AREA WIDE INVESTIGATION

SOUTHEAST IDAHO PHOSPHATE MINING RESOURCE AREA

Contract Number C023

Task Order AWI-00-01

FINAL

AREA WIDE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SELENIUM PROJECT

SOUTHEAST IDAHO PHOSPHATE MINING RESOURCE AREA

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Prepared for

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ACRONYMS AND ABBREVIATIONS

µ/day	Microgram per day
µ/kg/day	Microgram per kilogram per day
µ/L	Microgram per liter
ADD	Average daily dose
ADI	Average daily intake
ATSDR	Agency for Toxic Substances and Disease Registry
AWAC	Area-weighted average concentration
AWERA	Area Wide Ecological Risk Assessment
AWHHRA	Area Wide Human Health Risk Assessment
AWQC	Ambient water quality criteria
AWRA	Area wide risk assessment
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BTF	Biotransfer factor
BW	Body weight
C	Concentration
CCC	Chronic criterion concentration
COPC	Chemical of potential concern
COPEC	Chemical of potential ecological concern
CSM	Conceptual site model
CTE	Central tendency exposure
EcoSSL	Ecological soil screening level
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
FCM	Food chain model
FDA	U.S. Food and Drug Administration
FI	Fraction ingested
FS	U.S. Forest Service
g/day	Gram per day
GMU	Game management unit
HI	Hazard index
HHRA	Human health risk assessment
HQ	Hazard quotient
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDH	Idaho Department of Health
IDL	Idaho Department of Lands
IMA	Idaho Mining Association

ACRONYMS AND ABBREVIATIONS (continued)

IR	Ingestion rate
IRIS	Integrated Risk Information System
LADD	Lifetime average daily dose
LOAEL	Lowest observed adverse effect level
MDL	Method detection limits
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
mg/L	Milligram per liter
MOU	Memorandum of understanding
MS/MSD	Matrix spike and matrix spike duplicate
MW	Montgomery Watson
NA	Not applicable
Navy	U.S. Department of the Navy
NCP	Nation Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No observed adverse effect level
Nu-West	Nu-West Industries, Inc.
ORD	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
PEL	Probable effects level
PRG	Preliminary remediation goal
QC	Quality control
RA	Residential area
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
Resource Area	Southeast Idaho Phosphate Mining Resource Area
RfD	Reference dose
RME	Reasonable maximum exposure
SDHD	Southeastern District Health Department
SeAWAC	Selenium Area Wide Advisory Committee
SeWG	Selenium Working Group
SF	Slope factor
SQL	Sample quantitation limits
SQuiRT	Screening Quick-Reference Tables
SUF	Site use factor
TEC	Threshold effect concentration
TEL	Threshold effect level
TMDL	Total maximum daily loading
TRV	Toxicity reference value

ACRONYMS AND ABBREVIATIONS (continued)

TTC	Trophic transfer coefficient
TtEMI	Tetra Tech EM Inc.
UCL_{95}	95 percent upper confidence limit
UET	Upper effect threshold
UF	Uncertainty factor
USGS	U.S. Geological Survey
WW	Wet weight

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EXECUTIVE SUMMARY

This executive summary is provided to report the findings and conclusions of the Final Area Wide Human Health and Ecological Risk Assessment report for the Southeast Idaho Phosphate Resource Area developed by Tetra Tech EM Inc. (TtEMI) under the direction of the Idaho Department of Environmental Quality (IDEQ or Agency). The assessment was focused on potential regional impacts resulting from historic mining releases in the Southeast Idaho Phosphate Mining Resource Area (Resource Area). A draft risk assessment was published in April 2002 for stakeholder review and released in July 2002 for a formal 45-day public comment period. Comments and responses are appended in the final document. The following major conclusions resulted from the assessment efforts:

- There is a low probability of significant human health effects in the region based on current conditions, existing exposure pathways, and observed concentrations of chemicals. Potentially significant human health risks are indicated only in the case of subsistence use of resources in a limited number of highly impacted areas identified during previous area wide investigations. Based on regional observations, subsistence-level use by human receptors is considered highly unlikely.
- There is a low probability of population level impacts to regional wildlife based on current conditions and the low percentage of impacted zones in comparison to unaffected surrounding habitat.
- There is a high probability of subpopulation and/or individual effects occurring for ecological receptors residing in the vicinity of highly impacted areas.
- There is a potential for risks to aquatic and riparian ecological receptors residing in highly impacted areas as indicated by significant exceedances of conservative benchmarks for surface water, sediment and fish tissue concentrations.
- The contaminants of concern (COC) for future site-specific activities have been identified as cadmium, chromium, copper, nickel, selenium, vanadium and zinc. Selenium and cadmium are considered to be the primary hazard drivers on a regional basis.

PROJECT BACKGROUND

In 1996, isolated livestock deaths associated with excessive selenium uptake in the vicinity of historic phosphate mines in southeast Idaho prompted concerns regarding potential human health and ecological effects from past mining operations. In response to these concerns, the primary mine operators in the region formed the Idaho Mining Association (IMA) Selenium Committee, an *"ad hoc"* organization, to jointly and voluntarily investigate and address any mining-related environmental and public health issues associated with past operations. Similarly, an Interagency/Phosphate Industry Selenium Working Group (SeWG) consisting of voluntary participants from federal, state and tribal agencies, as well as other stakeholder groups, was established to collaborate on these efforts.

Since 1997, the IMA Selenium Committee's contractor, Agency investigators, and regional academic scholars and scientists have conducted numerous phased investigations. Due to the similarities in operations and mine design, and to provide some level of cost effectiveness, the investigations were initially directed at a limited number of constituents and conducted on an "Area Wide" basis.

In July 2000, the IDEQ was formally assigned the role of Lead Agency for the Selenium Area Wide Investigation through voluntary agreements with the companies and interagency participants. An Area Wide Investigation scope of work was developed and formalized through the agreements requiring IDEQ to review the previous data, conduct a data gaps analysis, and collect any remaining critical data to support an independent risk assessment effort by the IDEQ, and to develop regional risk management guidance for the performance of future mine-specific evaluations. The IDEQ retained TtEMI in October 2000 as their contractor for technical assistance and support in the implementation of the Area Wide Investigation scope of work.

The IDEQ established an Interagency Technical Group, comprised of other federal, state and tribal technical representatives with overlapping jurisdictions and interest in the Resource Area, to coordinate investigative activities and ensure collaborative efforts by all regulatory parties as specified in the July 2000 *Interagency Memorandum of Understanding Concerning Contamination from Mining Operations in Southeastern Idaho.* The IDEQ also formed a Selenium Area Wide Advisory Committee (SeAWAC) to continue to solicit input from mining company representatives, project stakeholders and other participants in the former SeWG.

GENERAL APPROACH

The focus of the Area Wide Investigation is a 2,500-square mile area, referred to as the Southeast Idaho Phosphate Mining Resource Area, comprised of portions of Caribou, Bear Lake and Bingham Counties. This region contains 15 major open pit mines previously owned or operated by the members of the IMA Selenium Committee consisting of FMC Corporation, J.R. Simplot Company, Nu West Industries, Inc., Rhodia, Inc., and P4 Production LLC. One of the sites, South Maybe Canyon Mine, is being addressed separately under an existing Consent Order between Nu West and the U.S. Forest Service. The region also contains 14 historic "orphaned" mine sites, primarily of underground design, that are not currently subject to future comprehensive site-specific investigations but are under independent review by the Interagency Technical Group using a preliminary assessment process to determine appropriate disposition.

Previous area wide investigations have indicated the presence of selenium and other mining-related metals at elevated levels in the environment as a result of mining activities in the Resource Area. The Agency's highest priority objectives were to identify any regional public health or wildlife population impacts requiring immediate action. The Area Wide Human Health Risk Assessment (AWHHRA) and the Area Wide Ecological Risk Assessment (AWERA) are intended to evaluate baseline risks to human receptors using regional resources and to assess the potential for population-level risks to ecological receptors in the region, respectively. Subsequent mine-specific investigations will be conducted under regulatory oversight to comprehensively identify and control localized sources, releases and exposures at each mine site, and to select and implement necessary remedial activities. The regional risk assessment results will provide supplemental information to support regulatory risk management decision-making processes resulting from site-specific activities.

The AWHHRA and AWERA were conducted using a tiered approach with conservative assumptions to ensure a high level of protectiveness for individual human receptors and regional wildlife populations. The assessments used deterministic methods, which are typically conservative, leading to risk estimates somewhat greater than those likely to be encountered by receptors. Deterministic methods require the development of discrete values to represent each exposure parameter. The parameters were used to calculate an estimated receptor dose that is compared to toxicological reference values by reporting a ratio referred to as a hazard quotient (HQ) or hazard index (HI) for combined risks. HQs/HIs less than 1.0 indicate exposure estimates below the no effects risk threshold while values above 1.0 may indicate a potential for risk but not a definitive statement that effects will occur. For this effort, the selected reference value was the no observed adverse effects level (NOAEL) consisting of the highest dose reported in the scientific literature that was administered to an applicable receptor group without causing any observed adverse effects. Due to the variations in developing model parameters and reference values, it is extremely important that risk assessment results be evaluated in context to actual conditions and not strictly on the basis of numeric outcomes in reaching risk conclusions.

