of the health of the overall habitat. Nevertheless, adverse impacts to lower level aquatic/riparian receptors such as benthic invertebrates and emergent vegetation could potentially impact the viability of the entire habitat.

For evaluating potential impacts of waste rock dumps on terrestrial receptors, this assessment selected grazing livestock including sheep, horses, and cattle for evaluation. Among other factors considered in the selection of these domestic ungulates for evaluation, was the fact that they are anticipated to receive higher exposures to COPCs in waste rock dump soils and vegetation than free-ranging ungulates such as elk and mule deer (see subsection H.2.2.4). However, certain resident terrestrial mammals with small home ranges (e.g., soil invertebrates and rodents) may, potentially, receive higher exposures to selenium in soil and vegetation than livestock.

H.2.6.2 Ecological Exposure Assessment

Uncertainty in the exposure assessment phase results primarily from the derivation of exposure point concentrations, and from the exposure assumptions that were used.

Exposure Point Concentrations

As described in subsection H.2.6.1, the 1998 regional investigation sampling was heavily biased towards those locations reasonably anticipated to have been impacted by phosphate mining discharges, and included waste rock dump seeps, french drains, stock ponds, tailings ponds, and streams located downstream of phosphate mining operations. On a regional basis, therefore, the data collected are biased towards affected locations, and unaffected areas are under-represented. This is highly relevant from an exposure standpoint, because ecological receptors undoubtedly use both affected and unaffected areas during the course of their migration, breeding, or foraging activities.

The receptor exposures that were evaluated in this preliminary assessment were based on upper bound exposure point concentrations, and mean exposure point concentrations. Upper bound exposure point concentrations were based on the maximum or 95% UCL on the mean concentration of chemicals measured in site media. When a 95% UCL concentration was higher than the maximum concentration detected in site medium, the maximum observed concentration was used. Because of the limited sampling data available for most locations evaluated in this preliminary assessment, the estimated 95% UCL generally exceeded the maximum concentration. Therefore, the maximum concentration that was measured in surface water, sediment, soil, or vegetation was assumed as the upper bound exposure point concentration. This results in an extremely conservative (i.e., protective) hazard estimate, because receptors are not anticipated to be exposed to maximum concentrations of targeted trace elements 100 percent of the time.

Because it is not reasonable to assume that most organisms are exposed to maximum concentrations of COPCs in media all of the time, mean exposure point concentrations were also evaluated to provide an estimate of central tendency, or more typical, exposures.

Exposure Assumptions

Some exposure parameters (e.g., soil ingestion rates, dermal surface areas, and absorption fractions) were not available for the specific indicator receptors that were evaluated in this preliminary assessment, and best estimates based on similar species or allometric equations were used. This introduces a level of uncertainty into the exposure estimate. However, appropriate exposure values and estimation methods were taken from the *Wildlife Exposure Factors Handbook* (EPA, 1993), where available.

Exposure pathways that were evaluated for aquatic/riparian and terrestrial indicator receptors included dietary uptake, ingestion of surface water and soil/sediment, and dermal contact with soil or sediment. Inhalation of particulate forms of cadmium and selenium was not evaluated due to a general lack of exposure assessment methodologies for this pathway in ecological receptors. It is worthwhile to note, however, that the ingestion pathway tends to dominate ecological exposures *(Manghan 1993).* Therefore, a failure to quantitatively evaluate this pathway is not anticipated to result in a significant underestimation of hazards for ecological receptors.

The exposure assumption that may contribute the most uncertainty to the exposure dose estimate is the site utilization factor. The SUF (i.e., the area of contamination that a receptor contacts relative to its home range) was assumed to be 1.00 for the red-winged blackbird, snipe, and muskrat for all surface water sources that were evaluated. This assumption implies that these receptors are only exposed to contaminated source media. This assumption may result in an overestimate of hazard, but is unlikely to result in an underestimate of hazard for these receptors. For the mallard and moose, SUF values were assumed to be less than 1.00, consistent with the much larger home ranges of these receptors. The use of an SUF less than 1.0 for the mallard and moose implies that these receptors will require multiple foraging access to meet their dietary needs. Some of these alternate foraging areas may be within the study area and may be associated with elevated selenium, while other foraging areas may be free of contamination. It is not possible to adequately address this variable in a deterministic risk assessment. It is recognized that assuming that non-site foraging areas are uncontaminated may potentially underestimate hazards to the mallard and moose. As a result, a stochastic version of this variable will be evaluated in the final ecological risk assessment.

H.2.6.3 Ecological Effects Assessment

The NAWQC of $_e\{0.7852$ [ln (hardness)] - 3.49} x {1.101672 - [ln (hardness)] x 0.041838} was selected as the aquatic toxicity benchmark for evaluating potential impacts of cadmium on cutthroat trout. This criterion was deemed appropriate for use in evaluating potential impacts to cutthroat trout, because the data set from which it was derived contained effects data for a related salmonid (i.e., brook trout).

The EPA (1987) freshwater FCV of 0.0097 mg/l derived for selenate was used to evaluate potential impacts of selenium on cutthroat trout. This benchmark is based on chronic effect values for three aquatic species including rainbow trout. The EPA (1987) also derived a freshwater FCV of 0.0276 mg/l for selenite that was intended to be protection of freshwater aquatic species including rainbow trout. Because surface water samples collected during the 1998 regional investigation were not speciated for the different forms of selenium, potential impacts to cutthroat trout were evaluated based on the more protective of the two freshwater FCVs.

A freshwater chronic NAWQC of 0.005 mg/l currently exists for selenium based on studies in Belews Lake, North Carolina demonstrating impacts to warm-water fish species at concentrations as low as 0.010 mg/l selenium. This criterion was not used to evaluate potential impacts to cutthroat trout because differences have been observed in the sensitivities of warm-water versus cold-water fish to the effects of selenium, and in their bioaccumulation potential (see subsection H.2.4). However, it is possible that non-salmonids may not be adequately protected by a benchmark of 0.010 mg/l.

The TRVs that were used in the evaluation of potential risks to indicator receptors (other than cutthroat trout) were derived from ecological toxicity benchmarks published in *Toxicological Benchmarks for Wildlife – 1996 Revision* (Sample et al., 1996). Emphasis was placed on studies in which reproductive and developmental endpoints were considered. These toxicity benchmarks were based on experimentally derived NOAELs and, thus, are protective of individuals (versus populations). Potential impacts at the population level may be preliminarily evaluated based on the LOAEL benchmark. Thus, the hazard estimates that are presented in this preliminary assessment may overestimate potential impacts to populations of receptors exposed to phosphate mining discharges.

The selenium TRV for avian species was derived from a NOAEL for selenomethionine in mallards, while the TRV for mammals was derived from a NOAEL for potassium selenate in rats. Thus, the TRV for avian indicator receptors (i.e., red-winged blackbird, snipe, and mallard) may be more protective than the TRV used to evaluate impacts to mammalian indicator receptors (i.e., muskrat, moose, and livestock). Because the avian TRV for selenium is based on selenomethionine, this preliminary assessment makes the assumption that all selenium in site media to which avian indicator receptors are exposed is as toxic as selenomethionine. Consequently, the ecological hazards for selenium are most likely overestimated for the avian indicator receptors evaluated in this preliminary assessment, since environmental selenium typically exists in multiple forms. For cadmium, the avian and mammalian toxicity benchmarks were based on studies using cadmium chloride in mallards and rats, respectively.

Finally, the TRVs used in this preliminary assessment were derived from toxicology studies in mallards and rats, and were allometrically converted for each indicator receptor based on established methods (Sample et al., 1996). It is not known whether the indicator receptors chosen may be more sensitive or less sensitive to the adverse effects of selenium or cadmium than the test species upon which the toxicity benchmark is based. However, the benchmarks are thought to be protective because they are based on the lowest toxicity values obtained from the literature.

H.2.6.4 Ecological Risk Characterization

The sources of uncertainty previously described are incorporated in the hazard estimate. Because the majority of these uncertainties err on the protective side, the hazard estimates that are presented in this preliminary assessment are considered to be protective. Nevertheless, there is a significant degree of uncertainty in these quantitative hazard estimates, based on the uncertainties previously described. Additional data to be collected as part of the more focused 1999 sampling investigation will allow for a refined evaluation of risks to ecological indicator receptors and habitats.

H.2.7 Data Gaps And Recommendations

In subsection H.2.6, an evaluation of the uncertainties and limitations in the preliminary assessment was performed. In the following section, specific data gaps in the assessment are described and recommendations for additional data collection intended to reduce the uncertainties in the assessment are presented.

H.2.7.1 Sampling and Characterization

The 1998 regional investigation was heavily biased towards those locations reasonably anticipated to have been impacted by phosphate mining discharges, and included waste rock dump seeps, french drains, stock ponds, tailings ponds, and streams located downstream of phosphate mining operations. Sampling data for non-impacted or low impact locations are under-represented, and were not evaluated in this preliminary assessment. The collection of sampling data from non-impacted or low impact sites within the footprint of phosphate mining operations would provide a more comprehensive and balanced assessment of regional impacts to ecological receptors and habitats.

As described in subsection H.2.5.2, there is evidence that cadmium concentrations in surface water, and associated hazard estimates for cutthroat trout, may be associated with regional ambient conditions. This line of evidence includes the fact that more than 25% of control sampling stations exceeded the CWBS for cadmium. Additional characterization of the regional extent of cadmium in surface waters would help to identify whether or not elevated cadmium concentrations, and associated hazards, are entirely representative of a natural phenomenon associated with ambient conditions in a mineralized region.

Although the 1998 regional investigation included an extensive evaluation of abiotic media that was heavily biased towards the detection of contamination, only limited sampling of non-vegetative biota was performed. Fish sample collection during the 1998 regional investigation was limited to three sampling stations (the Blackfoot River above Wooley Range Ridge Creek [ST026], East Mill Creek [ST227], and, for background characterization, South Fork of Sage Creek [ST228]). Additional fish muscle tissue collection would help to elucidate whether or not concentrations of selenium in fish are elevated on a regional basis. No sampling of non-fish aquatic biota (e.g., benthic macroinvertebrates, periphyton, plankton, submergent macrophytes, or riparian vegetation) has been performed. Sampling of non-fish aquatic biota would help to refine the exposure assessment for aquatic/riparian receptors, and would serve as a basis to evaluate the entire health of the aquatic ecosystem in surface waters having high ecological significance (e.g., the Blackfoot River).

To date, there has not been a significant evaluation of the forms of selenium present in abiotic and biotic media potentially impacted by phosphate mining discharges. The EPA (1987) has acknowledged that there are significant differences in the toxicity of the various forms of selenium, with selenite appearing to be the least toxic form and selenomethionine the most toxic. Because surface water samples collected during the 1998 regional investigation were not speciated for the different forms of selenium, potential impacts to cutthroat trout were evaluated based on the more protective of the two freshwater FCVs (i.e., 0.010 mg/l for selenate). A potentially higher aquatic benchmark of 0.0276 mg/l has been established by the EPA (1987) for selenite. As a result of differences in aquatic toxicity between selenate and selenite, the EPA (1996b) has established a method of calculating the criterion maximum concentration (CMC; i.e., acute criterion) for selenium that is based on apportioning the relative amounts of selenate and selenite that are detected. Speciation of the various forms of selenium present in surface water and/or sediment may allow for a similar approach to be used in the refined assessment.

Speciation of the various forms of selenium in abiotic, as well as biotic, media would also help to refine the hazard estimates for avian and mammalian indicator receptors. Because the avian TRV for selenium is based on selenomethionine, this preliminary assessment made the assumption that all selenium in site media to which avian indicator receptors are exposed is as toxic as selenomethionine. Alternately, the hazards estimated for mammalian indicator receptors (e.g., muskrat and moose) are based on the assumption that all selenium to which they are exposed is as toxic as selenate. In neither case, are these receptors considered to be exposed to less toxic forms such as selenite. Speciation of the various forms of selenium in abiotic and biotic media (e.g., such as in bird eggs) would help to evaluate the extent to which hazards for avian and mammalian indicator receptors may have been overestimated.

H.2.7.2 Ecological Exposure Assessment

In this preliminary assessment, upper bound and mean HQs in excess of 1.0 were routinely estimated for aquatic/riparian indicator receptors associated with the stock ponds, tailings ponds, East Mill Creek, and State Land Creek. In most instances, upper bound hazard estimates were based on the *maximum* concentrations of selenium and cadmium measured in surface water and sediment. The upper bound hazard estimates for aquatic/riparian indicator receptors, therefore, truly represent a worst-case (perhaps even a beyond-worst-case) analysis of ecological hazard. The collection of additional surface water and sediment samples from these areas would provide for the estimation of a more representative upper bound exposure point concentration for evaluation in the refined assessment.

As described in subsection H.2.7.1, sampling of non-fish aquatic biota (e.g., benthic macroinvertebrates, periphyton, plankton, submergent macrophytes, or riparian vegetation) would help to refine the exposure assessment for aquatic/riparian receptors.

H.2.7.3 Ecological Effects Assessment

As described in subsection H.2.7.1, collection of additional fish muscle tissue samples would help to elucidate whether or not concentrations of selenium in fish are elevated on a regional basis. In addition, speciation of the various forms of selenium present in surface water or sediment would allow for a refinement of the assessment for cutthroat trout (subsection H.2.7.1). However, a direct assessment of selenium impacts to aquatic receptors, such as cutthroat trout, would provide the most definitive evaluation of the regional impacts of phosphate mining operations on aquatic habitats. Field or laboratory studies evaluating the reproductive viability and/or long-term health impacts of cutthroat trout exposed to selenium would help to elucidate whether or not phosphate mining operations are impacting this important fishery.

An HI of <130 was estimated for snipe potentially exposed to selenium associated with East Mill Creek. In addition to the protective exposure point concentrations and exposure assumptions that were used in the estimation of hazard for this receptor, the avian TRV assumes that all forms of selenium to which the snipe is exposed are as toxic as selenomethionine. Sampling of eggs from avian species such as snipe, and speciation of the forms of selenium present, would serve to refine the impact assessment for avian indicator receptors.

For evaluating potential impacts of waste rock dumps on terrestrial receptors, this assessment selected grazing livestock including sheep, horses, and cattle for evaluation. Upper bound hazard estimates for grazing livestock exceeded an HI of 10, and mean HI estimates exceeded a value of 1.0. Additional studies on livestock, such as the pharmacodynamics of selenium uptake and depuration, and potential sub-chronic toxicity, would help to put the results of this preliminary assessment in context.

Among other factors considered in the selection of these domestic ungulates for risk evaluation, was the fact that they are anticipated to receive higher exposures to COPCs in waste rock dump soils and vegetation than free-ranging ungulates such as elk and mule deer (subsection H.2.2.4). Studies on free-ranging ungulates (e.g., elk), such as organ (i.e. liver) or muscle tissue sampling studies, would help to determine whether in fact the above assumption is true.

IMA Human Health Risk Assesssment Workshop #1: Input Variables for Revised Preliminary Human Health Risk Model

Glossary of Statistical Parameters, Symbols, and Terminology

1. μ. The population mean of a variable.

2. σ. The population standard deviation of a variable.

3. λ. The population lower bound of a variable.

4. υ. The population upper bound of a variable.

5. p_q. The population quantile q of a variable, i.e., the (q $\times$ 100)th percentile. For example, the median or 50th percentile of a variable is $p_{0.50}$. The use of p without a subscript denotes the probability of making a Type I error, i.e., the likelihood of falsely rejecting the null hypothesis.

6. m. The population mode (i.e., the most likely value) of a variable.

7. $\hat{c}$. An estimated value of parameter c (where c denotes any statistical parameter). For example $\hat{\mu}$ denotes an estimate of the population mean, μ.

8. x_i. The ith value of variable x.