The primary data used for risk estimates was collected in 2001, following a comprehensive data gaps analysis, although previous data was utilized for evaluation of temporal variations. The 2001 target analyte list consisted of 21 potential mining-related constituents identified through review of current and historic mining operation monitoring requirements, literature review, and results of U.S. Geological Survey site-specific analysis of regional geologic formations. All media samples were analyzed for the full target analyte list and the results were used to perform a comprehensive screening for the initial list of chemicals of potential concern (COPC) for human health risk and chemicals of potential ecological concern (COPEC) for ecological risks, to be evaluated in the risk assessment process. Constituents below

analytical detection limits, at background levels, or significantly less than conservative benchmarks were eliminated from formal risk assessment consideration.

Both the human health and the ecological risk assessments consist of three tiers. The first tier is a very conservative screening step using the highest observed media-specific concentrations from any location and the most conservative parameters to eliminate constituents that did not present a significant risk even under these hypothetical "worst case" conditions. In the second tier, more realistic exposure assumptions were used for human exposures, based on both reasonable maximum and central tendency parameters. Tier 2 ecological exposures were based on area- or watershed-weighted averages to represent population level conditions. The final tier was used to evaluate temporal variation, parameter sensitivity, and for watershed specific analysis.

AREA WIDE HUMAN HEALTH RISK ASSESSMENT

The four COPCs identified for human health risk evaluation were arsenic, cadmium, chromium and selenium. The receptor groups selected for evaluation were recreational hunters and fishers, Native Americans, and modified subsistence lifestyle users representing ranchers or residents within the boundaries of the Resource Area. Adult and child receptors were evaluated in each receptor group.

Tier 1 was designed as a screening step using maximum detected, medium-specific concentrations for each COPC to develop hypothetical "upper bound" risk estimates. The exposure pathways considered for all three receptor groups included inhalation of particulates; ingestion of impacted beef, elk and fish tissue; and ingestion of surface water. Additionally, subsistence receptor pathways included ingestion of homegrown produce and incidental soil ingestion, while the Native American scenario included ingestion of aquatic and terrestrial plants, and teas brewed from terrestrial plants. Pathways associated with carcinogenic risks of less than 1E-06 or toxic HIs less than 1.0, and individual COPCs associated with risks less than 1E-07 or HIs less than 0.1 were eliminated from further consideration.

The Tier 1 efforts identified ingestion of aquatic life as a potential risk for all receptors based on selenium and cadmium concentrations in fish, primarily driven by the high concentrations observed in fish tissues samples collected from East Mill Creek. HI exceedances were also observed for child subsistence lifestyle receptors for selenium from ingestion of surface water based on concentrations in samples from East Mill Creek, and for incidental soil ingestion from arsenic based on a maximum concentration observed in a sample from adjacent to Rasmussen Creek. Chromium was retained for further evaluation

because HIs exceeded 0.1. Elk and beef tissue ingestion were retained for further evaluation due to public interest in regional hunting and fishing.

Tier 2 of the human health risk assessment focused on further evaluation of the hazards identified in the Tier 1 screening using both reasonable maximum exposure (RME) and central tendency exposure (CTE) approaches. The RME approach estimates risks occurring in the area of highest impact while the CTE approach uses more realistic human health risk parameters and area-weighted average exposure point concentrations for each watershed. Tier 2 results indicated that threshold exceedances (HIs ranging from 1.5 to 5.3) occurred for ingestion of fish by all subsistence lifestyle users under the RME approach and for ingestion of soil (HI = 1.6) by the subsistence lifestyle child as summarized in Table 6-26 of the report. Under the CTE approach summarized in Table 6-27 of the report, exceedances (HI = 1.1) occurred only for ingestion of fish by the child subsistence user in the Blackfoot/Little Blackfoot watershed.

Tier 3 consisted of additional analysis of ingestion of fish and surface water pathways to evaluate the temporal variability in risks resulting from observed changes in media concentrations as affected by climatic and meteorological conditions. Tier 3 results indicated that the significant fluctuations observed in transitory media, such as surface water, has minimal effect on the overall risk estimates. The primary risk contributors consist of the more stable medias such as soil, plants and prey species; therefore, the overall risk estimates are similar regardless of temporal effects. On a watershed-specific basis, only the Blackfoot/Little Blackfoot watershed resulted in an RME risk exceedance for subsistence lifestyle receptors based on concentrations observed in samples from East Mill Creek, and all CTE estimates were below risk thresholds.

In evaluating the human health risk estimates presented, only subsistence lifestyle users were identified as exceeding risk thresholds. The subsistence lifestyle scenario was included in the assessment as a conservative upper-bound risk estimate to ensure the protection of lesser users who may supplement their dietary needs with regional resources. Under the subsistence lifestyle scenario, it is assumed that the receptor resides in the vicinity of the impacted media, as in the case of incidental soil ingestion, and that the only source of some component of their diet, as in the case of fish ingestion, is from a single area over an extended period of time; 30 years for the adult and 6 years for the child. While this type of exposure is theoretically possible, it is extremely unlikely in this application for numerous reasons. The areas of high impacts are very limited and occur primarily on public lands where a residential scenario cannot occur. This is particularly the case for the soil sample from Rasmussen Ridge and fish samples from East Mill Creek that are solely responsible for the reported risk threshold exceedances. East Mill Creek is a first order stream that does not support a highly productive fish population and at which fishing has never been

observed during frequent visits by site inspectors, let alone subsistence level use. While the region is sparsely populated by ranchers, it is highly unlikely that any residents rely solely on area resources for all their dietary needs or that those needs would only be met through the use of impacted areas that represent less than 5 percent of the total Resource Area, including mining disturbed lands such as pits and waste rock piles. Based on knowledge of the regional population and area resource use, the conservatism of the model, and the marginal level of risk exceedances presented by the subsistence use evaluation, it is concluded that regional human health effects are not likely to occur based on current conditions.

However, it should be noted that the Idaho Division of Health and Idaho Department of Fish and Game previously issued consumption advisories to area hunters recommending moderate ingestion of elk liver based on results from regional surveys. Calculations using the maximum detected concentrations indicated that mild gastrointestinal effects (i.e. diarrhea, nausea, etc.) could occur if large and persistent portions of liver containing these high levels of selenium were consumed. Similarly, the Idaho Fish Consumption Advisory Program Committee is in the process of issuing a temporary fish consumption advisory for East Mill Creek as a precautionary action. Their exposure calculations also indicate potential risk to child subsistence level users based on selenium concentrations, although they also agree that subsistence use of this area is considered highly unlikely.

Not all exposure pathways and risks are amenable to quantitative assessment procedures. The human health risk assessment contains some qualitative risk discussions, particularly for Native American use of the Resource Area under existing off-reservation treaty rights. Technical representatives of the Shoshone Bannock Tribes have collaborated on this effort and provided their general concurrence on the direct physical hazard estimates developed within the context of formal risk assessment procedures. However, they continue to have concerns that lie outside the realm of current standard practices for risk assessment, particularly in the area of unspecified traditional uses, spiritual health and cultural consequences. These caveats have been provided in the final document for future consideration in decision-making processes. A qualitative risk evaluation is included to discuss some of the potential pathways not included in the quantitative assessment such as traditional gardens, ceremonial uses and medicinal applications that are considered either proprietary in nature or are too diverse for comprehensive consideration. The Native American scenario included in the risk assessment does quantify risks using direct ingestion pathways for several plant species of common traditional use as identified by the Tribal Risk Assessment Committee, and other allowances have been made in using whole-body fish concentrations for ingestion and developing estimates for ingestion of native plant-based teas. These exposure pathways are believed to represent the most significant traditional use dose contributions to a Native American receptor and

resulted in HIs less than 1.0. However, a potential for increased risk could exist from the other undisclosed uses.

AREA WIDE ECOLOGICAL RISK ASSESSMENT

The primary objective of the AWERA was to evaluate the likelihood of population-level effects on regional wildlife based on current conditions. A population-level effect is defined as a significant decline or toxicological effect in the area-wide population of a particular species. Multiple lines of evidence were used to evaluate risks to ecological receptors including development of HQs for various receptors based on modeled doses, comparisons of tissue concentrations with literature values, comparisons of impacted versus reference area concentrations, and media concentration comparisons with reference benchmarks. HQs were developed for numerous ecological receptors representing various communities and feeding guilds using data collected in 2001 with a three-tiered, deterministic approach.

Tier 1 consisted of a screening level assessment to evaluate chemicals under worst-case conditions. Tier 1 used the maximum detected concentrations and most conservative parameters to calculate HQs for each target species and COPEC. The COPECs identified for evaluation were cadmium, chromium, copper, nickel, selenium, vanadium and zinc. The results summarized in Tables 7-7 through 7-14 of the report indicate threshold exceedances to mammalian and avian species for cadmium, copper, nickel, selenium and vanadium, and to avian receptors only for chromium based on maximum observed media concentrations.

Tier 2 consisted of an evaluation of regional ecological risks using area-weighted averages for exposure point concentrations of each media, and mean values for model parameters intended to represent an estimate of the average population-level exposures. Each medium was represented by average values for impacted and unimpacted areas, and was area weighted based on surface area ratios, stream segment lengths and other applicable weighting criteria. HQs were developed for each surrogate species using NOAELs and are summarized in Tables 7-15 through 7-22 of the report. Aquatic populations were assessed through direct comparisons with tissue and media concentration benchmarks and are summarized in Tables 7-23 and 7-24 of the report.

Tier 2 results indicate a significant decrease in HQs when viewed in the perspective of population-level risks, which is expected considering less than 5 percent of the overall Resource Area can be characterized as impacted. Selenium and cadmium are the only COPECs that appear to present a significant risk on a regional basis; however, Tier 1 results clearly indicate that the other COPECs may present significant

risks to individual or subpopulation receptors in specific localized areas. Aquatic benchmark comparisons also indicated exceedances for surface water, sediments, and fish tissue benchmarks in impacted areas.

Tier 3 consisted of an evaluation of temporal effects employing 1998 and 1999 surface water and fish tissue data. The Tier 3 results did not indicate a significant difference in risks as compared with Tier 2 results because the major portion of the dose for all receptors comes from media less transitory than surface water.

The AWERA concludes that population-level effects for ecological receptors are unlikely based on Tier 2 estimates; however, the high risk values reported in Tier 1 indicate a high probability of significant risks to individual and/or subpopulation ecological receptors in localized areas. Tier 3 indicates that while large fluctuations in surface water concentrations may occur temporally, these variations are dampened because the most significant dose contributors are in non-transitory media that serve as reservoirs and do not vary at the same rate as surface water. The evaluation of risks to aquatic receptors is inconclusive due to the lack of scientific consensus and the diversity in outcomes of selenium-related studies. However, concentrations for surface water, sediments, and fish tissue in impacted areas do exceed the conservative benchmarks published in reference literature.

1.0 INTRODUCTION

The Idaho Department of Environmental Quality (IDEQ) retained Tetra Tech EM Inc. (TtEMI) in October 2000 for an independent review of the existing data and preliminary risk assessment compiled and published by the Idaho Mining Association (IMA) Selenium Committee. TtEMI was also asked to assist IDEQ in developing final area wide human health and ecological risk assessments associated with past phosphate mining operations in the Southeast Idaho Phosphate Mining Resource Area (Resource Area) to support future risk management decisions by the agency for the region. This work is being carried out as part of an Area Wide Scope of Work, referenced in the July 2000 *Interagency Memorandum of Understanding Concerning Contamination from Phosphate Mining Operations in Southeastern Idaho* (MOU) negotiated between IDEQ and the tribal and federal agencies with jurisdictional responsibilities in the region. The MOU specified IDEQ as the lead agency for coordinating future activities of the area wide investigation and for establishing regional guidance cleanup to assist lead agencies in implementing future site-specific remedial efforts. The area wide investigation is incorporated as part of an Administrative Order of Consent negotiated with the responsible mining companies.

1.1 PURPOSE AND OBJECTIVES

This Area Wide Risk Assessment (AWRA) report, prepared by TtEMI, represents the sixth deliverable in a multitask process outlined in Contract No. CO23, Task Order No. AWI-00-01 (Area Wide Data Review/Risk Assessment). The major objectives of this project as a whole are to:

- Review and assess the existing data and preliminary risk assessment
- Establish data requirements to support area wide human health and ecological risk assessments
- Develop sampling and analysis plans and studies to fill potential data gaps
- Finalize an area wide human health and ecological risk assessment

The Area Wide Human Health Risk Assessment (AWHHRA) and Area Wide Ecological Risk Assessment (AWERA) follow a tiered approach to evaluating the risk of mining to human health and ecological receptors. Both the AWHHRA and AWERA follow a deterministic approach to developing doses for the risk assessment. Overall risk to ecological receptors was calculated based on a weight-of evidence approach.

The key EPA guidance documents that were used to prepare the AWHHRA are listed below.

- EPA. 1989. "Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A) (RAGS)." Interim Final. Office of Emergency and Remedial Response (OERR). Washington, DC. EPA/540/1-89/002. December.
- EPA. 1991. "RAGS, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors." Interim Final. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03. March 25.
- EPA. 1997. "Exposure Factors Handbook." Volumes 1 through 3. Office of Research and Development (ORD). EPA/600/P-95/002Fa, -Fb, and –Fc. August.

For the AWERA, U.S. Environmental Protection Agency's (EPA) "Ecological Risk Assessment (ERA) Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Draft Final" (EPA 1997b) (ERA Guidance for Superfund) was followed as opposed to EPA's "Guidelines for Ecological Risk Assessment, Final" (EPA 1998). EPA's ERA Guidance for Superfund is most widely employed for ERAs as opposed to the "Guidelines for Ecological Risk Assessment." Both use the same basic principles for conducting an ERA, but the terminology is different in some cases. For instance, EPA (1998) uses "measurement effect" for "measurement endpoint" (EPA 1997b). The outcome is the same regardless of the terminology used

1.2 REPORT ORGANIZATION

This report is organized into eight sections and includes figures, tables, eight appendices, and one compact disk containing analytical data. The report is presented in two volumes:

<u>Volume 1 of 2:</u>

- Area Wide Human Health and Ecological Risk Assessment Report
  - Section 1.0 – Introduction
  - Section 2.0 – Location, Environmental Setting, and Background
  - Section 3.0 – Data Quality Assessment
  - Section 4.0 – General Conceptual Site Model
  - Section 5.0 – Screening of Chemicals of Concern
  - Section 6.0 – Area Wide Human Health Risk Assessment
  - Section 7.0 – Area Wide Ecological Risk Assessment
  - Section 8.0 – References
  - Figures
  - Tables

- Appendices A – G
  - Appendix A Glossary
  - Appendix B Chemical of Potential Concern Screening
  - Appendix C Medium-specific Exposure Point Concentration Calculations
  - Appendix D Human Health Toxicity Profiles
  - Appendix E Human Health Tier-specific Exposure, Risk, and Hazard Calculations
  - Appendix F Ecological Toxicity Profiles
  - Appendix G Area Wide Ecological Risk Assessment Hazard Calculations

Volume 2 of 2:

- Appendices H and I
  - Appendix H 2001 Data Summary Report
  - Appendix I Responses to Comments on the Draft Area Wide Human Health and Ecological Risk Assessment

- Compact disk containing 2001 sampling analytical data

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2.0 LOCATION, ENVIRONMENTAL SETTING, AND BACKGROUND

This section presents the location, environmental setting, and background information for this report.

2.1 SOUTHEAST IDAHO PHOSPHATE MINING HISTORY

Phosphate mining has been practiced in southeastern Idaho throughout most of the Twentieth Century, starting with the Waterloo Mine in 1907. The major phosphate mines in this region are open pit or contour strip operations that were developed near surface exposures of the Phosphoria Formation. The phosphate ore is transported by truck, rail, and slurry pipeline to local processing facilities in Soda Springs and Pocatello, Idaho. Production from this region represents a significant source of phosphorous for industrial and agricultural applications. Nearly 40 percent of the U.S. phosphate reserves occur in the Phosphoria Formation in southeastern Idaho, northern Utah, and western Wyoming.

In 1996, isolated livestock losses associated with excessive selenium uptake prompted concerns about potential ecological and human health impacts from past mining operations (Montgomery Watson [MW] 1999b). In response to these concerns, five companies operating mines in the region formed an "*ad hoc*" Selenium Committee with the IMA to characterize the environmental risks and identify mitigation measures associated with phosphate mining. The IMA Selenium Committee, composed of the companies listed in Table 2-1, was formed in 1997 to voluntarily and jointly addresses mining related environmental issues from a regional basis. An Interagency/Phosphate Industry Selenium Working Group (SeWG) was subsequently established to facilitate communication and participation by cooperating federal, state, local, and tribal entities.

The SeWG consisted of voluntary representatives, including:

- IDEQ
- Idaho Department of Lands (IDL)
- Idaho Department of Fish and Game (IDFG)
- Idaho Department of Health (IDH)
- Shoshone Bannock Tribes
- Southeastern District Health Department (SDHD)
- U.S. Forest Service (FS)
- U.S. Bureau of Land Management (BLM)
- U.S. Bureau of Indian Affairs (BIA)

- U.S. Fish and Wildlife Service (USFWS)
- U.S. EPA
- U.S. Geological Survey (USGS)
- Other Interested Stakeholders (such as ranchers and the Greater Yellowstone Coalition)

In August 2000, IDEQ was specified as the Lead Agency for coordinating future activities of the area wide investigation and for establishing regional cleanup guidance to assist lead agencies in implementing future site-specific remedial efforts. IDEQ subsequently established an Interagency Technical Group to coordinate its activities with the other jurisdictional and administrative agencies. IDEQ also established the Selenium Area Wide Advisory Committee (SeAWAC) to continue to solicit input from the mining companies, project stakeholders, and other participants in the former SeWG.

Although IDEQ has been designated as the lead for the area wide assessments, other agencies such as FS, BLM, and IDL are responsible for specific mine sites and are the lead agencies for the site-specific work to be conducted at certain mines.

Much of the characterization and risk assessment conducted under the auspices of the IMA Selenium Committee is documented in a series of reports prepared by MW (MW 1998a, 1998b, 1999a, 1999b, 2000, 2001). The IMA Selenium Committee implemented a phased approach for investigating potential impacts from phosphate mining (MW 1999b). Because of the broad similarities in mining operations and material characteristics, those investigations and the corresponding risk assessments were approached from an area wide perspective. The focus of the investigations is a 2,500-square-mile area in southeastern Idaho that comprises portions of Caribou, Bear Lake, Bonneville, and Bingham Counties (Figure 1). This region contains 15 mines previously owned or operated by FMC Corporation; J.R. Simplot Company; Nu-West Industries, Inc., and Nu-West Mining, Inc. (Nu-West); Rhodia, Inc.; and P4 Production LLC (see Table 2-1), as well as numerous "orphaned" mine sites, primarily of underground design. One of the 15 mines, the South Maybe Canyon Mine, is being addressed separately under a consent order between Nu-West and FS and is not included in the scope of the Selenium Project.