9. x_T. A transformed value of variable x. For example, if $x_{i,T} = \ln(x_i - \lambda)$, $x_{i,T}$ is the logtransform of the ith value of variable x.

10. n. Sample size.

11. ν. Degrees of freedom.

12. $\bar{x}$. The sample mean of variable x. $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$.

13. s. The sample standard deviation of variable x. $s = \sqrt{\dfrac{n\sum_{i=1}^{n} x_i - \left(\sum_{i=1}^{n} x_i\right)^2}{n(n-1)}}$.

14. $s_{\bar{x}}$. The standard error of the mean of variable x: $s_{\bar{x}} = s/\sqrt{n}$.

15. $k_{s,\nu}$. The correction factor for s from a normal distribution with ν degrees of freedom. The sample standard deviation is an assymptotically unbiased estimator of σ: $\hat{\sigma} = k_{s,\nu}s$.

16. α. One of two shape parameters in a beta distribution.

$$\hat{\alpha} = \frac{\left(\hat{\mu} - \hat{\lambda}\right)\left[\dfrac{\left(\hat{\mu} - \hat{\lambda}\right)\left(\hat{\upsilon} - \hat{\mu}\right)}{\hat{\sigma}^2} - 1\right]}{\hat{\upsilon} - \hat{\lambda}}.$$

17. β. One of two shape parameters in a beta distribution. $\hat{\beta} = \left(\hat{\mu} - \hat{\lambda}\right)\left(\dfrac{\hat{\upsilon} - \hat{\mu}}{\hat{\sigma}^2}\right) - \hat{\alpha} - 1$.

18. N(μ, σ). A normal distribution with mean, μ, and standard deviation, σ. A normal distribution is the maximum entropy solution in arithmetic scale when knowledge constraints consist of μ and σ.

19. LN(μ, σ, λ). A lognormal distribution with mean, μ, standard deviation, σ, and lower bound, λ. If no value of λ is specified, λ = 0. A lognormal distribution can also be specified as $e^{N(\mu_T,\, \sigma_T)} + \lambda$, where μ_T and σ_T are the mean and standard deviation of the ln-transformed data. A lognormal distribution is the maximum entropy solution in logarithmic scale when knowledge constraints consist of μ (or $p_{0.50}$) and σ.

20. U(λ, υ). A uniform (rectangular) distribution between lower bound, λ, and upper bound, υ. A uniform distribution is the maximum entropy solution in arithmetic scale when knowledge constraints consist of λ and υ.

21. LU(λ, υ). A loguniform (logrectangular) distribution between lower bound, ln(λ), and upper bound, ln(υ). A loguniform distribution is the maximum entropy solution in logarithmic scale when knowledge constraints consist of λ and υ.

22. $e(\mu-\lambda, \lambda)$. An exponential distribution with mean, μ, and lower bound, λ. If no value of λ is specified, $\lambda = 0$. An exponential distribution is the maximum entropy solution in arithmetic scale when knowledge constraints consist of μ (or p_q) and λ.

23. $\beta(\alpha, \beta, \lambda, \upsilon)$. A beta distribution with shape parameters, α and β, lower bound, λ, and upper bound, υ. If only three parameters are specified, $\lambda = 0$. A beta distribution is the maximum entropy solution in arithmetic scale when knowledge constraints consist of μ (or $p_{0.50}$), σ, λ, and υ. If σ is unavailable, it can be estimated so as to generate a beta distribution having the maximum entropy possible given μ (or $p_{0.50}$), λ, and υ.

24. $T(\lambda, m, \upsilon)$. A triangular distribution with a lower bound of λ, a mode of m, and an upper bound of υ.

25. r_{xy}. Correlation coefficient between variables x and y.

26. r^2_{xy}. Coefficient of determination between variables x and y: $r^2_{xy} = (r_{xy})^2$. This value quantifies the amount of variability in y that is explained by x.

27. ln. Natural logarithm: $2.303\ln(x) = \log_{10}(x)$.

Definition of Input Variables

1. $ADI_{Se,diet}$

Definition: Average daily dietary intake of Se. The amount of Se a receptor would be exposed to through his diet if there were no releases from phosphate mining.
Units: mg/d.
Deterministic Value: 0.178, the $\hat{p}_{0.95}$ of the probabilistic values.
Probabilistic Values: $\beta(1.50, 3.5, 0.047, 0.25)$, where $\hat{\lambda} = 0.047$ is the intake below which Se deficiency disease can occur (i.e., background dietary intakes are assumed to be sufficient to prevent such disease, which is rare or non-existent in the United States), and $\hat{\upsilon} = 0.25$ is an intake that corresponds to the upper bound for this variable as reported in the Merck Manual. A $\hat{\mu} = 0.108$ and a $\hat{\sigma} = 0.038$ are the mean and standard deviation of a simulation that gives equal weight to each of

seven studies estimating $ADI_{Se,diet}$, and the shape parameters $\hat{\alpha}$ and $\hat{\beta}$, 1.50 and 3.5, respectively, are determined by maximum entropy inference applied to $\hat{\lambda}$, $\hat{\mu}$, $\hat{\sigma}$, and $\hat{\upsilon}$.

Correlates:

- Positively and weakly correlated with $ADI_{Se,supplements}$ because larger people who take supplements may tend to take more, and because health-conscious people tend to take mineral supplements and health-conscious people probably tend to have a higher dietary Se intake;
- Positively and moderately correlated with IR_{beef} because beef is a significant source of dietary Se and the diet is, by far, the primary source of Se intake;
- Positively and moderately correlated with IR_{fish} because fish can be a significant source of dietary Se and the diet is, by far, the primary source of Se intake; and,
- Positively and moderately correlated with BW because larger people tend to have larger diets and the diet is, by far, the primary source of Se intake.

2. $ADI_{Se,supplements}$

Definition: Average daily intake of Se attributable to the ingestion of multi-vitamins and mineral supplements.

Units: mg/d.

Deterministic Value: 0.164, the $\hat{p}_{0.95}$ of the probabilistic values.

Probabilistic Values: β(0.46, 1.40, 0.00060, 0.40), where $\hat{\lambda}$ = 0.00060 is a modeled lower bound intake for someone taking a low-dose, inorganic Se multi-vitamin, and $\hat{\upsilon}$ = 0.40 is an intake corresponding to what would result if someone took two high-dose supplement tablets (200 μg) per day. The shape parameters $\hat{\alpha}$ and $\hat{\beta}$, 0.46 and 1.40, respectively, are determined in a separate submodel that gives equal weight to the amount of Se in each Se-containing multi-vitamin or mineral supplement observed on the shelf of a presumably representative pharmacy (Klahanie QFC, Issaquah, Washington), and adjusting bioavailability for inorganic Se, the form in which Se was observed in multi-vitamins. (In the mineral supplements observed, Se was in organic form, and dietary Se—the Se in the background diet and in seleniferous beef and fish—is also assumed to be in the more bioavailable organic form.) Because only 40% of adults routinely take vitamins or mineral supplements and not all vitamins contain Se, two switches were added to the model. The first, P(supplements), accounts for the fact that not all adults take vitamins or mineral supplements. This variable is defined as $\beta(0.87, 1.31, 0, 1.00)$, which was derived assuming bounds of 0 and 1.00 (physical constraints), a $\hat{\mu}$ of 0.40, and applying maximum entropy inference. The second switch, P(Se_supplements), accounts for the fact that not all vitamins or mineral supplements contain Se. While most vitamins and mineral supplements observed in the pharmacy did not contain Se, the fraction was not quantified, so this variable is defined as U(0, 1.00) on the basis of maximum entropy inference applied to physical constraints. Thus, the model in effect sets $ADI_{Se,supplements}$ to 0 unless both switches are activated; i.e., unless in a given trial the randomly selected receptor is (1) taking supplements and (2) the supplements contain Se.

Correlates:

- Positively and weakly correlated with $ADI_{Se,diet}$ because health conscious individuals who are more likely to take supplements are also more likely to have a Se rich diet; and,
- Positively and weakly correlated with IR_{fish} because taking supplements and eating fish are regarded as health conscious activities.

3. $C_{Se,beef,site,pasture,mean}$

Definition: The concentration of Se in beef skeletal muscle at the time the animal is removed from seleniferous pasture. This concentration is estimated from a regression of skeletal muscle concentration on blood concentration using data from a study on selenomethionine ingestion (P. Talcott, personal communication). The regression equation is $\ln(C_{Se,beef,site,pasture,i}) = 0.881\ln(C_{Se,blood,site,pasture,i}) - 0.0611$, with $n = 4$, $r = 0.999$, and $p = 0.00086$.

Units: mg/kg (on a wet-weight basis).

Deterministic Value: 2.9, the $\hat{p}_{0.95}$ of the probabilistic values.

Probabilistic Values: Based on n = 9 blood samples, the distribution of Se concentration in beef skeletal muscle is LN(2.5, 0.63), where $\hat{\mu} = 2.5$ and $\hat{\sigma} = 0.63$ are minimum-variance-unbiased estimates. This best estimate of the Se concentration distribution is entered into the model nine times (because n = 9) to calculate $\hat{\mu}$ as follows:

$$\hat{\mu} = \frac{\sum_{i=1}^{9} x_i}{9}.$$

The resulting distribution of $\hat{\mu}$ is very well approximated by LN(2.5, 0.21), with a simulation of n =1,000 and X^2 goodness-of-fit test result of p = 0.83.

Correlates: None.

4. $C_{Se,beef,background,mean}$

Definition: The background concentration of Se in beef skeletal muscle as determined from market survey.

Units: mg/kg (on a wet-weight basis).

Deterministic Value: 0.22, the $\hat{\mu}$ of the probabilistic values.

Probabilistic Values: β(0.94, 1.10, 0.050, 0.42), where $\hat{\lambda}$ = 0.050 is the lowest reported concentration, $\hat{\upsilon}$ = 0.42 is the highest reported concentration, and $\hat{\mu}$ = 0.101. The shape parameters $\hat{\alpha}$ and $\hat{\beta}$, 0.94 and 1.10, respectively, are determined by maximum entropy inference applied to $\hat{\lambda}$, $\hat{\mu}$, and $\hat{\upsilon}$.

Correlates: None.

5. DT

Definition: Depuration time, the time between an animal being removed from seleniferous pasture until it is slaughtered.

Units: d.

Deterministic Value: 40, the $\hat{p}_{0.050}$ of the probabilistic values.

Probabilistic Values: T(0, 150, 0, 220), where $\hat{\lambda}$ = 0, a physical constraint, $\hat{\upsilon}$ = 220 is the maximum time a culled calf would spend on clean pasture or a feedlot before being slaughtered (M. Johnson, Nu-West, personal communication), and m = 150 is the typical time transpired (M. Vice, Solutia, personal communication). The triangular distribution was recommended and accepted by the participants of the first human health risk assessment workshop. (The maximum entropy solution to this set of knowledge constraints is $\beta[1.00, 1.00, 0, 220] \sim U[0, 220]$.)

Correlates: None.

6. BHL_{Se}

Definition: The biological half-life of Se in beef skeletal muscle—the time to excrete half of the elevated Se from the tissue.

Units: d.

Deterministic Value: 250, the $\hat{p}_{0.95}$ of the probabilistic values.

Probabilistic Values: LU(10.0, 300), where $\hat{\lambda}$ = 10.0 is the lowest value encountered in the literature rounded downward (P. Talcott, personal communication), and $\hat{\upsilon}$ = 300 is the highest value encountered in the literature rounded upward (ATSDR, 1994). The uniform distribution is derived by applying maximum entropy inference to the bounds, which are about 1.5 orders of magnitude apart.

Correlates: None.

7. IR_{beef}

Definition: Ingestion rate of beef skeletal muscle.

Units: kg/d (on a wet-weight basis).

Deterministic Value: 0.22, the $\hat{p}_{0.95}$ of the probabilistic values.

Probabilistic Values: LN(0.063, 0.112). This distribution is derived as follows—

- Total dietary meat ingestion dose is LN(0.0021, 0.00161) kg/(kg·d) on a wet-weight basis per USEPA (1996a) reported values of $\hat{\mu}$ and $\hat{p}_{0.95}$;
- USDA (1991) estimates beef to consist of 37% of total dietary meat consumption, thus $\beta(0.85, 1.45, 0, 1.00)$ is derived on the basis of maximum entropy inference applied to the following knowledge constraints—$\hat{\mu}$ = 0.37, $\hat{\lambda}$ = 0, and $\hat{\upsilon}$ = 1.00;
- Body weight is LN(70, 14.0) kg and is assumed to be positively and moderately correlated with the total dietary meat ingestion dose (see BW as defined below); and,

- The product of the three distributions above generates a frequency distribution with $\hat{\mu}$ = 0.036 kg/d and $\hat{p}_{0.95}$ = 0.22 kg/d, and these two parameters define the resulting distribution, LN(0.063, 0.112).

Correlates:

- Positively and moderately correlated with $ADI_{Se,diet}$ because beef is a significant source of dietary Se and the diet is the primary source of Se intake;
- Positively and moderately correlated with $F_{beef,site}$ because someone who consumes a lot of beef is more likely to find a source of local beef; and,
- Positively and moderately correlated with BW because larger people tend to consume more beef.

8. $F_{beef,site}$

Definition: The fraction of beef ingested that was exposed to seleniferous pasture.
Units: unitless.
Deterministic Value: 0.157, the $\hat{p}_{0.95}$ of the probabilistic values.
Probabilistic Values: β(0.86, 16.0, 0, 1.00), where $\hat{\lambda}$ = 0 and $\hat{\upsilon}$ = 1.00 are physical constraints. For the general public, $\hat{\mu}$ was assumed, by participants in the workshop, to be 0.050. For ranchers who have cattle grazing on leases containing seleniferous pastures, $\hat{\mu}$ was assumed by the workshop participants to be 0.167 (the fraction of cattle on leases within the Soda Springs District of the Caribou National Forest that have the potential to be exposed to seleniferous pasture). The workshop participants assumed that the size of the rancher population is 1% that of the general population. Beta distributions were derived for the general population and population of ranchers with that of the general population being given 100 times more weight. A separate submodel was run that generated a $\hat{\mu}$ of 0.51 and a $\hat{\sigma}$ of 0.52. Application of maximum entropy inference to the bounds and the $\hat{\mu}$ and $\hat{\sigma}$ derived from the submodel is the basis for the resulting beta distribution used.

Correlates:

- Positively and weakly correlated with IR_{beef} because someone who consumes a lot of beef is more likely to find a source of local beef; and,

- Positively and weakly correlated with EF because one who does not travel much is more likely to obtain beef from a local source (thus, $F_{beef,site}$ is negatively and weakly correlated with [1 - EF]).

9. $C_{Se,fish,site,mean}$

Definition: The concentration of Se in skin-on salmonid fillets obtained from fish inhabiting seleniferous water downstream of phosphate mines.
Units: mg/kg (on a wet-weight basis)
Deterministic Value: 7.9, the highest observed concentration in salmonid fillets.
Probabilistic Values: Based on n = 3 fish samples each from East Mill Creek and the Blackfoot River, the distribution of Se concentration in salmonid fillets is LN(6.1, 2.7, -0.047) for East Mill Creek and LN(0.99, 0.30, -0.047) for the Blackfoot River. These best estimates of the Se concentration distributions in the two stream are each entered into the model three times (because n = 3) to calculate a stream-specific $\hat{\mu}$ as follows:

$$\hat{\mu} = \frac{\sum_{i=1}^{3} x_i}{3}.$$

Because the fishing pressure on the two streams is not equal, the workshop participants assumed that, on average, 95% of such pressure was on the Blackfoot River. A switch was programmed in to the model, P(Blackfoot_River), to calculate a weighted average concentration. As such, a distribution for P(Blackfoot_River), β(17.3, 0.91, 0, 1.00), is derived by maximum entropy inference on the following knowledge constraints—$\hat{\mu}$ = 0.95, $\hat{\lambda}$ = 0, and $\hat{\upsilon}$ = 1.00. For each model trial, a random number is generated. If the random number is less than or equal to the value of P(Blackfoot_River), the estimated mean concentration from Blackfoot River fish is used. For those trials where the random number exceeds the value of P(Blackfoot_River), the estimated mean concentration from East Mill Creek fish is used. The resulting distribution of $C_{Se,fish,site,mean}$ is sufficiently complex to not allow for it to be easily described except, as is done here, to describe how it is generated.
Correlates: None.