Issues and concerns associated with the IMA studies and risk assessments are discussed in the "Final Existing Data and Risk Assessment Review" (TtEMI 2001a). The additional information deemed necessary to complete the AWHHRA and AWERA are discussed in the "Final Data Gap Technical Memorandum" (TtEMI 2001b) and the guidance followed was presented in the "Final Area Wide Human Health and Ecological Risk Assessment Work Plan" TtEMI 2002a), referred to as the Work Plan.

Additional studies of the general geology of the Phosphoria Formation and site-specific investigation of biogeochemistry of selenium have been or are being conducted by the various entities in SeWG (that is, USGS, FS, IDFG, USFWS, and individual mine operators). These investigations are described more fully, as appropriate, in the "Final Existing Data and Risk Assessment Review" (TtEMI 2001a).

2.2 REGIONAL ENVIRONMENTAL SETTING

The Resource Area covers about 2,500 square miles in the southeastern part of Idaho. The regional environmental setting is discussed in the following sections and is adapted primarily from MW (1999b).

2.2.1 Climate

The topography of southeastern Idaho influences wind patterns, temperature, and precipitation in the Resource Area (MW 1999b). The north-to-south-trending mountain ranges west of the Resource Area create a natural barrier for water-bearing Pacific air masses. Because of this rainshadow effect, the Snake River Plain region is semiarid, with a middle-latitude steppe climate. The southeastern part of the Resource Area is wetter and cooler than the other parts because of the increasing elevation (MW 1999b). Fall and winter are dominated by cold, dry continental air and cyclonic storms. In the cooler months, precipitation is generally from snow, while in the springtime, cool marine air from the south brings precipitation. In the summer, precipitation is associated with localized, orographic thunderstorms (MW 1999b). Average precipitation increases in an easterly direction, with 12 inches in the west and 25 to 35 inches in the central and eastern districts.

2.2.2 Regional Geology

The Resource Area is situated within the northern region of the Basin and Range Physiographic province. The mountain ranges in southeastern Idaho generally are composed of deformed Paleozoic and Mesozoic sedimentary rocks, including thick marine clastic units, cherts, and limestones (MW 1999b). The valleys are largely filled with Quaternary alluvium and colluvium that overlay Pleistocene basalt flows. Thick rhyolite flows of the Snake River Plain region, and rhyolite domes, located south of the Blackfoot Reservoir, make up the remaining volcanic sequences in the area. Large accumulations of marine sediment occurred during the Paleozoic era over a large area of eastern Idaho, southwestern Montana, northern Utah, and western Idaho (MW 1999b). The Phosphoria Formation was deposited during Permian time, forming the western phosphate field, part of which is located in the Resource Area. Additional information on stratigraphy and concentrations of target elements in ore-bearing units is

provided in MW (1999b). MW (1999b) also provides additional information on soils and vegetation; water resources, including surface water and discussions on each major watershed located in the Resource Area; and groundwater.

2.2.3 Regional Ecology

This section briefly discusses the biological resources in the Resource Area. MW (1999b) presents a detailed discussion of the regional ecology.

2.2.3.1 Ecological Characteristics

The vegetation in the Resource Area is transitional between the Great Basin vegetation to the south and the Rocky Mountain vegetation to the north (MW 1999b). Six vegetation types within the Resource Area are a result of elevation, moisture, temperature, soil type, slope, and aspect. A list of plant species found in the Resource Area is presented in Table A.1 of Appendix A of MW (1999b). Based on previous investigations, the Resource Area contains or supports about 75 species of mammals, 272 species of birds, 16 species of reptiles, 16 species of fish, and seven species of amphibians (USGS and USFWS 1977; USFWS 1985, 1997; and Idaho Conservation Center Data Base (ICCDB) 1999, all as cited in MW 1999b). In MW (1999b), Table A.2 presents a list of mammals, Table A.3 presents a list of birds, and Table A.4 presents a list of reptiles and amphibians known or believed to reside in the Resource Area.

2.2.3.2 Threatened and Endangered Species

Several threatened and endangered species may live full time or are seasonal migrants in the Resource Area (MW 1999b): bald eagle, gray wolf, whooping crane, the Canada lynx, and Ute ladies' tresses, (listed species). Several species are classified as sensitive by federal and state agencies: northern goshawk, Columbian sharp-tailed grouse, trumpeter swan, Harlequin duck, great gray owl, flammulated owl, boreal owl, three-toed woodpecker, western big-eared bat, wolverine, spotted bat, spotted frog, Snake River finespotted cutthroat, Yellowstone and Bonneville cutthroat trout, Idaho sedge, slick-spot peppergrass, starveling milkvetch, Payson's bladderpod, and Cache beardtongue (MW 1999b).

2.3 HUMAN POPULATIONS

The Resource Area consists of about 2,500 square miles in Caribou, Bingham, Bannock, and Bear Lake Counties in southeastern Idaho. As stated in the "Final 1998 Regional Investigation Report" (MW

1999b), "a significant portion of the project area land is within the Caribou National Forest, the Fort Hall Indian Reservation, or is administered by the BLM." The Resource Area is sparsely populated. The largest nearby population centers are located in Pocatello, Fort Hall, Montpelier, and Soda Springs, Idaho, and Afton, Wyoming. Farming and ranching are the dominant land uses in the Resource Area (MW 1999b).

2.4 SUMMARY OF PREVIOUS INVESTIGATIONS AND ASSESSMENTS

This section presents a summary of the previous investigations and assessments that pertain to human health risk assessments (HHRA) and ERAs that have been conducted in the Resource Area.

A wide range of environmental media and facilities were sampled and analyzed, including biotic and abiotic media. Overall, the investigations were conducted using a phased approach, where preliminary sampling was used to help define the requirements for future investigations.

IMA Fall 1997 Interim Surface Water Survey: The 1997 survey represents the initial effort by SeWG to assess surface water quality in the Resource Area. The 1997 water quality survey was intended as a preliminary investigation that would lay the foundation for subsequent regional investigations. The results of the 1997 survey are documented in the "Fall 1997 Interim Surface Water Survey Report" (MW 1998a). The results showed that surface water samples collected from or near many of the mine facilities contained elevated concentrations of selenium.

1998 Regional Investigation: In 1998, the media represented were increased to include groundwater, stream sediments, soil and vegetation on waste rock piles, water from waste rock pile seeps, and background uplands (Phosphoria outcrops) soils, and trout fillets. The frequency of stream sampling also was increased to include the spring runoff (May), as well as the September low-flow event. The data collected in 1998 were used in the preliminary ecological and human health risk assessments and are documented in the "Final 1998 Regional Investigation Report" (MW 1999b). The preliminary assessments were intended to be refined based on new data gathered during future investigations. Samples were analyzed for a limited set of inorganic chemicals that included selenium, cadmium, copper, chromium, cobalt, manganese, nickel, vanadium, zinc, calcium, iron, magnesium, potassium, and sodium.

IMA 1999 Interim Regional Investigation: In 1999, additional investigations were conducted to collect time-critical data and implement special studies on selected biotic components in the Resource Area. Surface water was the primary environmental medium sampled outside of the special studies, and the list

of target elements was reduced to selenium and cadmium. The results of the 1999 interim regional investigation are documented in the "1999 Interim Investigation Data Report" (MW 2000).

Additionally, IMA initiated four special studies in 1999 to obtain information on selected biotic components in the Resource Area:

(1) Bird eggs
(2) Cutthroat trout
(3) Elk tissue
(4) Cattle tissue

IMA 1999-2000 Regional Investigation: This report presented data for surface water, sediment, and aquatic biological samples collected in September and October 1999, and May 2000. Media sampled included surface water, sediment, periphyton, plankton, submerged macrophytes, benthic macroinvertebrates, forage fish, salmonids, and riparian vegetation. Samples were analyzed for a limited set of inorganic chemicals. The results of the 1999-2000 regional investigation are documented in the "1999-2000 Regional Investigation Data Report for Surface Water, Sediment, and Aquatic Biota Sampling Activities, Draft" (MW 2001).

IMA 2001 Waste Pile, Seep, and On-site Pond Investigations: IMA collected samples from the waste rock piles, seeps, and on-site ponds at 14 of the mine sites during Spring 2001. These samples were analyzed for a comprehensive list of inorganic chemicals.

IMA 2001 Terrestrial Invertebrate, Terrestrial Plant, Soil, and Small Mammal Investigation: The IMA collected small mammals along with collocated terrestrial invertebrates, soils, and vegetation samples from waste rock piles, upland background areas (Phosphoria outcrops), impacted riparian zones, and background riparian areas during Summer 2001. These samples were analyzed for a comprehensive list of inorganic chemicals.

IDEQ 2001 Surface Water and Sediment Investigation: As part of the Total Daily Maximum Load (TMDL) program for the Resource Area and the AWRA, IDEQ collected surface water and sediment samples for analysis from selected segments of various streams where there was a potential for impacts from phosphate mining. These data can be used to support the AWHHRA and ERA and also will be used to provide baseline data to establish TMDL requirements for streams in the Resource Area. These samples were analyzed for a comprehensive list of inorganic chemicals. The results of the 2001 surface

water and sediment investigation are documented in the "Final 2001 TMDL Baseline Monitoring Report" (TtEMI 2002b).

IDEQ Summer 2001 Risk Assessment Sampling: IDEQ initiated an extensive sampling effort for the Spring and Summer of 2001 to collect a variety of media, including surface water, sediment, soil, vegetation, and biota for laboratory analysis. These data were used to support the AWHHRA and ERA for the Resource Area and the analytical results were used to help refine the list of chemicals of potential ecological concern (COPEC) and to identify potential exposure scenarios. These samples were analyzed for a comprehensive list of inorganic chemicals. Results of the Summer 2001 risk assessment sampling are provided in Appendix H.

Additional Studies: A number of additional studies have been conducted by various government agencies including, but not limited to, USFWS, FS, and USGS. These additional studies varied in the type of samples collected, types of analyses, and collection locations. These additional studies will be evaluated to obtain supporting information for the risk assessment.

Table 2-2 presents the numbers and type of data that were used to conduct the AWHHRA and AWERA.

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3.0 DATA QUALITY ASSESSMENT

The AWERA and AWHHRA are based primarily on data collected during calendar year 2001. The IMA and TtEMI collected the data as a joint effort. The breakdown of responsibility for data collection was as follows.

- Waste Rock – IMA
- On-site Surface Water and Sediment – IMA
- Off-site Surface Water and Sediment – TtEMI
- Aquatic Plants – TtEMI
- Fish – TtEMI
- Aquatic Invertebrates – TtEMI
- Terrestrial Plants and Invertebrates – IMA
- Small Mammals – IMA
- Riparian and Upland Soil – IMA

TtEMI did not evaluate the quality of the data collected by IMA. However, both groups used the same laboratories, and the data are therefore assumed to be of comparable quality. The following sections discuss the overall quality of the data collected by TtEMI but are assumed to apply to all data collected by both groups.

The laboratory analyses were performed according to EPA methods, as described in the "Final Sampling and Analysis Plan" (TtEMI 2001d). However, the information reported by the laboratory was not adequate to validate the data according to EPA functional guidelines. An overall assessment of the available information was therefore used to assess the quality of the laboratory data. This evaluation included a review of quality control (QC) information in the raw data package, analytical methods, and discussions with laboratory staff. In particular, the following data from the sampling events were evaluated:

- Check standards
- Blanks
- Matrix spike and matrix spike duplicate (MS/MSD) samples
- Laboratory control samples
- Standard reference material
- Sensitivity

The laboratory quality assessment was restricted to selenium, boron, and other constituents analyzed using the EPA Methods 200.7 and 200.8.

3.1 CHECK STANDARDS

Check standards were consistently reported for all constituents. The check standard recoveries were generally within 95 to 100 percent. The recoveries were never outside of the QC guidance limits of 85 and 115 percent. The recoveries for check samples indicate that the instruments maintained calibration throughout the analytical runs.

3.2 BLANKS

The results for method blank results were generally below method detection limits (MDL). With the exception of blank samples with detectable concentrations of aluminum and boron, constituents were rare. In such cases, concentrations of the detected constituents only slightly exceeded the MDL. These elevated levels are probably related to normal analytical variability rather than to significant laboratory contamination. Normal analytical variability is exacerbated by the very low detection limits that were selected for the project. Aluminum and boron tended to occur in the blanks more regularly than the other elements and at somewhat higher concentrations. The source of aluminum and boron is problematic. However, dust could be the source for aluminum in the blanks, whereas glassware was the probable source for boron. Thus, the results for method blank samples suggest that laboratory contamination was minimal.

3.3 MATRIX SPIKES AND MATRIX SPIKE DUPLICATES

Matrix spikes were determined only for selenium and cadmium. Matrix spike recoveries for cadmium were always within the QC guidance limits of 75 to 125 percent. The recoveries for selenium were generally within the desired range but were low in some cases. Thus, the analysis of selenium may be affected by matrix interference in some instances.

3.4 LABORATORY CONTROL SAMPLES

Blank spikes were reported for selenium and cadmium, but not for other constituents. Laboratory control sample (blank spike) recoveries were generally within the QC guidance of 80 to 120 percent. These data indicate that analytical precision was reasonable and generally within acceptable analytical bounds.

3.5 STANDARD REFERENCE MATERIALS

Standard reference materials were included with the analytical runs for all elements, except for uranium. The standard reference materials are prepared by external sources and provide a measure of laboratory accuracy. Recoveries for the external standards were generally good. Analytical methods used in the source laboratory that developed the standard reference materials may vary from those used in the reporting laboratory, so it is not uncommon for recoveries to deviate from the true values. The recoveries were almost always within acceptable limits, indicating good precision and high accuracy.

3.6 SENSITIVITY

The detection limits were below proposed regulatory benchmarks, and the data are adequate from this perspective. Notably, the detection limits reported are generally lower than in previous investigations in the Resource Area (TtEMI 2001a). The relatively high sensitivity associated with the low detection limits resulted in low magnitude, but high proportional, variation.

3.7 OVERALL ASSESSMENT OF LABORATORY DATA

Overall, only minor and isolated problems were noted with calibrations, blanks, matrix spikes, laboratory control samples, and standard reference materials. No apparent and consistent bias was detected in the analysis. The primary limitation of the data from a quality perspective is that matrix spikes, duplicates, and laboratory control samples were not consistently analyzed for all elements. Nonetheless, the data are considered both accurate and precise based on the results of the analysis for check standard, blank, and standard reference materials. The detection limits are much improved from previous investigations and are appropriate for the proposed regulatory comparisons and use in the risk assessment.

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4.0 GENERAL CONCEPTUAL SITE MODEL

Problem formulation represents a critical stage of the risk assessment process, where the goals, breadth, and focus of the assessment are determined. The major goal of the problem formulation step is to develop a conceptual site model (CSM) that addresses the following major issues:

- Environmental setting and chemicals known or suspected to exist at the site
- Chemical fate and transport mechanisms that might exist at the site
- Mechanisms of toxicity associated with chemicals and likely categories of human health and ecological receptors that could be affected
- Complete exposure pathways that might exist at the site (a complete exposure pathway is one in which the chemical can be traced or expected to travel from the source to a receptor)
- Selection of exposed populations for AWHHRA and selection of assessment and measurement endpoints for the AWERA

Because of differences in exposure, separate CSMs have been developed for human health and ecological receptors and are discussed in more detail in the following sections (see Figures 3 and 6).

4.1 FATE AND TRANSPORT OF CHEMICALS OF POTENTIAL CONCERN

The primary source of contamination from phosphate mining in the Resource Area appears to be the waste rock piles associated with the various mine sites. Primary chemical release mechanisms for the piles are as follows:

- Erosion from waste rock piles to surface soils
- Percolation from waste rock piles to surface soils, subsurface soils, groundwater, and surface water
- Biotic uptake from contaminated soils or sediments
- Storm water runoff from waste rock piles to surface water

Each of these primary release mechanisms results in a pathway of exposure of various metals from mining to human health and ecological receptors. The primary chemical is selenium, but other chemicals were identified as posing a potential concern in the screening process discussed in Section 5.0. The sources of chemicals and each of the primary chemical release mechanisms for metals are described in the following sections. These processes may vary, depending on the specific metal.

4.1.1 Sources of Chemicals

The Dinwoody, Phosphoria, and Wells Formations, the "phosphate sequence," are the principal sedimentary formations mined to produce all phosphate ore (MW 1999a). The Meade Peak member of the Phosphoria Formation in southeastern Idaho is extensively mined for its phosphate content and is a marine sedimentary deposit of Permian age (MW 1999a; Piper and others 2000). An analysis of the formation indicated that it consists of two fractions: the original marine organic matter, and the terrigenous, detrital source fraction. Sources of these fractions appear to include (1) detrital debris from the terrestrial environment, (2) planktonic debris that settled out of the photic zone of the water column of the ancient sea and onto the ocean floor, and (3) a hydrogenous fraction derived largely from bottom water of the ancient basin by means of inorganic reactions. The origins of these components of the Phosphoria Formation explain the increased levels of many metals.

The waste rock that results from phosphate mining is composed of overburden and underburden materials that have been removed to reach the bodies of phosphate ore. The waste rock typically is deposited on the surface, where it's exposed to the elements. Weathering of the waste rock results in material that more readily releases chemicals into the environment.

4.1.2 Wind Erosion from Waste Rock Piles to Surface Soils

In southeastern Idaho, extensive, wide-open spaces are common and create the potential for strong air currents. Therefore, wind erosion and subsequent deposition may be a significant mechanism of chemical transportation in the Resource Area, particularly at locations that may be frequented by recreational users and no longer actively managed by site operators.

The potential exists for wind to erode and re-suspend surface soil and transport it to other areas, both near and far away, depending on wind speed and other factors. Any metals that are closely associated with soil particles also will be transported. Deposition from this mechanism of transport may increase levels of metals at points some distance from the source. In addition, soils transported by wind will settle on leaf surfaces of nearby plants, where they may be directly taken up by the plant, washed onto the ground by rain, or eaten by herbivores or omnivores, thereby making any metals present available to the plants and animals in the vicinity.

4.1.3 Percolation from Waste Rock Piles to Groundwater and Surface Water

Precipitation can percolate through the waste rock piles and carry chemicals into the groundwater, or they may be released directly to surface water through seeps, springs, or french drains in the waste piles. Even though the Resource Area is relatively arid, percolation is one of the major transport mechanisms.

Chemicals may be carried into the groundwater, but based on current information, they do not appear to create a significant problem in the Resource Area. However, any chemicals dissolved in groundwater may be carried along until exiting into a stream, lake, or wetland.

4.1.4 Storm Water Runoff from Waste Rock Piles to Surface Water

As a result of spring snowmelt and storms, significant quantities of water may move across the waste piles as surface runoff. This surface flow will move particles of the waste rock into the local streams and ponds or onto adjacent terrestrial areas. Depending on the topography of the various waste rock piles, storm water runoff may be a significant transport mechanism.