10. $C_{Se,fish,background,mean}$

Definition: The concentration of Se in edible background fish tissue.
Units: mg/kg (on a wet-weight basis).
Deterministic Value: 0.48, the $\hat{\mu}$ of the probabilistic values.
Probabilistic Values: β(0.90, 7.7, 0.140, 3.4), where $\hat{\lambda}$ = 0.140 is the lowest reported concentration, $\hat{\upsilon}$ = 3.4 is the highest reported concentration, and $\hat{\mu}$ = 0.48 is a combined mean of freshwater and saltwater fish tissue with each given equal weight. The shape parameters $\hat{\alpha}$ and $\hat{\beta}$, 0.90 and 7.7, respectively, are determined by maximum entropy inference applied to $\hat{\lambda}$, $\hat{\mu}$, and $\hat{\upsilon}$.
Correlates: None.

11. IR_{fish}

Definition: Ingestion rate of recreationally caught freshwater fish.
Units: kg/d (on a wet-weight basis).
Deterministic Value: 0.025, the $\hat{p}_{0.95}$ of the probabilistic values.
Probabilistic Values: LN(0.0080, 0.0103), based on $\hat{\mu}$ = 0.0080 and $\hat{p}_{0.95}$ = 0.025 (USEPA, 1996b).
Correlates:

- Positively and moderately correlated with $F_{fish,site}$ because someone who consumes a lot of recreationally caught fish is more likely to be a local and avid fisherman;
- Positively and weakly correlated with BW because larger people tend to consume more fish;
- Positively and moderately correlated with $ADI_{Se,diet}$ because fish provide a significant portion of dietary Se; and,
- Positively and weakly correlated with $ADI_{Se,supplements}$ because eating fish and taking supplements are regarded as health conscious behavior.

12. $F_{fish,site}$

Definition: The fraction of fish ingested that was exposed to seleniferous water.
Units: unitless.
Deterministic Value: 1.00, the $\hat{p}_{0.95}$ of the probabilistic values.
Probabilistic Values: β(7.8, .87, 0, 1.00), where $\hat{\lambda}$ = 0 and $\hat{\upsilon}$ = 1.00 are physical constraints, and a $\hat{\mu}$ of 0.90 was assumed by the workshop participants. The beta distribution is derived by applying maximum entropy inference to these knowledge constraints.
Correlates:

- Positively and moderately correlated with IR_{fish} because someone who consumes a lot of recreationally caught fish is more likely to be a local and avid fisherman; and,
- Positively and weakly correlated with EF because one who does not travel much is more likely to obtain fish from a local source (thus, $F_{fish,site}$ is negatively and weakly correlated with [1-EF]).

13. EF

Definition: Exposure frequency, the number of days per year a randomly selected member of the target population is "at home" and can thus be exposed to affected beef and fish. This assumes that, on those days one is away from home, affected affected meats are not taken along on one's travels.
Units: d/yr.
Deterministic Value: 350, USEPA's default value.
Probabilistic Values: 1 - EF (non-exposure frequency) is defined as LN(33, 14.7). This distribution is derived under the assumption that $\hat{p}_{0.050}$ is 15.25 (USEPA's default value), and $\hat{p}_{0.50}$ is 30.5 (one month). EF is then determined by the back-transformation—1 - (1 - EF).
Correlates:

- Positively and weakly correlated with $F_{beef,site}$ because one who does not travel much is more likely to obtain beef from a local source (thus, $F_{beef,site}$ is negatively and weakly correlated with [1 - EF]); and,

- Positively and weakly correlated with $F_{fish,site}$ because one who does not travel much is more likely to obtain fish from a local source (thus, $F_{fish,site}$ is negatively and weakly correlated with [1 - EF]).

14. UCF_t

Definition: Unit conversion factor for time.
Units: d/yr.
Deterministic Value: 365.25.
Probabilistic Values: Not applicable.
Correlates: None.

15. BW

Definition: Body weight of the receptor.
Units: kg.
Deterministic Value: 70, USEPA's default value, the $\hat{p}_{0.50}$ of the probabilistic values.
Probabilistic Values: LN(72, 14.0) (derived from $\hat{\mu}$ and $\hat{p}_{0.95}$ information contained in USEPA, 1996a).
Correlates:

- Positively and weakly correlated with IR_{fish} because larger people tend to consume more fish (but because eating fish is a health conscious behavior, the degree of correlation is not as large as with IR_{beef});
- Positively and moderately correlated with IR_{beef} because larger people tend to consume more beef; and,
- Positively and moderately correlated with $ADI_{Se,diet}$ because larger people tend to have larger diets and the diet is the primary source of Se intake.

16. $cNOAEL_{Se}$

Definition: Chronic no-observed-adverse-effects level for Se. The highest dose of the exposure group in the epidemiological study at which no one has manifested symptoms of chronic selenosis.

Units: mg/(kg·d).

Deterministic Value: 0.0153, as defined by USEPA in their *Integrated Risk Information System* database. (The USEPA reports a rounded value of 0.015.) Of 50 individuals with blood Se concentrations ranging from 0.50 to 0.99 mg/L, none manifested symptoms of chronic selenosis (Yang et al., 1989b). The intake was estimated by rearranging the following regression—

$$\log_{10}[Se]_{blood} = 0.767\log_{10}(ADI_{Se,diet}) - 2.248$$

(where $[Se]_{blood}$ is the blood concentration of Se in mg/L and $ADI_{Se,diet}$ here is the average daily intake of Se in µg/d), with n = 167, r = 0.962, and $p < 0.001$ (Yang et al., 1989a). Estimates of $ADI_{Se,diet}$ were obtained from Se-deficient, Se-normal, and Se-elevated regions of China. The USEPA converted the intake to a dose by dividing the intake by a median Chinese peasant body weight of 55 kg. Substituting 0.99 mg/L for $[Se]_{blood}$ into the regression equation, solving for $ADI_{Se,diet}$, converting the $ADI_{Se,diet}$ from µg/d to mg/d by dividing by 1,000 µg/mg, and dividing by 55 kg, yields a $cNOAEL_{Se}$ of 0.0153 mg/(kg·d).

Probabilistic Values: Not applicable—there is no uncertainty as what USEPA has defined this value to be.

Correlates: None.

17. $UF_{H,Se}$

Definition: The uncertainty factor by which the $cNOAEL_{Se}$ is divided by to account for humans that may be more sensitive to Se than those in the epidemiological study.

Units: unitless.

Deterministic Value: 3.06, as defined by USEPA. (The USEPA applies a value of 3 to the rounded $cNOAEL_{Se}$ of 0.015.)

Probabilistic Values: LU(0.67, 4.1), where $\hat{\lambda}$ = $cNOAEL_{Se}/cLOAEL_{Se}$ = 0.0153/0.23 = 0.67, and $\hat{\upsilon}$ = $cNOAEL_{Se}/Dose_{Se,background,0.95}$ = 0.0153/0.0037 = 4.1. Because the values range over nearly an order of magnitude, a loguniform distribution is derived by applying maximum entropy inference to the bounds. (Perhaps the most common value of UF_H for other systemic toxicants is 10. The fact that USEPA rates their confidence in their estimate of the chronic oral reference dose for Se [$cRfD_{Se}$ = $cNOAEL_{Se}/UF_H$] as high is directly reflected in their choice of a value of 3 for this variable. Major factor in the agency's choice are that [1] the $cNOAEL_{Se}$ is derived from a human study rather than the more typical animal study, and [2] Se is an essential trace element.)

Correlates: None.

SE HAZARDS ARE NOT ADDITIVE WITH ANY OF THE OTHER FIVE TARGET TRACE ELEMENTS; IN FACT, EVIDENCE INDICATES THAT SE AND CD ARE ANTAGONISTIC; THUS, IT IS INAPPROPRIATE TO ADD ANY OTHER HQ TO THE SE HQ TO ESTIMATE AN HI

SCREEN SOIL AND WATER INGESTION PATHWAYS USING EPA-9 OCCUPATIONAL PRGS IN THE PROBLEM FORMULATION PHASE

DEVELOP A CONCEPTUAL MODEL

DEFINE MONTE CARLO SIMULATION

DEFINE MAXIMUM ENTROPY INFERENCE

Fish Ingestion Exposure Submodel

Row	Variable (A)	Distribution or Value (B)	Transformed Distribution (C)
3	$C_{Se,fish,emc,1}$, mg/kg	7.9	7.9
4	$C_{Se,fish,emc,2}$, mg/kg	7.9	7.9
5	$C_{Se,fish,emc,3}$, mg/kg	7.9	7.9
6	$C_{Se,fish,emc,mean}$, mg/kg	7.9	
7	$C_{Se,fish,br,1}$, mg/kg	1.80	1.85
8	$C_{Se,fish,br,2}$, mg/kg	1.80	1.85
9	$C_{Se,fish,br,3}$, mg/kg	1.80	1.85
10	$C_{Se,fish,br,mean}$, mg/kg	1.80	
11	P(Blackfoot_River), unitless	0.85	
12	RANDOM 1	0.86	
13	$C_{Se,fish,site,mean}$, mg/kg	7.9	
14	IR_{fish}, kg/d	0.0250	
15	$F_{fish,site}$, unitless	1.00	
16	$C_{Se,fish,background,mean}$, mg/kg	0.48	0.34
17	EF, d/yr	350.00	15.25
18	UCF_t, d/yr	365.25	
19	BW, kg	70.0	
20	$\Delta Dose_{Se,fish}$, mg/(kg·d)	0.0025	

Beef Ingestion Exposure Submodel

Row	Variable (D)	Distribution or Value (E)	Transformed Distribution (F)
3	$C_{Se,beef,site-pasture,1}$, mg/kg	2.90	
4	$C_{Se,beef,site-pasture,2}$, mg/kg	2.90	
5	$C_{Se,beef,site-pasture,3}$, mg/kg	2.90	
6	$C_{Se,beef,site-pasture,4}$, mg/kg	2.90	
7	$C_{Se,beef,site-pasture,5}$, mg/kg	2.90	
8	$C_{Se,beef,site-pasture,6}$, mg/kg	2.90	
9	$C_{Se,beef,site-pasture,7}$, mg/kg	2.90	
10	$C_{Se,beef,site-pasture,8}$, mg/kg	2.90	
11	$C_{Se,beef,site-pasture,9}$, mg/kg	2.90	
12	$C_{Se,beef,site-pasture,mean}$, mg/kg	2.9	
13	DT, d	40	
14	BHL_{Se}, d	252	5.53
15	DF_{Se}, unitless	0.90	
16	$C_{Se,beef,site-slaughter,mean}$, mg/kg	2.6	
17	IR_{beef}, kg/d	0.220	
18	$F_{beef,site}$, unitless	0.157	
19	$C_{Se,beef,background,mean}$, mg/kg	0.220	0.170
20	EF, d/yr	350	
21	UCF_t, d/yr	365.25	
22	BW, kg	70	
23	$\Delta Dose_{Se,beef}$, mg/(kg·d)	0.0011	

Correlation Matrix: r

Row	(G)	IR_{fish} (H)	$F_{fish,site}$ (I)	1-EF (J)	BW (K)	IR_{beef} (L)	$F_{beef,site}$ (M)	$ADI_{Se,diet}$, transformed (N)	$ADI_{Se,supplements}$, transformed (O)
3	IR_{fish}								
4	$F_{fish,site}$	0.71							
5	1-EF	0	-0.50						
6	BW	0.50	0	0					
7	IR_{beef}	0	0	0	0.71				
8	$F_{beef,site}$	0	0	-0.50	0	0.50			
9	$ADI_{Se,diet}$, transformed	0.71	0	0	0.71	0.71	0		
10	$ADI_{Se,supplements}$, transformed	0.50	0	0	0	0	0	0.50	
11	An r of 0 applied to all variable pairs not tabulated.								

Row	r^2	|r|	Qualitative Interpretation
13	1.00	1.00	perfect
14	0.75	0.87	strong
15	0.50	0.71	moderate
16	0.25	0.50	weak
17	0	0	none

Toxicity Submodel

Row	Variable	Distribution or Value	Transformed Distribution or Value
20	$cLOAEL_{Se}$, mg/(kg·d)	0.023	
21	$cNOAEL_{Se}$, mg/(kg·d)	0.0153	
22	$Dose_{Se,background,0.95}$, mg/(kg·d)	0.0038	
23	$cNOAEL_{Se}/cLOAEL_{Se}$, unitless	0.67	-0.41
24	$cNOAEL_{Se}/Dose_{Se,background,0.95}$, unitless	4.0	1.39
25	$UF_{H,Se}$, unitless	3.06	1.12
26	$cRfD_{Se}$, mg/(kg·d)	0.0050	

Contribution Analysis

Row	Variable	Transformed Distribution	Distribution
20	$Contribution_{fish}$	0.0014	0.3467
21	$Contribution_{beef}$	0.0000	0.0000
22	$Contribution_{diet}$	0.0014	0.3516
23	$Contribution_{supplements}$	0.0012	0.3017
24	$Contribution_{total}$		1.0000

Cumulative Risk Model

Row	Variable	Distribution	Transformed Distribution
29	$ADI_{Se,diet}$, mg/d	0.178	0.131
30	P(supplements), unitless	0.88	
31	RANDOM 2	0.87	
32	P(Se_supplements), unitless	0.95	
33	RANDOM 3	0.94	
34	$ADI_{Se,supplements}$, mg/d	0.164	0.1634
35	BW, kg	70	
36	$Dose_{Se,diet}$, mg/(kg·d)	0.0025	
37	$HQ_{Se,diet}$, unitless	0.51	
38	$Dose_{Se,supplements}$, mg/(kg·d)	0.0023	
39	$Dose_{Se,background}$, mg/(kg·d)	0.0049	
40	$HQ_{Se,background}$, unitless	0.98	
41	$Dose_{Se,site}$, mg/(kg·d)	0.0085	
42	$HQ_{Se,site}$, unitless	1.71	