4.1.5 Surface Water Transport

After chemicals enter the local streams or surface water bodies, the material can be transported significant distances from the waste rock piles. This material can be deposited in terrestrial environments during floods or in areas where sediment is trapped. In some areas, the chemicals may be deposited in fields or stock ponds by irrigation or pumping. Surface water transport is a significant transport mechanism for movement of chemicals away from waste rock piles.

4.1.6 Biotic Uptake

Plants may take up metals in significant quantities. The rate of uptake depends on the species and chemical and can vary significantly between species. In terrestrial systems, humans and animals can ingest various metals in water or food or through incidental ingestion of dust, soil, or sediment.

Metals also maybe taken up in significant quantities by aquatic plants. The rate of uptake depends on the species and can vary significantly among species. Similar to terrestrial systems, uptake by aquatic animals can occur by ingestion of food, water, and sediments. However, direct absorption from the surrounding media may be significant for some receptors in aquatic systems.

4.2 HUMAN HEALTH RISK ASSESSMENT

The preliminary CSM links potential or actual releases to potential human exposures. Specifically, the CSM identifies (1) potential chemical sources and mechanisms of potential release, (2) potential receptors and exposure pathways, and (3) exposure scenarios. These three elements were first presented in the "Draft Conceptual Site Model" (TtEMI 2001c) (referred to as the Draft CSM) and are repeated here.

As described in the EPA's RAGS (EPA 1989), an exposure pathway consists of four primary elements:

(1) Source or sources
(2) Release and transport mechanisms
(3) Exposure media
(4) Receptors

The human health CSM (see Figure 3) depicts human health exposure pathways specific to the Resource Area.

4.3 ECOLOGICAL RISK ASSESSMENT

For the AWERA, investigations are focused on ecological receptors most likely to be affected, given the fate and transport mechanisms of the chemicals involved, the ecotoxicological properties of the chemicals, and habitats at the site (EPA 1997b). The CSM for the AWERA is presented in Figure 6. The expected and potential primary producers and the primary, secondary, and tertiary consumers are presented. Assessment endpoints are highlighted for each trophic level that is included in the CSM. The CSM for the AWERA is discussed in more detail in Section 7.4.3.

5.0 SCREENING OF CHEMICALS OF CONCERN

Screening the data to select chemicals of potential concern (COPC) for humans and COPECs for ecological receptors involved the following steps:

- Tier 1 – The results of analysis of the waste rock were compared with data on the naturally occurring levels found in background soils in the western U.S. If the maximum concentration detected in waste rock was less than 2 times the mean background level for the western U.S., the chemical was considered for elimination as a COPC or COPEC. Data for sediment, surface water, and soil were evaluated for chemicals present at background levels in the waste rock. If the concentrations were not elevated in the other media, the chemical was eliminated from consideration. This evaluation resulted in the elimination of barium, lead, manganese, and thallium from further consideration. All other chemicals were evaluated in Tiers 2 and 3.
- Tier 2 – The concentrations of chemicals that passed the Tier 1 assessment were evaluated for riparian soils, surface water, and sediment against area-specific background concentrations. If the maximum detected concentration for the medium was less than 2 times the mean area-specific background level for the chemical, it was eliminated from consideration as a COPC or COPEC for that media. All chemicals retained after this comparison were evaluated on a media specific basis in Tier 3.
- Tier 3 – The maximum detected concentrations of chemicals for each medium that remained after the Tier 2 assessment was compared with media-specific benchmarks. The Tier 3 screening was conducted separately for COPCs for human health and COPECs for ecological receptors. For human COPCs, sediments were not considered because the exposure was evaluated as de minimis for the exposure scenarios under consideration.

The following benchmarks were used for selection of human health COPCs:

- Soils – EPA Region 9 residential preliminary remediation goals (PRG)
- Surface Water – EPA Region 9 tap water PRGs

If the maximum detected concentration did not exceed the applicable benchmark, the chemical was eliminated from consideration for that medium as a human health COPC.

The following benchmarks were used for ecological COPEC selection:

- Soils – EPA ecological soil screening levels (EcoSSL) were given priority when they were available for a chemical. For chemicals without EPA EcoSSLs, EPA Region 4 soil screening levels were used (see Table 7-1).

- Sediments – The lowest available benchmark from the threshold effects level (TEL), probable effects level (PEL), or upper effects threshold (UET) values were used for the comparisons (see Table 7-1).
- Surface Water – The ambient water quality criterion (AWQC) chronic criterion concentrations (CCC) were used for the comparisons (see Table 7-1).

If the maximum detected concentration did not exceed the applicable benchmark, the chemical was dropped from consideration for that medium as an ecological COPEC. After all media were screened, any chemical retained for any medium was retained for Tier 3 as an ecological COPEC for all media.

- Tier 4 - After all media were screened, a full evaluation was conducted of the information on each chemical based on the results of the medium-specific screening. The individual data sets were evaluated to identify any additional information that would provide an additional weight of evidence for retaining or rejecting a chemical as a human health COPC or COPEC. Based on this evaluation, a COPC or COPEC was selected or rejected for the AWRA.

The following chemicals were retained as COPCs for evaluation of risk to humans:

- Arsenic
- Cadmium
- Chromium
- Selenium

The following chemicals were retained as COPECs for evaluation of risk to ecological receptors:

- Cadmium
- Chromium
- Copper
- Nickel
- Selenium
- Vanadium
- Zinc

A more detailed discussion of how the chemicals of concern were selected is provided in Appendix B.

6.0 AREA WIDE HUMAN HEALTH RISK ASSESSMENT

The overall scope of this AWHHRA is to evaluate potential exposures to COPCs in multiple media and characterize the associated risks and hazards across the entire Resource Area for several receptor groups. The specific objectives of the AWHHRA are to (1) identify exposure scenarios (receptor and exposure pathway combinations), locations (for example, particular watersheds or stream segments), and COPCs that are associated with or contribute significantly to cancer risks and hazards greater than acceptable levels; and (2) focus ongoing and subsequent field investigations on the exposure scenarios, locations, and COPCs associated with or contributing significantly to unacceptable risks and hazards.

As described in EPA's RAGS, a risk assessment is typically conducted in the following four basic steps: (1) data evaluation and identification of COPCs, (2) exposure assessment, (3) toxicity assessment, and (4) risk and hazard characterization (EPA 1989).

The AWHHRA is organized as follows: Section 6.1 discusses the technical approach and identifies primary guidance documents used in the AWHHRA; Section 6.2 presents the analytical data selection procedures; Section 6.3 discusses selection of COPCs; Sections 6.4 and 6.5 discuss exposure and toxicity assessments, respectively; Section 6.6 discusses characterization of risk and hazard; Sections 6.7 through 6.9 present the Tier 1, 2 and 3 assessments, respectively; Section 6.10 discusses the uncertainty assessment, and Section 6.11 presents the AWHHRA summary and conclusions.

6.1 AREA WIDE HUMAN HEALTH RISK ASSESSMENT APPROACH

The AWHHRA was conducted following a tiered approach (see Figure 5). The objectives of the tiered approach were two-fold:

(1) To identify exposure scenarios (receptor and exposure pathway combinations) and locations (for example, particular watersheds or stream segments) that were associated with cancer risks and noncancer hazards greater than acceptable levels and

(2) To focus ongoing and subsequent field investigations on the exposure scenarios and locations associated with unacceptable risks and hazards.

The tiered approach consisted of three tiers. Sections 6.1.1 to 6.1.3 present descriptions of each tier.

TtEMI used the following the key EPA guidance documents in the AWHHRA:

- EPA. 1989. "Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)." Interim Final. OERR. Washington, DC. EPA/540/1-89/002. December.
- EPA. 1991. "RAGS, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors." Interim Final. OSWER Directive 9285.6-03. March 25.
- EPA. 1992. "Supplemental Guidance to RAGS: Calculating the Concentration Term." OSWER Publication 9285.7-081. May.
- EPA. 1997d. "Exposure Factors Handbook." Volumes 1 through 3. ORD. EPA/600/P-95/002Fa, - Fb, and - Fc. August.

6.1.1 Tier 1 Assessment

Purpose: Tier 1 was the first screening step for all potentially complete exposure scenarios identified in the human health CSM (see Figure 3). Other complete (or potentially complete) exposure pathways were considered to be de minimus or contribute only a negligible part of the total dose to the receptor. A qualitative discussion regarding why these exposure pathways are considered de minimus is presented in Section 6.4.2. It should be noted that no gardens, residential or otherwise, have been observed in any riparian areas in the Resource Area. Therefore, ingestion of homegrown produce from such a garden is a theoretical exposure scenario.

Detail: Exposure pathways resulting in cancer risks and noncancer hazards lower than acceptable levels (defined as hazard index [HI] = 1.0 and one in a million incremental cancer risk, see Section 6.1.2) were eliminated from further evaluation in the AWHHRA, except for exposure pathways that were deemed to be common in the Resource Area and were likely to be of particular concern to the general public (for example, ingestion of elk and beef cattle tissue associated with hunting and ranching). These and all other exposure pathways resulting in cancer risk and noncancer hazards greater than acceptable levels were carried forward in the Tier 2 quantitative evaluation.

Data: Tier 1 evaluated medium-specific analytical data collected by TtEMI in 2001 (referred to hereafter as 2001 data) (see Appendix H).