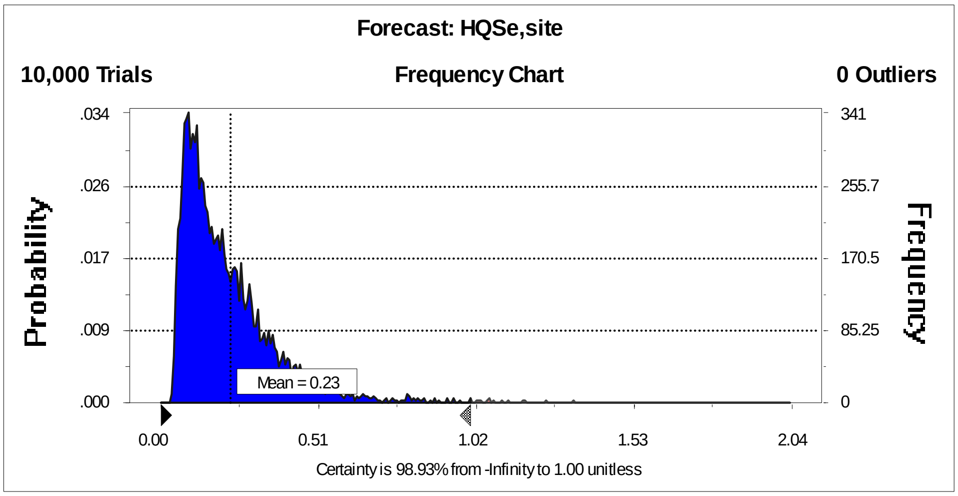
Crystal Ball Report

Simulation started on 11/11/99 at 17:38:36

Simulation stopped on 11/11/99 at 17:44:46

Forecast: $HQ_{Se,site}$ **Cell: H42**

Statistics:	Value
Trials	10,000
Mean	0.23
Standard Deviation	0.183

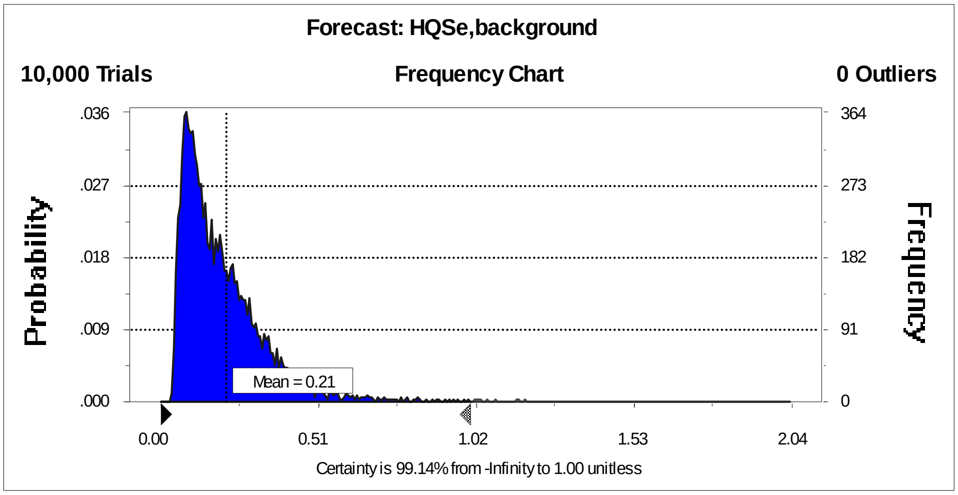


Percentile	unitless
0.01%	0.035
5.00%	0.064
10.00%	0.077
15.00%	0.087
20.00%	0.098
25.00%	0.109
30.00%	0.119
35.00%	0.132
40.00%	0.145
45.00%	0.160
50.00%	0.178
55.00%	0.195
60.00%	0.21
65.00%	0.24
70.00%	0.26
75.00%	0.29
80.00%	0.32
85.00%	0.36
90.00%	0.42
95.00%	0.53
98.00%	0.75
99.00%	1.02

99.90%	1.55
99.98%	1.71
99.99%	2.0

Forecast: $HQ_{Se,background}$ **Cell: H40**

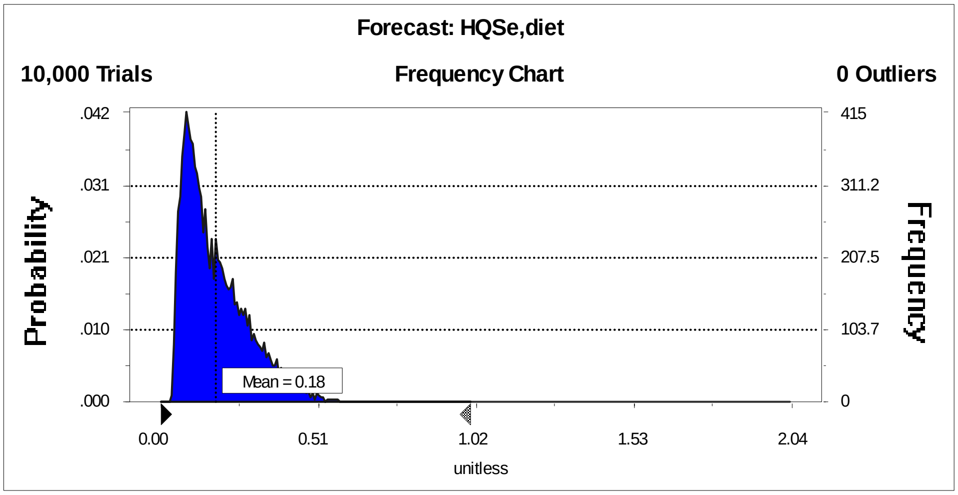
Statistics:	Value
Trials	10,000
Mean	0.21
Standard Deviation	0.171



Percentile	unitless
0.01%	0.034
5.00%	0.062
10.00%	0.074
15.00%	0.083
20.00%	0.093
25.00%	0.103
30.00%	0.113
35.00%	0.125
40.00%	0.137
45.00%	0.152
50.00%	0.169
55.00%	0.186
60.00%	0.20
65.00%	0.22
70.00%	0.25
75.00%	0.27
80.00%	0.30
85.00%	0.34
90.00%	0.39
95.00%	0.49
98.00%	0.70
99.00%	0.91
99.13%	0.98
99.90%	1.44
99.99%	2.0

Forecast: $HQ_{Se,diet}$ **Cell: H37**

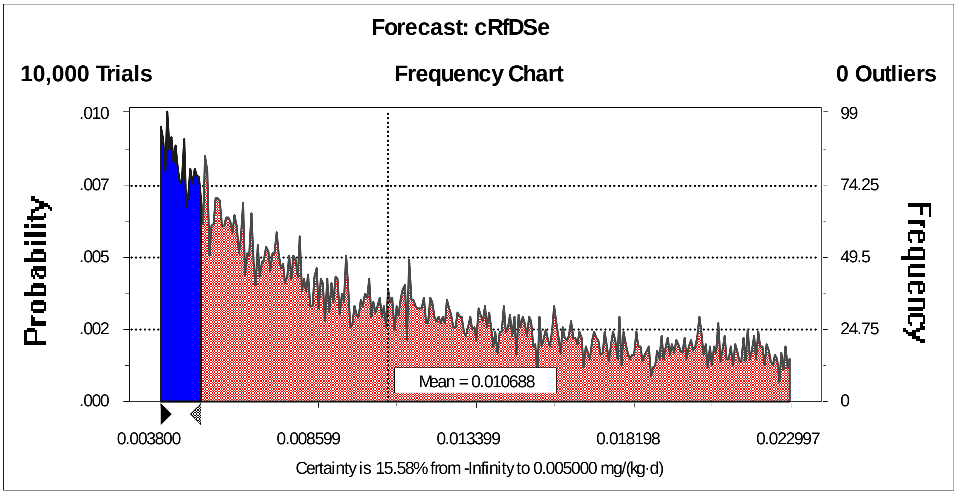
Statistics:	Value
Trials	10,000
Mean	0.180
Standard Deviation	0.105



Percentile	unitless
0.01%	0.034
5.00%	0.060
10.00%	0.071
15.00%	0.080
20.00%	0.088
25.00%	0.097
30.00%	0.106
35.00%	0.116
40.00%	0.126
45.00%	0.138
50.00%	0.151
55.00%	0.168
60.00%	0.184
65.00%	0.20
70.00%	0.22
75.00%	0.24
80.00%	0.27
85.00%	0.29
90.00%	0.33
95.00%	0.39
98.00%	0.46
99.00%	0.49
99.41%	0.51
99.90%	0.61
99.99%	0.64

Forecast: $cRfD_{Se}$ **Cell: H26**

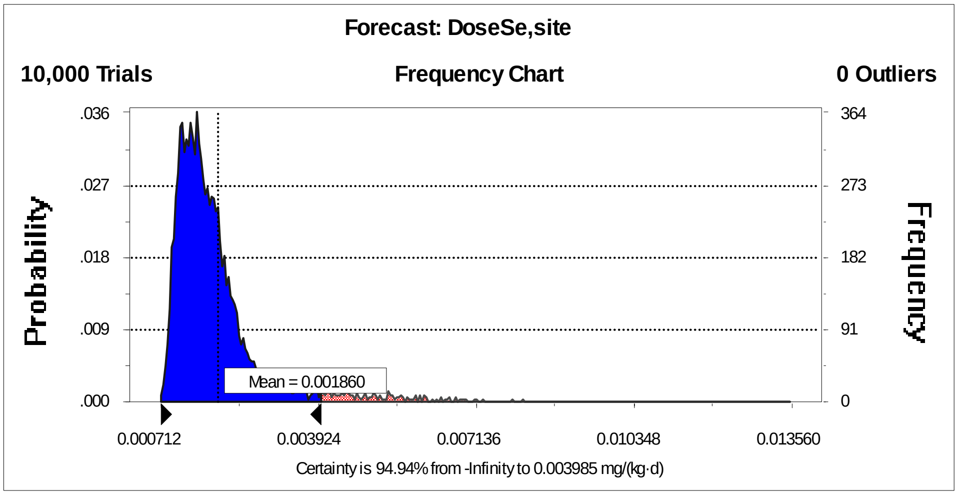
Statistics:	Value
Trials	10,000
Mean	0.0107
Standard Deviation	0.0054



Percentile	mg/(kg·d)
0.01%	0.0038
0.10%	0.0038
1.00%	0.0039
2.00%	0.0040
5.00%	0.0042
10.00%	0.0045
15.00%	0.0050
15.71%	0.0050
20.00%	0.0054
25.00%	0.0059
30.00%	0.0065
35.00%	0.0071
40.00%	0.0078
45.00%	0.0085
50.00%	0.0094
55.00%	0.0103
60.00%	0.0113
65.00%	0.0123
70.00%	0.0134
75.00%	0.0147
80.00%	0.0160
85.00%	0.0176
90.00%	0.0194
95.00%	0.021
99.99%	0.023

Forecast: Dose$_{Se,site}$ **Cell: H41**

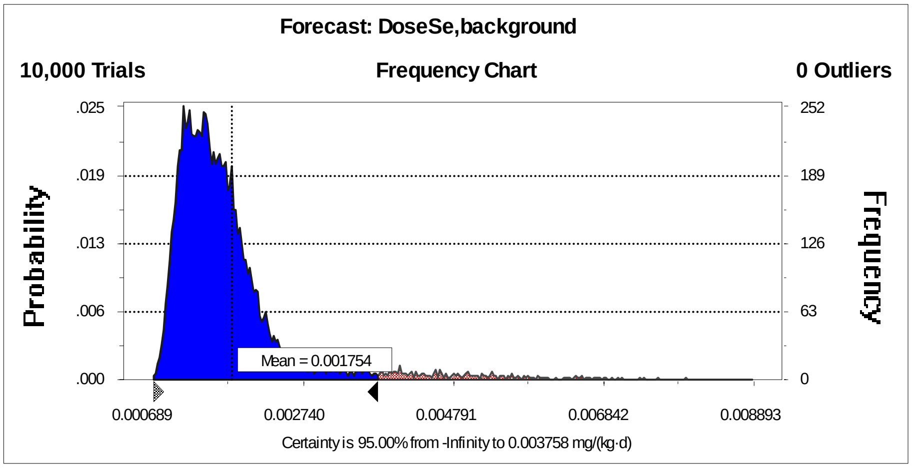
Statistics:	Value
Trials	10,000
Mean	0.00186
Standard Deviation	0.00102



Percentile	mg/(kg·d)
0.01%	0.00071
5.00%	0.00098
10.00%	0.00107
15.00%	0.00113
20.00%	0.00120
25.00%	0.00126
30.00%	0.00133
35.00%	0.00139
40.00%	0.00145
45.00%	0.00152
50.00%	0.00159
55.00%	0.00167
60.00%	0.00175
65.00%	0.00183
70.00%	0.00192
75.00%	0.0020
80.00%	0.0022
85.00%	0.0024
90.00%	0.0028
95.00%	0.0040
98.00%	0.0054
99.00%	0.0061
99.90%	0.0077
99.93%	0.0085
99.99%	0.0136

Forecast: $Dose_{Se,background}$ **Cell: H39**

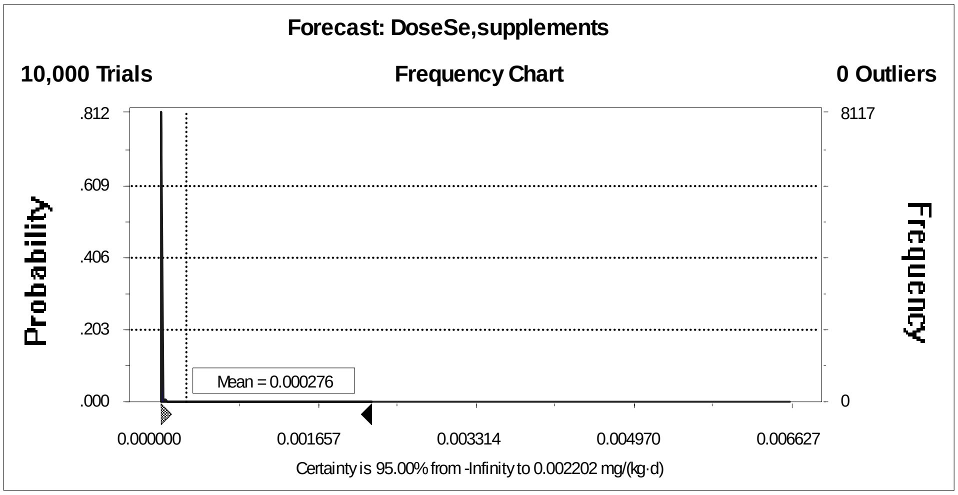
Statistics:	Value
Trials	10,000
Mean	0.00175
Standard Deviation	0.00095



Percentile	mg/(kg·d)
0.01%	0.00069
5.00%	0.00096
10.00%	0.00104
15.00%	0.00110
20.00%	0.00116
25.00%	0.00121
30.00%	0.00128
35.00%	0.00133
40.00%	0.00139
45.00%	0.00145
50.00%	0.00152
55.00%	0.00158
60.00%	0.00165
65.00%	0.00172
70.00%	0.00179
75.00%	0.00189
80.00%	0.0020
85.00%	0.0022
90.00%	0.0025
95.00%	0.0038
97.48%	0.0049
98.00%	0.0052
99.00%	0.0059
99.90%	0.0075
99.99%	0.0089

Forecast: Dose$_{Se,supplements}$ **Cell: H38**

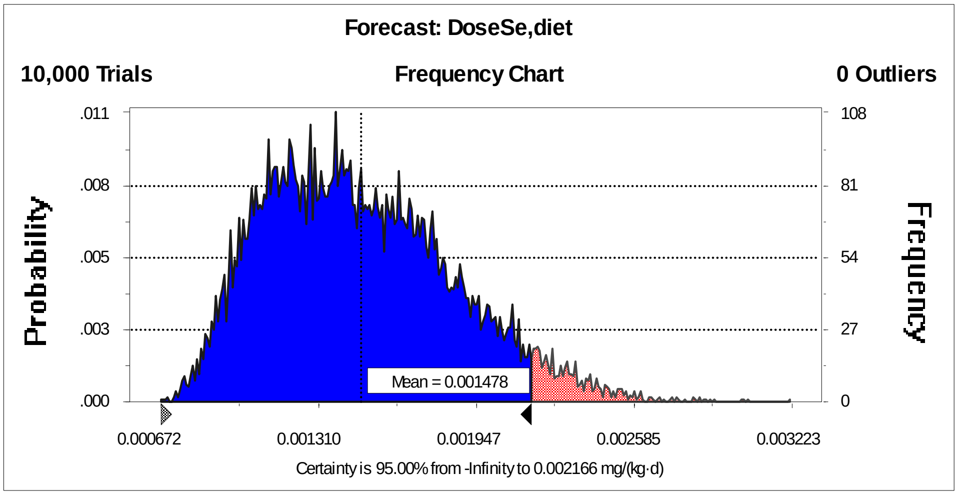
Statistics:	Value
Trials	10,000
Mean	0.00028
Standard Deviation	0.00083