Exposure Point Concentrations (EPC): TtEMI used maximum detected concentrations of COPCs (see Section 6.3 for a discussion on COPC identification) in all media to quantify cancer risks and noncancer hazards for all exposure scenarios, except in cases where maximum detected concentrations were

measured in an exposure medium which did not correlate with the corresponding exposure scenario. For instance, the subsistence lifestyle receptor was not evaluated using maximum observed concentrations from the Resource Area stream segments, such as values from East Mill Creek, that cannot reasonably be expected to have the potential to support that scenario. Similarly, maximum soil concentrations for homegrown produce models did not use waste rock pile soils where it is indisputable that residential gardens do not and will not occur. Instead, fluvial or riparian soils were used to represent areas where residential gardens could occur. Soil chemical concentration data from these areas are considered relevant to the evaluation of the subsistence scenario, and the maximum detected concentration was used.

Exposure Parameters: Reasonable maximum exposure (RME) conditions, as defined by EPA (EPA 1989) were used in Tier 1.

6.1.2 Tier 2 Assessment

Purpose: Tier 2 was an area-wide evaluation of exposure pathways and COPCs carried over from the Tier 1 assessment, based on a watershed-, stream-, or riparian area-specific exposure area.

Detail: Tier 2 assessments consisted of two categories, Tier 2a and Tier 2b, based on the following exposure area definitions:

- Tier 2a: This tier involved evaluation of all exposure pathways associated with exposure areas that extend (or could extend) beyond stream-specific areas. For example, to account for ingestion of fish that may have been caught by receptors in a variety of streams, fish tissue EPCs were calculated on a watershed-specific basis (an exposure area that extends beyond stream-specific areas). Tier 2a addressed six exposure scenarios, including ingestion of (1) fish, (2) wild game (represented by elk), (3) beef cattle, (4) aquatic and terrestrial plants, (5) teas brewed from aquatic and terrestrial plants, and (6) surface water.
- Tier 2b: This tier involved evaluation of exposure pathways associated with stream-, riparian area-, and mine-specific exposure areas, including ingestion of homegrown produce, ingestion of surface soil, and inhalation of particulates.

In general, exposure scenarios and pathways associated with risks and hazards lower than acceptable levels were eliminated from further evaluation in the AWHHRA.

The following exposure pathways were not evaluated beyond Tier 2:

- Ingestion of wild game (as represented by elk) and ingestion of beef cattle (considered under Tier 2a): these exposure pathways were evaluated using data sets that could not be further broken down (see Section 6.3). Also, additional elk and beef tissue data sets are unavailable for comparison.
- Ingestion of homegrown produce, ingestion of surface soil, and inhalation of particulates: these exposure pathways were already evaluated on a stream- or mine-specific basis in Tier 2b. Also, it was assumed that there is little temporal variation of COPC concentrations in plant tissue, surface soil, and waste rock. Additional details regarding the proposed exposure scenario-specific application of the tiered approach are presented in Sections 6.4.2.

Data: Tier 2 evaluated medium-specific 2001 data (See Appendix H).

EPCs: For the fish and surface water ingestion exposure pathways, EPCs were calculated under RME and central tendency exposure (CTE) conditions as watershed-specific averages weighted by the relative presence of impacted and unimpacted stream segments as described in Appendix C. For all other exposure pathways, EPCs were calculated as the lower of the maximum detected concentration and 95 percent upper confidence limit of the mean (UCL_{95}) for RME conditions and the mean value for CTE conditions, consistent with EPA guidance (EPA 1992). Appendix C details the procedures used to calculate media-specific COPCs.

Exposure Parameters: In addition to evaluating RME conditions, Tier 2 evaluated CTE conditions (see Tables 6-1 and 6-2 for RME and CTE exposure parameters, respectively). Exposure parameters for CTE conditions represented central tendency values (for example, mean or fiftieth percentile), consistent with EPA guidance (EPA 1992). In general, CTE values were generally consistent with EPA guidance based on area-specific knowledge.

6.1.3 Tier 3 Assessment

Purpose: Tier 3 consisted of evaluating fish ingestion exposure scenarios in order to assess the impact of temporal changes in COPC concentrations.

Detail: Cancer risks and noncancer hazards were calculated on a watershed-specific basis. As necessary, this exposure pathway could also be evaluated on a stream-specific basis in the future as part of mine-specific risk assessments. As part of these future stream-specific evaluations, the potential for each stream to support a particular exposure scenario should be considered. For example, some streams in the

Resource Area (for example, Maybe Creek) have been shown to currently support little if any aquatic life – ingestion of fish from impacted stretches of these streams is unlikely to occur under current conditions. The potential for each stream to support the fish ingestion exposure scenario could be characterized through the use of stream-specific fraction-ingested (FI) values. These FI values should reflect the productivity of each stream and should be developed using a variety of criteria including, but not limited to, order; the number, type, size and species of fish present; and whether spawning has been observed in the stream. It should be noted, however, that (1) it is considered unlikely that receptors will be exposed exclusively to fish and surface water from individual streams and (2) based on the large number of fishable streams in each watershed, each of the three watersheds evaluated in the AWHHRA was assumed to be productive enough to support the alluvial ingestion rates (in other words, the FI for each watershed was assumed to be 1).

Data: Tier 3 evaluated medium-specific 2001 data and historical data (see Appendix H and MW [1999b]).

EPCs: EPCs were calculated in the same manner as for Tier 2.

Exposure Parameters: Tier 3 evaluated RME and CTE conditions, as described in Tier 2.

6.2 SELECTION OF ANALYTICAL DATA

This section presents analytical data selection procedures for evaluation of receptor-specific exposures. The medium-specific data sets used as the basis for the AWHHRA are discussed in detail in Section 7.2.1 of the Work Plan (TtEMI 2002a). In general, the AWHHRA is based on medium-specific analytical results associated primarily with samples collected in 2001 and supplemented by historical data. More specifically, Tiers 1 and 2 of the AWHHRA are based primarily on analytical data for 2001 (see Appendix H), as well as on data for elk and beef cattle presented in MW (2000), although Tier 3 is based on historical analytical data collected in 1998 (MW 1999b). Medium-specific analytical data sets that form the basis of Tiers 1 and 2 of the AWHHRA (with the exception of data sets for elk and beef tissue) are summarized in Table 6-3 (including the number and location of medium-specific samples). All medium-specific analytical data sets (waste rock, surface water, plant tissue, soil, game, beef cattle, and historical sample results) are briefly discussed in the following sections.

6.2.1 Waste Rock

MW, a consultant to IMA, collected samples of waste rock in Summer 2001 (TtEMI 2001e). Samples were collected from all or a portion of the waste piles at each of 14 mines. Samples of waste rock were analyzed for a comprehensive list of metals. Analytical results for waste rock are summarized in Appendix H. The locations of waste rock samples are shown in Figure 7. It should be noted that the samples were collected from black shale areas and may not be representative of the entire waste rock pile at each site.

6.2.2 Surface Water

TtEMI and IDEQ personnel collected surface water samples in May, June, July, and September 2001 (TtEMI 2001d; see also Appendix H). In total, surface water samples were collected from 39 locations associated with 24 different streams at locations upstream (uncontaminated) and downstream (potentially contaminated) of various mining sites. Surface water samples were analyzed for the list of parameters presented in Table 6-4. Figure 7 shows the location of the 2001 surface water samples that were used to form the basis for Tiers 1 and 2 of the AWHHRA.

6.2.3 Fish Tissue

TtEMI and IDEQ personnel collected fish tissue samples in July 2001 (TtEMI 2001d). In total, samples of fish tissue were collected from six sampling locations associated with both impacted and unimpacted reaches of the stream (see Table 6-3). The location, species, and weight of fish samples are summarized in Table 6-5. Samples of fish tissue were analyzed for a comprehensive list of metals (see Table 6-4). Figure 7 shows the locations of fish tissue samples considered in Tiers 1 and 2 of the AWHHRA.

6.2.4 Plant Tissue

TtEMI and IDEQ personnel collected samples of both aquatic and terrestrial plants in May and July 2001 (TtEMI 2001d). Specifically, tissue samples were collected from two aquatic species – watercress (*Nasturtium officinale*) and water buttercup (*Cara photomycetin*), and from four terrestrial species – wild onion (*Allium canadense*), bitterroot (*Camus spp.*), golden sage (*Artemesia spp.*), and red willow (*Salix spp.*). These plants represent species that members of the Shoshone Bannock Tribe either ingest or use to brew teas (TtEMI 2001f). Samples of plant tissue were collected in streams or riparian areas downstream of specific mines (impacted reaches) and from unimpacted (background) zones. The number and location

of plant tissue samples collected by TtEMI are summarized in Table 6-3. Figure 7 shows the locations of plant tissue samples TtEMI collected in Summer 2001 and considered in the AWHHRA.

Samples of bitterroot were collected only from unimpacted zones; therefore, receptor-specific exposure to contaminants in bitterroot was not considered in the AWHHRA. It was judged that human receptors were more likely to ingest watercress than water buttercup; therefore, receptor-specific exposures to contaminants in water buttercup were not considered in the AWHHRA. Contaminant concentrations in water buttercup are similar to levels detected in watercress samples (see Appendix H).

IMA collected additional samples of plant tissue in Summer 2001. However, the sampling methodology followed by IMA did not specify that samples be collected of the plant species mentioned above. Rather, samples were collected of whatever vegetation was present in selected locations. Therefore, the analytical results from plant tissue samples collected by IMA in Summer 2001 were not considered in the AWHHRA because samples of plant species likely to be ingested by human receptors were not collected.