Percentile	mg/(kg·d)
0.01%	0
5.00%	0
10.00%	0
15.00%	0
20.00%	0
25.00%	0
30.00%	0
35.00%	0
40.00%	0
45.00%	0
50.00%	0
55.00%	0
60.00%	0
65.00%	0
70.00%	0
75.00%	0
80.00%	0.0000109
85.00%	0.00022
90.00%	0.00091
95.00%	0.0022
95.40%	0.0023
98.00%	0.0035
99.00%	0.0041
99.90%	0.0056
99.99%	0.0066

Forecast: Dose$_{Se,diet}$ **Cell: H36**

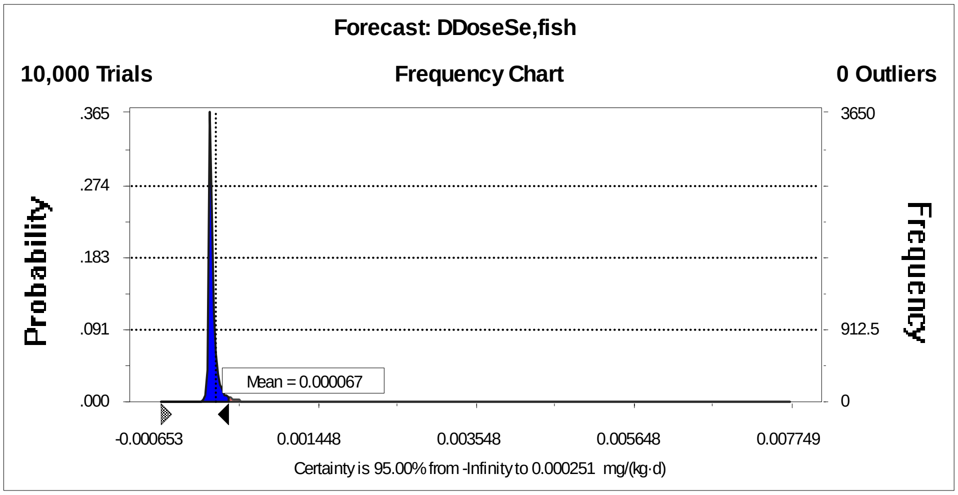
Statistics:	Value
Trials	10,000
Mean	0.00148
Standard Deviation	0.00038



Percentile	mg/(kg·d)
0.01%	0.00067
5.00%	0.00094
10.00%	0.00102
15.00%	0.00108
20.00%	0.00113
25.00%	0.00118
30.00%	0.00123
35.00%	0.00128
40.00%	0.00133
45.00%	0.00138
50.00%	0.00143
55.00%	0.00149
60.00%	0.00155
65.00%	0.00161
70.00%	0.00166
75.00%	0.00173
80.00%	0.00180
85.00%	0.00189
90.00%	0.0020
95.00%	0.0022
98.00%	0.0024
99.00%	0.0025
99.27%	0.0025
99.90%	0.0028
99.99%	0.0032

Forecast: $\Delta Dose_{Se,fish}$ **Cell: B20**

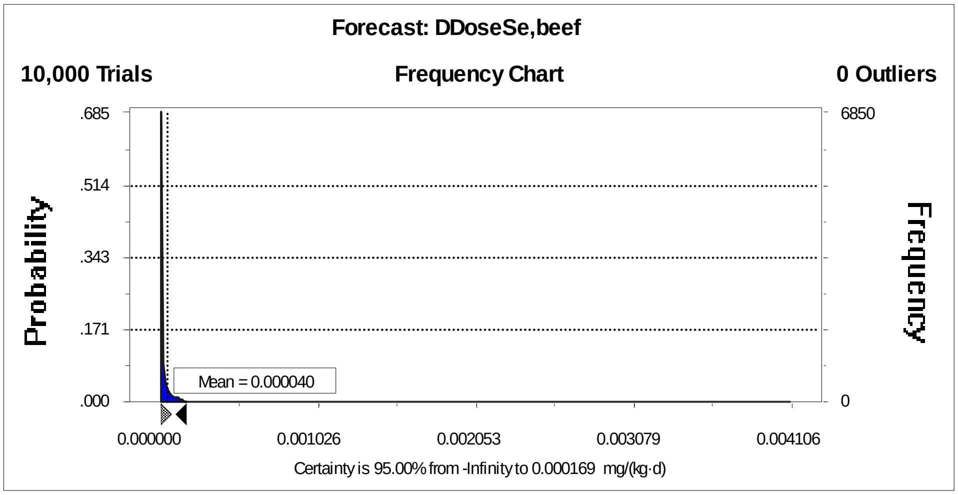
Statistics:	Value
Trials	10,000
Mean	0.000067
Standard Deviation	0.00020



Percentile	mg/(kg·d)
0.01%	-0.00065
5.00%	-0.0000128
10.00%	-0.00000100
15.00%	0.0000031
20.00%	0.0000061
25.00%	0.0000089
30.00%	0.0000117
35.00%	0.0000143
40.00%	0.0000174
45.00%	0.000021
50.00%	0.000025
55.00%	0.000030
60.00%	0.000035
65.00%	0.000042
70.00%	0.000051
75.00%	0.000062
80.00%	0.000078
85.00%	0.000100
90.00%	0.000141
95.00%	0.00025
98.00%	0.00044
99.00%	0.00076
99.90%	0.0021
99.94%	0.0025
99.99%	0.0077

Forecast: $\Delta Dose_{Se,beef}$ **Cell: E23**

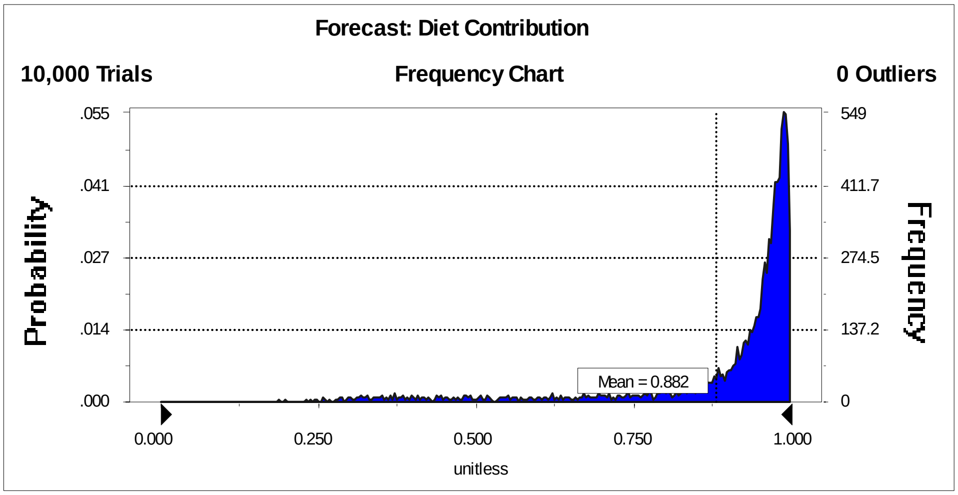
Statistics:	Value
Trials	10,000
Mean	0.000040
Standard Deviation	0.000154



Percentile	mg/(kg·d)
0.01%	0.000000000000043
5.00%	0.0000000040
10.00%	0.000000023
15.00%	0.000000067
20.00%	0.000000165
25.00%	0.00000035
30.00%	0.00000061
35.00%	0.00000103
40.00%	0.00000162
45.00%	0.0000024
50.00%	0.0000036
55.00%	0.0000052
60.00%	0.0000075
65.00%	0.0000107
70.00%	0.0000153
75.00%	0.000022
80.00%	0.000032
85.00%	0.000050
90.00%	0.000085
95.00%	0.000169
98.00%	0.00036
99.00%	0.00061
99.61%	0.00114
99.90%	0.0023
99.99%	0.0041

Forecast: Diet Contribution **Cell: L22**

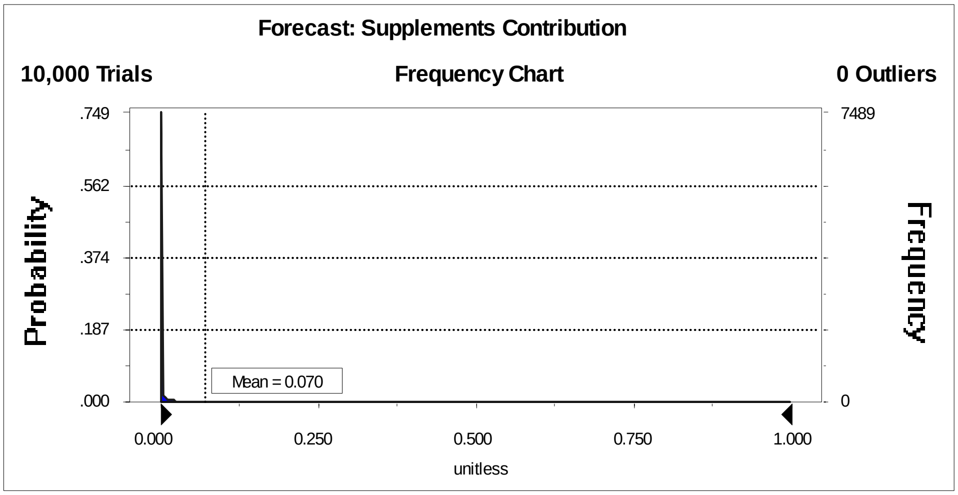
Statistics:	Value
Trials	10,000
Mean	0.88
Standard Deviation	0.178



Percentile	unitless
0.01%	0.131
3.36%	0.35
5.00%	0.41
10.00%	0.59
15.00%	0.74
20.00%	0.84
25.00%	0.88
30.00%	0.91
35.00%	0.93
40.00%	0.94
45.00%	0.95
50.00%	0.96
55.00%	0.97
60.00%	0.97
65.00%	0.97
70.00%	0.98
75.00%	0.98
80.00%	0.99
85.00%	0.99
90.00%	0.99
95.00%	1.00
98.00%	1.00
99.00%	1.00
99.90%	1.00
99.99%	1.00

Forecast: Supplements Contribution **Cell: L23**

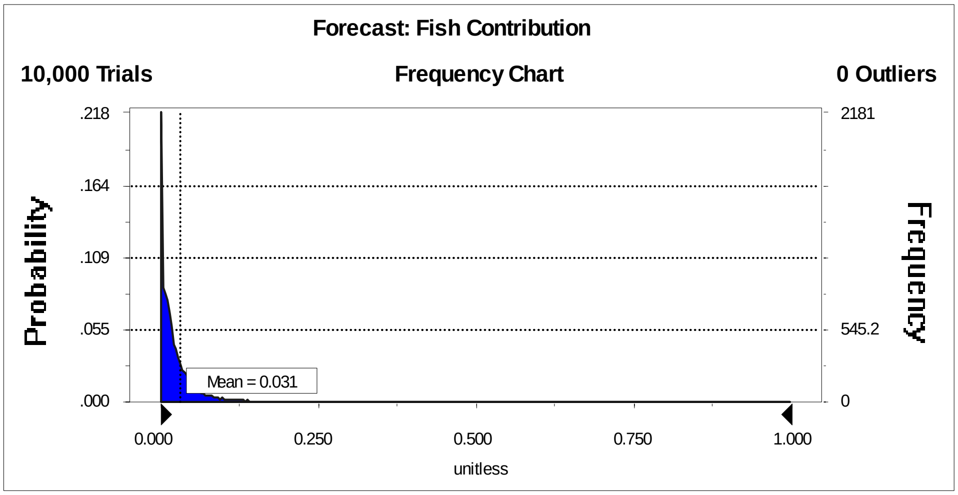
Statistics:	Value
Trials	10,000
Mean	0.070
Standard Deviation	0.174



Percentile	unitless
0.01%	0
5.00%	0
10.00%	0
15.00%	0
20.00%	0
25.00%	0
30.00%	0
35.00%	0
40.00%	0
45.00%	0
50.00%	0
55.00%	0
60.00%	0
65.00%	0
70.00%	0
75.00%	0.0035
80.00%	0.0172
85.00%	0.108
88.91%	0.30
90.00%	0.35
95.00%	0.56
98.00%	0.67
99.00%	0.71
99.90%	0.80
99.99%	0.82

Forecast: Fish Contribution **Cell: L20**

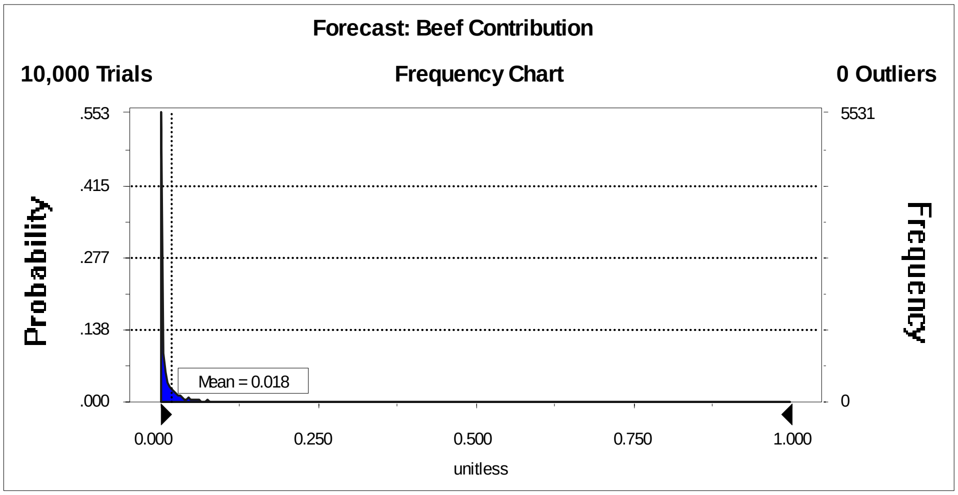
Statistics:	Value
Trials	10,000
Mean	0.031
Standard Deviation	0.055



Percentile	unitless
0.01%	0
5.00%	0
10.00%	0
15.00%	0.00051
20.00%	0.0027
25.00%	0.0046
30.00%	0.0065
35.00%	0.0085
40.00%	0.0105
45.00%	0.0126
50.00%	0.0151
55.00%	0.018
60.00%	0.021
65.00%	0.025
70.00%	0.029
75.00%	0.035
80.00%	0.042
85.00%	0.053
90.00%	0.069
95.00%	0.116
98.00%	0.20
99.00%	0.29
99.56%	0.35
99.90%	0.53
99.99%	0.68

Forecast: Beef Contribution **Cell: L21**

Statistics:	Value
Trials	10,000
Mean	0.0177
Standard Deviation	0.045



Percentile	unitless
0.01%	0
5.00%	0
10.00%	0
15.00%	0.00000032
20.00%	0.0000092
25.00%	0.000055
30.00%	0.000170
35.00%	0.00038
40.00%	0.00075
45.00%	0.00133
50.00%	0.0021
55.00%	0.0033
60.00%	0.0047
65.00%	0.0068
70.00%	0.0096
75.00%	0.0140
80.00%	0.020
85.00%	0.029
90.00%	0.048
95.00%	0.086
98.00%	0.160
99.00%	0.23
99.90%	0.46
99.99%	0.86

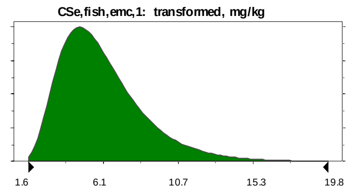
Assumptions

Assumption: $C_{Se,fish,East\_Mill\_Creek}$: transformed, mg/kg **Cell: C3**

Lognormal distribution with parameters:

Mean	6.1
Standard deviation	2.7

Selected range is from 0 to +Infinity
Mean value in simulation was 6.1
Back-transformation: $x_i = x_{i,T} + (-0.047)$

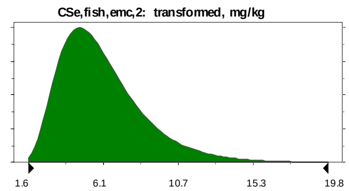


Assumption: $C_{Se,fish,East\_Mill\_Creek,2}$: transformed, mg/kg **Cell: C4**

Lognormal distribution with parameters:

Mean	6.1
Standard deviation	2.7

Selected range is from 0 to +Infinity
Mean value in simulation was 6.1
Back-transformation: $x_i = x_{i,T} + (-0.047)$

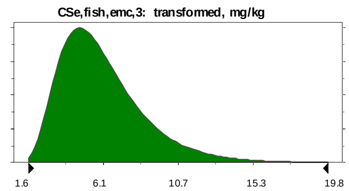


Assumption: $C_{Se,fish,East\_Mill\_Creek,3}$: transformed, mg/kg **Cell: C5**

Lognormal distribution with parameters:

Mean	6.1
Standard deviation	2.7

Selected range is from 0 to +Infinity
Mean value in simulation was 6.1
Back-transformation: $x_i = x_{i,T} + (-0.047)$

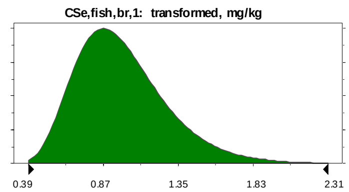


Assumption: $C_{Se,fish,Blackfoot\_River,1}$: transformed, mg/kg **Cell: C7**

Lognormal distribution with parameters:

Mean	0.99
Standard deviation	0.30

Selected range is from 0 to +Infinity
Mean value in simulation was 0.99
Back-transformation: $x_i = x_{i,T} + (-0.047)$

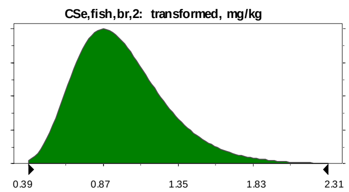


Assumption: $C_{Se,fish,Blackfoot\_River,2}$: transformed, mg/kg **Cell: C8**

Lognormal distribution with parameters:

Mean	0.99
Standard deviation	0.30

Selected range is from 0 to +Infinity
Mean value in simulation was 0.99
Back-transformation: $x_i = x_{i,T} + (-0.047)$

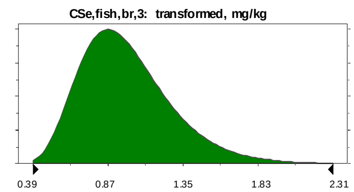


Assumption: $C_{Se,fish,Blackfoot\_River,3}$: transformed, mg/kg **Cell: C9**

Lognormal distribution with parameters:

Mean	0.99
Standard deviation	0.30

Selected range is from 0 to +Infinity
Mean value in simulation was 0.99
Back-transformation: $x_i = x_{i,T} + (-0.047)$

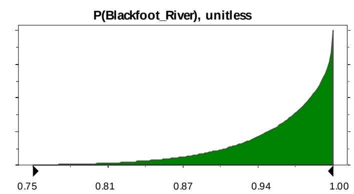


Assumption: P(Blackfoot_River), unitless **Cell: B11**

Beta distribution with parameters:

Alpha	17.3
Beta	0.91
Scale	1.00

Selected range is from 0 to 1.00
Mean value in simulation was 0.95

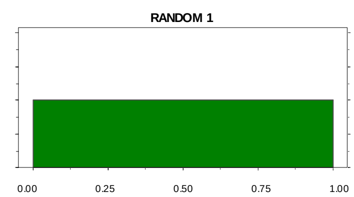


Assumption: RANDOM 1 **Cell: B12**

Uniform distribution with parameters:

Minimum	0
Maximum	1.00

Mean value in simulation was 0.50



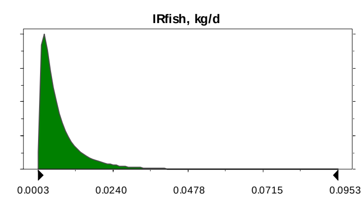
Assumption: IR_{fish}, kg/d **Cell: B14**

Lognormal distribution with parameters:

Mean	0.0080
Standard deviation	0.0103

Selected range is from 0 to +Infinity
Mean value in simulation was 0.0081
Correlated with:

$F_{fish,site}$, unitless (B15)	0.71
BW, kg (B19)	0.50
$ADI_{Se,diet}$: transformed, mg/d (I29)	0.71
$ADI_{Se,supplements}$: transformed, mg/d (I34)	0.50



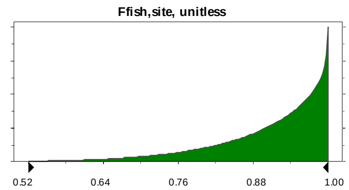
Assumption: $F_{fish,site}$, unitless **Cell: B15**

Beta distribution with parameters:

Alpha	7.8
Beta	0.87
Scale	1.00

Selected range is from 0 to 1.00
Mean value in simulation was 0.90
Correlated with:

1-EF, d/yr (C17)	-0.50
IR_{fish}, kg/d (B14)	0.71

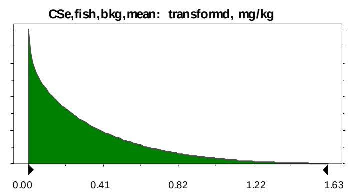


Assumption: $C_{Se,fish,background,mean}$: transformed, mg/kg **Cell: C16**

Beta distribution with parameters:

Alpha	0.90
Beta	7.7
Scale	3.26

Selected range is from 0 to 3.26
Mean value in simulation was 0.34
Back-transformation: $x_i = x_{i,T} + 0.140$



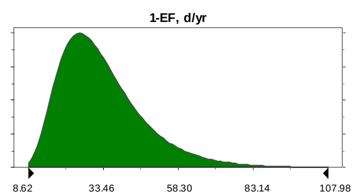
Assumption: 1-EF, d/yr **Cell: C17**

Lognormal distribution with parameters:

5% - tile	15.25
50% - tile	30.5

Selected range is from 0 to +Infinity
Mean value in simulation was 33.15
Correlated with:

$F_{fish,site}$, unitless (B15)	-0.50
$F_{beef,site}$, unitless (E18)	-0.50



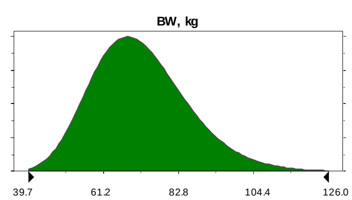
Assumption: BW, kg **Cell: B19**

Lognormal distribution with parameters:

Mean	72
Standard deviation	14.0

Selected range is from 0 to +Infinity
Mean value in simulation was 72
Correlated with:

$ADI_{Se,diet}$: transformed, mg/d (I29)	0.71
IR_{fish}, kg/d (B14)	0.50
IR_{beef}, kg/d (E17)	0.71

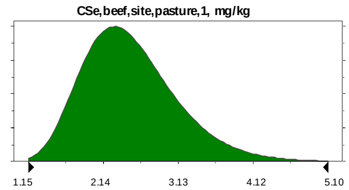


Assumption: $C_{Se,beef,site,pasture,1}$, mg/kg **Cell: E3**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

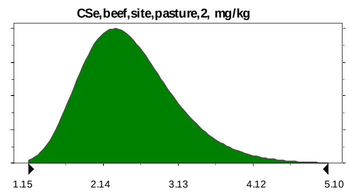


Assumption: $C_{Se,beef,site,pasture,2}$, mg/kg **Cell: E4**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

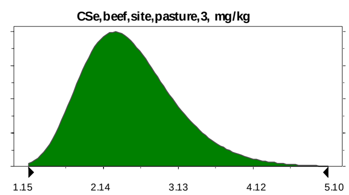


Assumption: $C_{Se,beef,site,pasture,3}$, mg/kg **Cell: E5**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

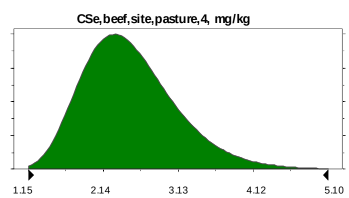


Assumption: $C_{Se,beef,site,pasture,4}$, mg/kg **Cell: E6**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

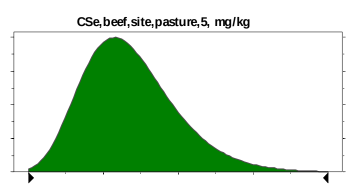


Assumption: $C_{Se,beef,site,pasture,5}$, mg/kg **Cell: E7**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

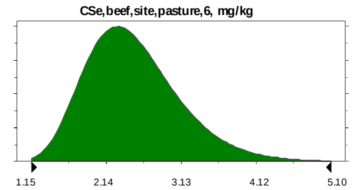


Assumption: $C_{Se,beef,site,pasture,6}$, mg/kg **Cell: E8**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

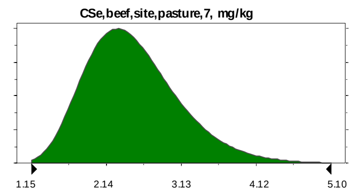


Assumption: $C_{Se,beef,site,pasture,7}$, mg/kg **Cell: E9**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

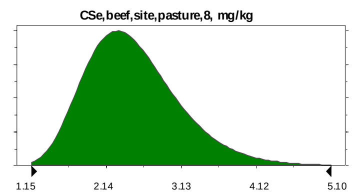


Assumption: $C_{Se,beef,site,pasture,8}$, mg/kg **Cell: E10**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

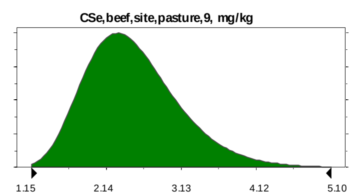


Assumption: $C_{Se,beef,site,pasture,9}$, mg/kg **Cell: E11**

Lognormal distribution with parameters:

Mean	2.5
Standard deviation	0.63

Selected range is from 0 to +Infinity
Mean value in simulation was 2.5

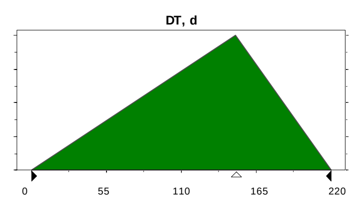


Assumption: DT, d **Cell: E13**

Triangular distribution with parameters:

Minimum	0
Likeliest	150
Maximum	220

Selected range is from 0 to 220
Mean value in simulation was 123



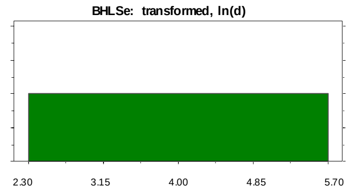
Assumption: BHL_{Se}: transformed, ln(d) **Cell: F14**

Uniform distribution with parameters:

Minimum	2.30
Maximum	5.70

Mean value in simulation was 4.0

Back-transformation: $x_i = e^{x_{i,T}}$



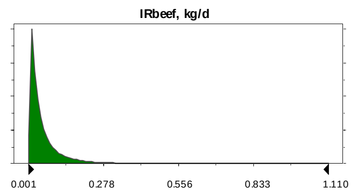
Assumption: IR_{beef}, kg/d **Cell: E17**

Lognormal distribution with parameters:

Mean	0.063
Standard deviation	0.112

Selected range is from 0 to +Infinity

Mean value in simulation was 0.062



Correlated with:

BW, kg (B19)	0.71
$F_{beef,site}$, unitless (E18)	0.50
$ADI_{Se,diet}$: transformed, mg/d (I29)	0.71

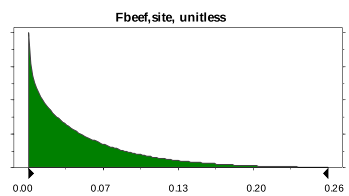
Assumption: $F_{beef,site}$, unitless **Cell: E18**

Beta distribution with parameters:

Alpha	0.86
Beta	16.0
Scale	1.00

Selected range is from 0 to 1.00

Mean value in simulation was 0.050



Correlated with:

1-EF, d/yr (C17)	-0.50
IR_{beef}, kg/d (E17)	0.50

Assumption: $C_{Se,beef,background,mean}$: transformed, mg/kg **Cell: F19**

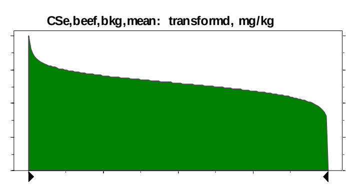
Beta distribution with parameters:

Alpha	0.94
Beta	1.10
Scale	0.37

Selected range is from 0 to 0.37

Mean value in simulation was 0.172

Back-transformation: $x_i = x_{i,T} + 0.050$



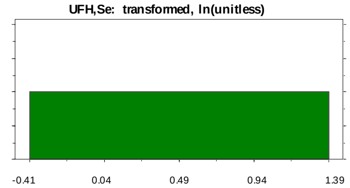
Assumption: $UF_{H,Se}$: transformed, ln(unitless) **Cell: I25**

Uniform distribution with parameters:

Minimum	-0.41	(=I23)
Maximum	1.39	(=I24)

Mean value in simulation was 0.49

Back-transformation: $x_i = e^{x_{i,T}}$



Assumption: $ADI_{Se,diet}$: transformed, mg/d **Cell: I29**

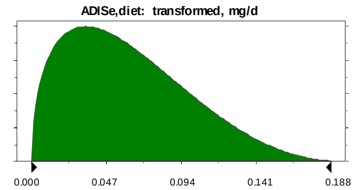
Beta distribution with parameters:

Alpha	1.50
Beta	3.5
Scale	0.203

Selected range is from 0 to 0.203

Mean value in simulation was 0.061

Back-transformation: $x_i = x_{i,T} + 0.047$



Correlated with:

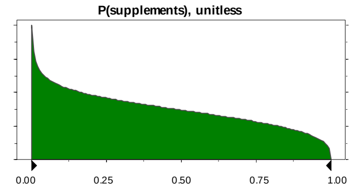
BW, kg (B19)	0.71
IR_{fish}, kg/d (B14)	0.71
IR_{beef}, kg/d (E17)	0.71
$ADI_{Se,supplements}$: transformed, mg/d (I34)	0.50

Assumption: P(supplements), unitless **Cell: H30**

Beta distribution with parameters:

Alpha	0.87
Beta	1.31
Scale	1.00

Selected range is from 0 to 1.00
Mean value in simulation was 0.40

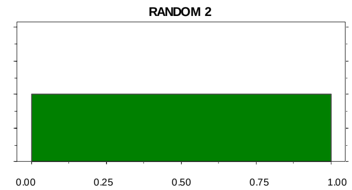


Assumption: RANDOM 2 **Cell: H31**

Uniform distribution with parameters:

Minimum	0
Maximum	1.00

Mean value in simulation was 0.50

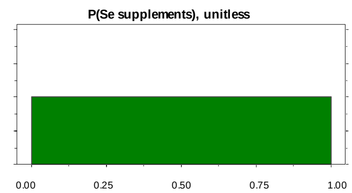


Assumption: P(Se_supplements), unitless **Cell: H32**

Uniform distribution with parameters:

Minimum	0
Maximum	1.00

Mean value in simulation was 0.50

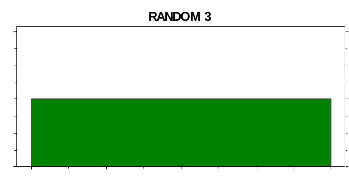


Assumption: RANDOM 3 **Cell: H33**

Uniform distribution with parameters:

Minimum	0
Maximum	1.00

Mean value in simulation was 0.50



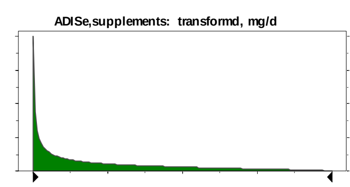
Assumption: $ADI_{Se,supplements}$: transformed, mg/d **Cell: I34**

Beta distribution with parameters:

Alpha	0.46
Beta	1.40
Scale	0.3994

Selected range is from 0 to 0.3994
Mean value in simulation was 0.100
Back-transformation: $x_i = x_{i,T} + 0.00060$
Correlated with:

$ADI_{Se,diet}$: transformed, mg/d (I29)	0.50
IR_{fish}, kg/d (B14)	0.50



Sensitivity Analysis

Sensitivity Data — **$HQ_{Se,site}$**

Input Variable	Contribution to Uncertainty: Incremental	Contribution to Uncertainty: Cumulative
$UF_{H,Se}$, unitless	64.0%	64.0%
$ADI_{Se,diet}$, mg/d	21.6%	85.6%
BW, kg	7.7%	93.3%
$ADI_{Se,supplements}$, mg/d	5.9%	99.2%
$C_{Se,fish,site}$, mg/kg	0.2%	99.4%
$F_{beef,site}$, unitless	0.2%	99.5%
IR_{fish}, kg/d	0.2%	99.7%
$C_{Se,beef,site,pasture}$, mg/kg	0.1%	99.8%
IR_{beef}, kg/d	0.1%	99.9%
$C_{Se,fish,background,mean}$, mg/kg	0.0%	100.0%
$F_{fish,site}$, unitless	0.0%	100.0%
BHL_{Se}, d	0.0%	100.0%
DT, d	0.0%	100.0%
$C_{Se,beef,background,mean}$, mg/kg	0.0%	100.0%
1-EF, d/yr	0.0%	100.0%

Sensitivity Data — **$HQ_{Se,background}$**

Input Variable	Contribution to Uncertainty: Incremental	Contribution to Uncertainty: Cumulative
$UF_{H,Se}$, unitless	62.5%	62.5%
$ADI_{Se,diet}$, mg/d	23.8%	86.3%
BW, kg	7.5%	93.9%
$ADI_{Se,supplements}$, mg/d	6.1%	100.0%

Sensitivity Data — **$HQ_{Se,diet}$**

Input Variable	Contribution to Uncertainty: Incremental	Contribution to Uncertainty: Cumulative
$UF_{H,Se}$, unitless	65.5%	65.5%
$ADI_{Se,diet}$, mg/d	26.8%	92.3%
BW, kg	7.7%	100.0%

TABLE 4-1

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - RED-WINGED BLACKBIRD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00084	9.3	3,461	3	0.364	3	1.1	0.014	0.00006	0.00001	1.1	3.0	0.4
Selenium	0.26	2.9	1,261	328	0.016	0.046	19.2	0.004	0.01828	0.0000032	19.2	0.8	24.0
												Total HI:	**24.4**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-2

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - SNIPE
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATION

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00084	9.3	3,461	3	0.364	3	0.9	0.106	0.00005	0.00001	1.0	2.6	0.4
Selenium	0.26	2.9	1,261	328	0.016	0.046	88.3	0.033	0.01579	0.0000027	88.4	0.7	126.3
												Total HI:	**126.6**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-3

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - MALLARD
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATION

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00084	9.3	3,461	3	0.364	3	0.0030	0.000060	0.00000017	0.000000028	0.0030	1.50	0.0020
Selenium	0.26	2.9	1,261	328	0.016	0.046	0.029	0.000019	0.000051	0.0000000088	0.029	0.39	0.075
												Total HI:	**0.1**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-4

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - MUSKRAT
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATION

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00084	9.3	3,461	3	0.364	3	1.4	0.080	0.00008	0.00001	1.5	0.77	1.9
Selenium	0.26	2.9	1,261	328	0.016	0.046	6.8	0.025	0.02621	0.0000027	6.8	0.2	42.7
												Total HI:	**44.6**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-5

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - MOOSE ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATION

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00084	9.3	3,461	3	0.364	3	0.00050	0.0000061	0.000000088	0.0000000022	0.00051	0.16	0.0032
Selenium	0.26	2.9	1,261	328	0.016	0.046	0.0000069	0.0000019	0.000027	0.00000000067	0.000036	0.033	0.0011
												Total HI:	**0.004**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-6

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - RED-WINGED BLACKBIRD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATION

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0052	130	3,461	18	0.364	47	14.6	0.197	0.00037	0.00014	14.8	3.0	4.9
Selenium	0.12	69	1,261	151	0.016	1.1	9.2	0.105	0.00844	0.00008	9.3	0.8	11.6
												Total HI:	**16.5**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-7

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - SNIPE ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATION

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0052	130	3,461	18	0.364	47	4.6	1.191	0.00025	0.00010	5.8	2.6	2.2
Selenium	0.12	69	1,261	151	0.016	1.1	32.6	0.632	0.00583	0.00005	33.3	0.7	47.5
												Total HI:	**49.8**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-8

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MALLARD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATION

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0052	130	3,461	18	0.364	47	0.022	0.00048	0.00000059	0.00000022	0.023	1.50	0.015
Selenium	0.12	69	1,261	151	0.016	1.1	0.0082	0.00025	0.000014	0.00000012	0.0084	0.39	0.022
												Total HI:	**0.04**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.
[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).
[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).
[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).
[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).
[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).
[g]Daily dose from all dietary food items.
[h]Daily dose from incidental ingestion of sediment.
[i]Daily dose from water consumption.
[j]Daily dose from dermal contact with sediment or water.
[k]Daily dose from all exposure pathways.
[l]Refer to Table H-12 for derivation of ecological toxicity reference values.
[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-9

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MUSKRAT
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0052	130	3,461	18	0.364	47	18.9	1.117	0.00052	0.00012	20.0	0.77	26.0
Selenium	0.12	69	1,261	151	0.016	1.1	3.6	0.593	0.01210	0.00006	4.2	0.2	26.0
												Total HI:	**52.0**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-10

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MOOSE ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0052	130	3,461	18	0.364	47	0.0035	0.000042	0.00000027	0.000000015	0.0035	0.16	0.022
Selenium	0.12	69	1,261	151	0.016	1.1	0.000082	0.000023	0.0000063	0.0000000080	0.00011	0.033	0.0033
												Total HI:	**0.03**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-11

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - RED-WINGED BLACKBIRD
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0083	1.33	3,461	29	0.364	0.48	1.8	0.002	0.00058	0.0000015	1.8	3.0	0.6
Selenium	0.030	9	1,261	38	0.016	0.14	2.3	0.014	0.00211	0.000010	2.3	0.8	2.8
												Total HI:	**3.4**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-12

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - SNIPE
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0083	1.33	3,461	29	0.364	0	7.7	0.015	0.00050	0.0000012	7.8	2.6	3.0
Selenium	0.030	9	1,261	38	0.016	0.1	10.2	0.103	0.00182	0.00001	10.3	0.7	14.7
												Total HI:	**17.7**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-13

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - MALLARD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0083	1.33	3,461	29	0.364	0.48	0.0084	0.000024	0.0000047	0.000000011	0.0084	1.5	0.0056
Selenium	0.030	9	1,261	38	0.016	0.14	0.010	0.00017	0.000017	0.000000078	0.010	0.39	0.026
												Total HI:	**0.03**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-14

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - MUSKRAT
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0083	1.33	3,461	29	0.364	0	0.8	0.011	0.00084	0.0000012	0.8	0.77	1.0
Selenium	0.030	9	1,261	38	0.016	0.1	0.8	0.077	0.00302	0.00001	0.9	0.2	5.7
												Total HI:	**6.8**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-15

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - MOOSE ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0083	1.33	3,461	29	0.364	0.48	0.00021	0.0000026	0.0000026	0.00000000092	0.00022	0.16	0.0014
Selenium	0.030	9	1,261	38	0.016	0.14	0.000064	0.000018	0.0000095	0.0000000063	0.000091	0.033	0.0028
												Total HI:	**0.004**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-16

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR STATE LAND CREEK - RED-WINGED BLACKBIRD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0035	10	3,461	12	0.364	4	1.7	0.015	0.00025	0.00001	1.8	3.0	0.6
Selenium	0.029	9.4	1,261	37	0.016	0.2	2.2	0.014	0.00204	0.00001	2.2	0.8	2.7
												Total HI:	**3.3**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-17

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - SNIPE
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0035	10	3,461	12	0.364	4	3.3	0.114	0.00021	0.00001	3.5	2.6	1.3
Selenium	0.029	9.4	1,261	37	0.016	0.2	9.9	0.108	0.00176	0.00001	10.0	0.7	14.2
												Total HI:	**15.6**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-18

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - MALLARD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0035	10	3,461	12	0.364	4	0.0028	0.000046	0.00000049	0.000000022	0.0029	1.5	0.0019
Selenium	0.029	9.4	1,261	37	0.016	0.2	0.0024	0.000043	0.0000041	0.000000020	0.0024	0.39	0.0063
												Total HI:	**0.008**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-19

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - MUSKRAT
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0035	10	3,461	12	0.364	4	1.7	0.086	0.00035	0.00001	1.8	0.77	2.3
Selenium	0.029	9.4	1,261	37	0.016	0.2	0.8	0.081	0.00292	0.00001	0.9	0.2	5.6
												Total HI:	**7.9**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-20

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - MOOSE
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0035	10	3,461	12	0.364	4	0.00054	0.0000065	0.00000037	0.0000000023	0.00054	0.16	0.0034
Selenium	0.029	9.4	1,261	37	0.016	0.2	0.000022	0.0000061	0.0000031	0.0000000022	0.000031	0.033	0.0010
												Total HI:	**0.004**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-21

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - RED-WINGED BLACKBIRD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0041	4.6	3,461	14	0.364	2	1.3	0.007	0.00029	0.00001	1.3	3.0	0.4
Selenium	0.012	1.4	1,261	15	0.016	0.0	0.9	0.002	0.00084	0.0000015	0.9	0.8	1.1
												Total HI:	**1.6**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-22

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - SNIPE
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0041	4.6	3,461	14	0.364	2	3.9	0.053	0.00025	0.0000043	3.9	2.6	1.5
Selenium	0.012	1.4	1,261	15	0.016	0.022	4.1	0.016	0.00073	0.0000013	4.1	0.7	5.8
												Total HI:	**7.4**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-23

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - MALLARD ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0041	4.6	3,461	14	0.364	2	0.019	0.00021	0.0000058	0.00000010	0.019	1.5	0.012
Selenium	0.012	1.4	1,261	15	0.016	0.022	0.010	0.000064	0.000017	0.000000030	0.0098	0.39	0.025
												Total HI:	**0.04**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-24

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - MUSKRAT ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0041	4.6	3,461	14	0.364	2	0.9	0.040	0.00041	0.0000043	1.0	0.77	1.3
Selenium	0.012	1.4	1,261	15	0.016	0.022	0.3	0.012	0.00121	0.0000013	0.3	0.2	2.1
												Total HI:	**3.4**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-25

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MOOSE
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0041	4.6	3,461	14	0.364	2	0.0025	0.000030	0.0000043	0.000000011	0.0025	0.16	0.016
Selenium	0.012	1.4	1,261	15	0.016	0.022	0.000033	0.0000091	0.000013	0.0000000032	0.000055	0.033	0.0017
												Total HI:	**0.02**

[a]Based on the maximum or 95% UCL of the mean concentration detected in site water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-26

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - RED-WINGED BLACKBIRD ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00043	9.3	3,461	1	0.364	3	1.1	0.014	0.00003	0.00001	1.1	3.0	0.4
Selenium	0.17	2.9	1,261	214	0.016	0.046	12.5	0.004	0.01195	0.0000032	12.6	0.8	15.7
												Total HI:	**16.1**

[a]Based on the mean concentration detected in site water.
[b]Based on the mean concentration detected in site sediment (values are in dry weight).
[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).
[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).
[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).
[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).
[g]Daily dose from all dietary food items.
[h]Daily dose from incidental ingestion of sediment.
[i]Daily dose from water consumption.
[j]Daily dose from dermal contact with sediment or water.
[k]Daily dose from all exposure pathways.
[l]Refer to Table H-12 for derivation of ecological toxicity reference values.
[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-27

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - SNIPE
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00043	9.3	3,461	1	0.364	3	0.5	0.106	0.00003	0.00001	0.6	2.6	0.2
Selenium	0.17	2.9	1,261	214	0.016	0.0	57.8	0.033	0.01033	0.0000027	57.8	0.7	82.6
												Total HI:	**82.8**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-28

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - MALLARD
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00043	9.3	3,461	1	0.364	3	0.0028	0.000060	0.000000085	0.000000028	0.0029	1.5	0.0019
Selenium	0.17	2.9	1,261	214	0.016	0.046	0.019	0.000019	0.000034	0.0000000088	0.019	0.39	0.049
												Total HI:	**0.1**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-29

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - MUSKRAT ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00043	9.3	3,461	1	0.364	3	1.4	0.080	0.00004	0.00001	1.4	0.77	1.9
Selenium	0.17	2.9	1,261	214	0.016	0.046	4.4	0.025	0.01714	0.0000027	4.5	0.2	28.0
												Total HI:	**29.9**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-30

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR EAST MILL CREEK - MOOSE ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.00043	9.3	3,461	1	0.364	3	0.00050	0.0000061	0.000000045	0.0000000022	0.00051	0.16	0.0032
Selenium	0.17	2.9	1,261	214	0.016	0.046	0.0000069	0.0000019	0.000018	0.00000000067	0.000027	0.033	0.00081
												Total HI:	**0.004**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-31

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - RED-WINGED BLACKBIRD ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0028	49	3,461	10	0.364	18	5.7	0.074	0.00020	0.00005	5.7	3.0	1.9
Selenium	0.061	26	1,261	77	0.016	0.4	4.6	0.039	0.00429	0.00003	4.7	0.8	5.8
												Total HI:	**7.7**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC Transfer coefficient
HI Hazard index
HQ Hazard quotient
mg/kg Milligrams per kilogram
mg/kg-d Milligrams per kilogram per day
mg/L Milligrams per liter

TABLE 4-32

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - SNIPE ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0028	49	3,461	10	0.364	18	2.4	0.449	0.00014	0.00004	2.8	2.6	1.1
Selenium	0.061	26	1,261	77	0.016	0.4	16.6	0.238	0.00296	0.00002	16.8	0.7	24.0
												Total HI:	**25.1**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-33

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MALLARD
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0028	49	3,461	10	0.364	18	0.0086	0.00018	0.00000032	0.000000085	0.0088	1.5	0.0059
Selenium	0.061	26	1,261	77	0.016	0.4	0.0041	0.000095	0.0000069	0.000000045	0.0042	0.39	0.011
												Total HI:	**0.02**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-34

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MUSKRAT
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0028	49	3,461	10	0.364	18	7.2	0.421	0.00028	0.00005	7.6	0.77	9.9
Selenium	0.061	26	1,261	77	0.016	0.4	1.7	0.223	0.00615	0.00002	2.0	0.2	12.4
												Total HI:	**22.2**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-35

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MOOSE ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0028	49	3,461	10	0.364	18	0.0013	0.000016	0.00000015	0.0000000057	0.0013	0.16	0.0083
Selenium	0.061	26	1,261	77	0.016	0.4	0.000031	0.0000085	0.0000032	0.0000000030	0.000042	0.033	0.0013
												Total HI:	**0.01**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-36

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - RED-WINGED BLACKBIRD
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	0.48	3,461	10	0.364	0.17	0.66	0.001	0.00021	0.00000053	0.66	3.0	0.22
Selenium	0.010	3.00	1,261	13	0.016	0.048	0.75	0.005	0.00070	0.0000033	0.76	0.80	0.94
												Total HI:	**1.2**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).
The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-37

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - SNIPE
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	0.48	3,461	10	0.364	0.17	2.8	0.005	0.00018	0.00000045	2.8	2.6	1.1
Selenium	0.010	3.00	1,261	13	0.016	0.048	3.4	0.034	0.00061	0.0000028	3.4	0.7	4.9
												Total HI:	**6.0**

[a]Based on the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-38

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - MALLARD
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	0.48	3,461	10	0.364	0.17	0.0030	0.0000088	0.0000017	0.0000000041	0.0030	1.5	0.0020
Selenium	0.010	3.00	1,261	13	0.016	0.048	0.0033	0.000055	0.0000056	0.000000026	0.0034	0.4	0.0086
												Total HI:	**0.01**

[a]Based on the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-39

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - MUSKRAT ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	0.48	3,461	10	0.364	0.17	0.3	0.004	0.00030	0.00000045	0.3	0.77	0.4
Selenium	0.010	3.00	1,261	13	0.016	0.048	0.3	0.026	0.00101	0.0000028	0.3	0.2	1.9
												Total HI:	**2.3**

[a]Based on the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-40

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE TAILINGS PONDS - MOOSE ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	0.48	3,461	10	0.364	0.17	0.000077	0.00000094	0.00000095	0.00000000033	0.000079	0.16	0.00050
Selenium	0.010	3.00	1,261	13	0.016	0.048	0.000021	0.0000059	0.0000032	0.0000000021	0.000030	0.033	0.00092
												Total HI:	**0.001**

[a]Based on the mean concentration detected in site water.

[b]Sediment samples were not collected from the Tailings Ponds; sediment concentrations were estimated from surface water concentrations based upon the sediment-water partition coefficient (Kd). The highest Kd values reported in the literature (cadmium = 160; selenium = 300) were used. Estimated values are in dry weight.

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-41

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR STATE LAND CREEK - RED-WINGED BLACKBIRD ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0031	10.00	3,461	11	0.364	4	1.7	0.015	0.00022	0.00001	1.7	3.0	0.6
Selenium	0.015	9.40	1,261	19	0.016	0.2	1.1	0.014	0.00105	0.00001	1.2	0.8	1.5
												Total HI:	**2.0**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-42

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - SNIPE
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0031	10.00	3,461	11	0.364	4	3.0	0.114	0.00019	0.00001	3.1	2.6	1.2
Selenium	0.015	9.40	1,261	19	0.016	0.2	5.1	0.108	0.00091	0.00001	5.2	0.7	7.4
												Total HI:	**8.6**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-43

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - MALLARD ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0031	10.00	3,461	11	0.364	4	0.0028	0.000046	0.00000044	0.000000022	0.0028	1.5	0.0019
Selenium	0.015	9.40	1,261	19	0.016	0.2	0.0013	0.000043	0.0000021	0.000000020	0.0013	0.4	0.0034
												Total HI:	**0.005**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-44

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - MUSKRAT
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0031	10.00	3,461	11	0.364	4	1.6	0.086	0.00031	0.00001	1.7	0.77	2.3
Selenium	0.015	9.40	1,261	19	0.016	0.2	0.4	0.081	0.00151	0.00001	0.5	0.2	3.3
												Total HI:	**5.6**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-45

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STATE LAND CREEK - MOOSE
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.0031	10.00	3,461	11	0.364	4	0.00054	0.0000065	0.00000033	0.0000000023	0.00054	0.16	0.0034
Selenium	0.015	9.40	1,261	19	0.016	0.2	0.000022	0.0000061	0.0000016	0.0000000022	0.000030	0.033	0.00091
												Total HI:	**0.004**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-46

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - RED-WINGED BLACKBIRD
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	3.5	3,461	10	0.364	1	1.0	0.005	0.00021	0.0000038	1.0	3.0	0.3
Selenium	0.0042	1.0	1,261	5	0.016	0.016	0.3	0.002	0.00030	0.0000011	0.3	0.8	0.4
												Total HI:	**0.7**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-47

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - SNIPE ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	3.5	3,461	10	0.364	1	2.8	0.040	0.00018	0.0000033	2.9	2.6	1.1
Selenium	0.0042	1.0	1,261	5	0.016	0.016	1.4	0.011	0.00026	0.00000093	1.4	0.7	2.1
												Total HI:	**3.2**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-48

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - MALLARD ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	3.5	3,461	10	0.364	1	0.014	0.00016	0.0000042	0.000000076	0.014	1.5	0.0093
Selenium	0.0042	1.0	1,261	5	0.016	0.016	0.0034	0.000046	0.0000059	0.000000022	0.0035	0.4	0.0090
												Total HI:	**0.02**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-49

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE BLACKFOOT RIVER - MUSKRAT ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	3.5	3,461	10	0.364	1	0.7	0.030	0.00030	0.0000033	0.7	0.77	1.0
Selenium	0.0042	1.0	1,261	5	0.016	0.016	0.1	0.009	0.00042	0.00000094	0.1	0.2	0.8
												Total HI:	**1.7**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-50

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE STOCK PONDS - MOOSE ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Sediment Concentration[b] (mg/kg)	Water to Aq Invert TC[c] (kg dry sed/ kg tissue-wet)	Aq Invert Concentration[d] (mg/kg)	Sediment to Aq Flora TC[e] (kg dry sed/ kg tissue-wet)	Aq Flora Concentration[f] (mg/kg)	Dietary Ingestion Dose[g] (mg/kg-day)	Sediment Ingestion Dose[h] (mg/kg-day)	Water Ingestion Dose[i] (mg/kg-day)	Dermal Dose[j] (mg/kg-day)	Total Exposure Dose[k] (mg/kg-day)	Toxicity Reference Value[l] (mg/kg-day)	Hazard Quotient[m] (HQ)
Cadmium	0.003	3.5	3,461	10	0.364	1	0.0019	0.000023	0.0000032	0.0000000081	0.0019	0.16	0.012
Selenium	0.0042	1.0	1,261	5	0.016	0.016	0.000024	0.0000065	0.0000044	0.0000000023	0.000035	0.033	0.0010
												Total HI:	**0.013**

[a]Based on the mean concentration detected in site water.

[b]Based on the mean concentration detected in site sediment (values are in dry weight).

[c]Water to aquatic invertebrate transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic invertebrate tissue (wet weight).

[d]Concentration of COPC in aquatic invertebrate tissue (values are in wet weight).

[e]Sediment to aquatic flora transfer coefficient in units of kilograms sediment (dry weight) per kilograms aquatic flora tissue (wet weight).

[f]Concentration of COPC in aquatic invertebrates (values are in wet weight).

[g]Daily dose from all dietary food items.

[h]Daily dose from incidental ingestion of sediment.

[i]Daily dose from water consumption.

[j]Daily dose from dermal contact with sediment or water.

[k]Daily dose from all exposure pathways.

[l]Refer to Table H-12 for derivation of ecological toxicity reference values.

[m]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-51

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE WASTE ROCK DUMPS - SHEEP
ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Soil Concentration[b] (mg/kg)	Vegetation Concentration[c] (mg/kg)	Dietary Ingestion Dose[d] (mg/kg-day)	Soil Ingestion Dose[e] (mg/kg-day)	Water Ingestion Dose[f] (mg/kg-day)	Dermal Dose[g] (mg/kg-day)	Total Exposure Dose[h] (mg/kg-day)	Toxicity Reference Value[i] (mg/kg-day)	Hazard Quotient[j] (HQ)
Cadmium	0.0052	100	5.2	0.1	0.010	0.00006	0.000004	0.1	0.27	0.5
Selenium	0.12	160	84	1.9	0.016	0.00133	0.00001	1.9	0.055	34.1
									Total HI:	**34.5**

[a]Based on the maximum or 95% UCL of the mean concentration detected in Stock Ponds water.
[b]Based on the maximum or 95% UCL of the mean concentration detected in Waste Rock Dump soils (values are in dry weight).
[c]Concentration of COPC in vegetation (values are in wet weight).
[d]Daily dose from all dietary food items.
[e]Daily dose from incidental ingestion of soil.
[f]Daily dose from water consumption.
[g]Daily dose from dermal contact with soil.
[h]Daily dose from all exposure pathways.
[i]Refer to Table H-12 for derivation of ecological toxicity reference values.
[j]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC Transfer coefficient
HI Hazard index
HQ Hazard quotient
mg/kg Milligrams per kilogram
mg/kg-d Milligrams per kilogram per day
mg/L Milligrams per liter

TABLE 4-52

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE WASTE ROCK DUMPS - HORSES ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Soil Concentration[b] (mg/kg)	Vegetation Concentration[c] (mg/kg)	Dietary Ingestion Dose[d] (mg/kg-day)	Soil Ingestion Dose[e] (mg/kg-day)	Water Ingestion Dose[f] (mg/kg-day)	Dermal Dose[g] (mg/kg-day)	Total Exposure Dose[h] (mg/kg-day)	Toxicity Reference Value[i] (mg/kg-day)	Hazard Quotient[j] (HQ)
Cadmium	0.0052	100	5.2	0.1	0.008	0.00007	0.000003	0.1	0.16	0.6
Selenium	0.12	160	84	1.5	0.013	0.00162	0.0000046	1.5	0.033	46.3
									Total HI:	**46.9**

[a]Based on the maximum or 95% UCL of the mean concentration detected in Stock Ponds water.
[b]Based on the maximum or 95% UCL of the mean concentration detected in Waste Rock Dump soils (values are in dry weight).
[c]Concentration of COPC in vegetation (values are in wet weight).
[d]Daily dose from all dietary food items.
[e]Daily dose from incidental ingestion of soil.
[f]Daily dose from water consumption.
[g]Daily dose from dermal contact with soil.
[h]Daily dose from all exposure pathways.
[i]Refer to Table H-12 for derivation of ecological toxicity reference values.
[j]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC Transfer coefficient
HI Hazard index
HQ Hazard quotient
mg/kg Milligrams per kilogram
mg/kg-d Milligrams per kilogram per day
mg/L Milligrams per liter

TABLE 4-53

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE WASTE ROCK DUMPS - CATTLE ASSUMING UPPER BOUNDS EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Soil Concentration[b] (mg/kg)	Vegetation Concentration[c] (mg/kg)	Dietary Ingestion Dose[d] (mg/kg-day)	Soil Ingestion Dose[e] (mg/kg-day)	Water Ingestion Dose[f] (mg/kg-day)	Dermal Dose[g] (mg/kg-day)	Total Exposure Dose[h] (mg/kg-day)	Toxicity Reference Value[i] (mg/kg-day)	Hazard Quotient[j] (HQ)
Cadmium	0.0052	100	5.2	0.1	0.008	0.00007	0.000003	0.1	0.16	0.6
Selenium	0.12	160	84	1.5	0.013	0.00162	0.0000046	1.5	0.033	46.3
									Total HI:	**46.9**

[a]Based on the maximum or 95% UCL of the mean concentration detected in Stock Ponds water.

[b]Based on the maximum or 95% UCL of the mean concentration detected in Waste Rock Dump soils (values are in dry weight).

[c]Concentration of COPC in vegetation (values are in wet weight).

[d]Daily dose from all dietary food items.

[e]Daily dose from incidental ingestion of soil.

[f]Daily dose from water consumption.

[g]Daily dose from dermal contact with soil.

[h]Daily dose from all exposure pathways.

[i]Refer to Table H-12 for derivation of ecological toxicity reference values.

[j]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-54

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE WASTE ROCK DUMPS - SHEEP
ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Soil Concentration[b] (mg/kg)	Vegetation Concentration[c] (mg/kg)	Dietary Ingestion Dose[d] (mg/kg-day)	Soil Ingestion Dose[e] (mg/kg-day)	Water Ingestion Dose[f] (mg/kg-day)	Dermal Dose[g] (mg/kg-day)	Total Exposure Dose[h] (mg/kg-day)	Toxicity Reference Value[i] (mg/kg-day)	Hazard Quotient[j] (HQ)
Cadmium	0.0028	41	1.9	0.042	0.004	0.00003	0.000002	0.046	0.27	0.2
Selenium	0.061	43	16	0.4	0.004	0.00067	0.0000016	0.4	0.055	6.5
									Total HI:	**6.7**

[a]Based on the mean concentration detected in Stock Ponds water.

[b]Based on the mean concentration detected in Waste Rock Dump soils (values are in dry weight).

[c]Concentration of COPC in vegetation (values are in wet weight).

[d]Daily dose from all dietary food items.

[e]Daily dose from incidental ingestion of soil.

[f]Daily dose from water consumption.

[g]Daily dose from dermal contact with soil.

[h]Daily dose from all exposure pathways.

[i]Refer to Table H-12 for derivation of ecological toxicity reference values.

[j]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-55

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE WASTE ROCK DUMPS - HORSES ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Soil Concentration[b] (mg/kg)	Vegetation Concentration[c] (mg/kg)	Dietary Ingestion Dose[d] (mg/kg-day)	Soil Ingestion Dose[e] (mg/kg-day)	Water Ingestion Dose[f] (mg/kg-day)	Dermal Dose[g] (mg/kg-day)	Total Exposure Dose[h] (mg/kg-day)	Toxicity Reference Value[i] (mg/kg-day)	Hazard Quotient[j] (HQ)
Cadmium	0.0028	41	1.9	0.034	0.003	0.00004	0.000001	0.038	0.16	0.2
Selenium	0.061	43	16	0.3	0.003	0.00082	0.0000012	0.3	0.033	8.9
									Total HI:	**9.1**

[a]Based on the mean concentration detected in Stock Ponds water.

[b]Based on the mean concentration detected in Waste Rock Dump soils (values are in dry weight).

[c]Concentration of COPC in vegetation (values are in wet weight).

[d]Daily dose from all dietary food items.

[e]Daily dose from incidental ingestion of soil.

[f]Daily dose from water consumption.

[g]Daily dose from dermal contact with soil.

[h]Daily dose from all exposure pathways.

[i]Refer to Table H-12 for derivation of ecological toxicity reference values.

[j]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter

TABLE 4-56

EXPOSURE DOSE AND HAZARD CALCULATIONS FOR THE WASTE ROCK DUMPS - CATTLE ASSUMING MEAN EXPOSURE POINT CONCENTRATIONS

COPC	Water Concentration[a] (mg/L)	Soil Concentration[b] (mg/kg)	Vegetation Concentration[c] (mg/kg)	Dietary Ingestion Dose[d] (mg/kg-day)	Soil Ingestion Dose[e] (mg/kg-day)	Water Ingestion Dose[f] (mg/kg-day)	Dermal Dose[g] (mg/kg-day)	Total Exposure Dose[h] (mg/kg-day)	Toxicity Reference Value[i] (mg/kg-day)	Hazard Quotient[j] (HQ)
Cadmium	0.0028	41	1.9	0.034	0.003	0.00004	0.000001	0.038	0.16	0.2
Selenium	0.061	43	16	0.3	0.003	0.00082	0.0000012	0.3	0.033	8.9
									Total HI:	**9.1**

[a]Based on the mean concentration detected in Stock Ponds water.

[b]Based on the mean concentration detected in Waste Rock Dump soils (values are in dry weight).

[c]Concentration of COPC in vegetation (values are in wet weight).

[d]Daily dose from all dietary food items.

[e]Daily dose from incidental ingestion of soil.

[f]Daily dose from water consumption.

[g]Daily dose from dermal contact with soil.

[h]Daily dose from all exposure pathways.

[i]Refer to Table H-12 for derivation of ecological toxicity reference values.

[j]The hazard quotient is calculated as the total exposure dose divided by the toxicity reference value.

TC	Transfer coefficient
HI	Hazard index
HQ	Hazard quotient
mg/kg	Milligrams per kilogram
mg/kg-d	Milligrams per kilogram per day
mg/L	Milligrams per liter