6.2.5 Soil

Analytical results from soil samples collected in riparian areas along streams in the Resource Area were used to (1) assess potential receptor-specific exposure through incidental ingestion of soil, and (2) estimate the concentration of COPCs in homegrown produce from gardens planted in riparian areas. It should be noted that no gardens, residential or otherwise, have been observed on any riparian areas in the Resource Area. Therefore, ingestion of homegrown produce from such a garden should be considered a theoretical exposure scenario.

IMA collected soil samples from riparian areas in Summer 2001. Soil samples were collected from locations both upstream and downstream of mining facilities. Riparian areas upstream of mining facilities are referred to as unimpacted (or background) reaches and riparian areas downstream of mining facilities are referred to as impacted reaches. The number and locations of riparian area soil samples are summarized in Table 6-3; the locations of riparian soil samples are shown in Figure 7.

6.2.6 Game

Analytical results from skeletal muscle and liver samples (used to represent offal) collected from elk harvested from Idaho Game Management Units (GMU) 76 and 66A, as reported in MW's "1999 Interim

Investigation Data Report" (MW 2000), were used to represent the concentrations of COPCs in game tissue potentially ingested by human receptors.

6.2.7 Beef Cattle

Fifteen steers were confined on a seleniferous pasture for 9 weeks on a reclaimed overburden pile at the Henry Mine in July and August 1999 were included as part of a feedlot depuration study in Fall 1999 (MW 2000). Skeletal muscle and liver (as well as kidney and heart) samples were collected post-mortem. Analytical results associated with these samples were used to represent beef tissue potentially ingested by human receptors; as for elk, liver samples were used to represent offal. While cattle are not typically penned on a waste rock pile, the reclaimed areas present the most palatable forage in the Resource Area and appear to attract free-ranging animals; therefore, sufficient evidence does not exist to conclude that this study represents a "worst-case" scenario.

6.2.8 Historical Surface Water and Fish Tissue

Samples of surface water and fish tissue were collected by IMA throughout the Resource Area in May and September 1998 (MW 1999b). In total, surface water samples were collected from 51 sampling locations associated with 20 streams (in the three study watersheds) at locations upstream (unimpacted) and downstream (impacted) of different mining sites. Surface water samples were analyzed for selenium, cadmium, copper, chromium, cobalt, manganese, nickel, vanadium, zinc, calcium, iron, magnesium, potassium, and sodium, as well as a variety of water quality parameters such as sulfate and total alkalinity. Figure 7 shows the locations of the surface water samples collected by IMA in 1998. Similarly, samples of fish tissue were collected from three sampling locations associated with three streams at locations upstream (unimpacted) and downstream (impacted) of various mining sites. The number, species, and size of the fish IMA collected are summarized in Table 6-5. Samples of fish tissue were analyzed for six metals. Figure 7 shows the locations of the fish tissue samples collected by IMA in 1998.

6.3 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

This section presents the COPC selection process and the medium-specific COPCs that are evaluated in the tiered risk assessment approach described in Section 6.1.

Appendix B presents a description of the process used to select medium-specific COPCs. This process is briefly summarized below.

(1) Chemicals detected in waste rock at a maximum concentration less than twice the mean background level found in soils in the western U.S. were eliminated from further consideration in the AWHHRA (Shacklette and Boerngen 1984) unless found to be elevated in other media.

(2) Remaining chemicals were evaluated subsequently on a medium-specific basis against area-specific background concentrations. Chemicals with maximum detected concentrations for the specific medium less than twice the mean area-specific background level were eliminated from further consideration.

(3) For the remaining chemicals, maximum detected concentrations in soil were compared with EPA Region 9 residential PRG. The maximum detected concentration in water was compared with EPA Region 9 PRGs for tap water (EPA 2000d). Chemicals with maximum detected concentrations equal to or lower than applicable PRGs were eliminated from further consideration.

(4) Finally, each chemical and individual data set were evaluated to identify any additional information that would provide a weight-of-evidence basis for retaining or rejecting a chemical as a COPC (for example, association with historical operations, of particular concern to the public, etc.).

Generally, the chemicals retained as COPCs for evaluation of risk to humans include arsenic, cadmium, chromium, and selenium. Additional chemicals were retained as COPCs in waste rock, aquatic and terrestrial plants, and homegrown produce. The following sections identify the COPCs retained for each medium. Details providing rationale for the selection or rejection of COPCs are presented in Appendix B.

6.3.1 Riparian Area Surface Soil

Arsenic, cadmium, chromium, and selenium were retained as COPCs for evaluation of exposures to surface soil in riparian areas.

6.3.2 Waste Rock Pile Surface Soil

All chemicals detected at elevated concentrations in waste rock piles were retained as COPCs to be evaluated for potential exposure through inhalation of fugitive dust only. Those chemicals are listed below.

- Aluminum
- Antimony
- Arsenic
- Beryllium

- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Mercury
- Molybdenum
- Nickel
- Selenium
- Uranium
- Vanadium
- Zinc

6.3.3 Surface Water

Arsenic, cadmium, chromium, and selenium were retained as COPCs for evaluation of exposures to surface water.

6.3.4 Terrestrial Vegetation

There are no PRGs for ingestion of plant tissue. Therefore, chemicals present in soil and terrestrial plant tissue at concentrations greater than twice the average terrestrial plant background levels were retained for evaluation as COPCs. The chemicals retained for evaluation of terrestrial vegetation are listed below.

- Aluminum
- Antimony
- Arsenic
- Cadmium
- Chromium
- Cobalt
- Nickel
- Selenium
- Vanadium
- Zinc

6.3.5 Aquatic Vegetation

There are no PRGs for ingestion of plant tissue. Therefore, chemicals present in sediment and aquatic plant tissue at concentrations greater than twice the average aquatic plant background levels were retained for evaluation as COPCs. The chemicals retained for evaluation of aquatic vegetation include the metals and other inorganic chemicals listed for terrestrial vegetation, with the addition of copper.

6.3.6 Freshwater Fish

Arsenic, cadmium, chromium, and selenium were retained as COPCs for evaluation of exposure to freshwater fish.

6.3.7 Beef Cattle

Cadmium and selenium were retained as COPCs for evaluation of ingestion of beef cattle tissue. Skeletal muscle and liver samples from beef cattle were not analyzed for arsenic and chromium (MW 2000).

6.3.8 Elk

Cadmium and selenium were retained as COPCs for evaluation of ingestion of elk tissue. Samples of skeletal muscle and liver from elk were not analyzed for arsenic and chromium (MW 2000).

6.3.9 Homegrown Produce

There are no PRGs for ingestion of plant tissue. Therefore, chemicals present in soil and terrestrial plant tissue at concentrations greater than twice the average terrestrial plant background levels were retained for evaluation as COPCs. The chemicals retained for evaluation of homegrown produce include the substances listed for terrestrial vegetation.

6.4 EXPOSURE ASSESSMENT

This section discusses the methods used to quantify exposure associated with each complete exposure pathway in the Resource Area.

6.4.1 Human Receptors Evaluated Quantitatively

Three receptor groups were selected for quantitative evaluation in the AWHHRA: recreational hunter/fishers, Native Americans, and subsistence lifestyle. These receptor groups were selected primarily to allow for evaluation of a range of potential exposure and to address particular public and stakeholder concerns. No studies have been conducted regarding the potential presence of subsistence lifestyle receptors in the Resource Area. Therefore, no statements can be made regarding the potential presence or specific number of such receptors in the Resource Area. However, it is acknowledged that the Resource Area is very sparsely populated by ranchers, none of who rely solely on study area resources for subsistence. While selected numbers of the local population may rely on area resources for a significant supplement to their diets, a true subsistence lifestyle is unlikely within the Resource Area. Therefore, for the purpose of the AWHHRA, the subsistence lifestyle receptor should be considered a conservative, theoretical receptor.

6.4.2 Exposure Pathways Evaluated Quantitatively

Figure 3 presents the human health CSM that depicts human health exposure pathways specific to the Resource Area that are considered in the AWHHRA. Only complete exposure pathways (that is, exposure pathways that contain or potentially contain the four primary elements identified by EPA – source or sources, release and transport mechanisms, exposure media, and receptors) were considered in the AWHHRA.

The complete exposure pathways considered in the AWHHRA include:

- Ingestion of wild game (represented by elk) and beef cattle by receptors that include the recreational hunter and fisher, Native American, and subsistence lifestyle
- Ingestion of aquatic life (fish) by receptors that include the recreational hunter and fisher, Native American, and subsistence lifestyle
- Ingestion of teas brewed using aquatic and terrestrial plants by Native American receptors
- Ingestion of aquatic and terrestrial plants by Native American receptors and homegrown produce by subsistence lifestyle receptors. It should be noted that no home gardens associated with subsistence lifestyle receptors have been identified in the Resource Area and no resources have been expended for the purpose of such identification.
- Ingestion of surface soil by subsistence lifestyle receptors
- Ingestion of surface water by receptors that include the recreational hunter and fisher, Native American, and subsistence lifestyle
- Inhalation of fugitive dusts by receptors that include the recreational hunter and fisher, Native American, and subsistence lifestyle receptors while hunting by tracking on foot or using all-terrain vehicles near or on waste rock piles

Other complete (or potentially complete) exposure pathways are considered to be de minimus or contribute only a negligible part of the total dose to the receptor and were considered only qualitatively in the AWHHRA. These exposure pathways include: direct contact with surface water; ingestion and direct contact with sediment; ingestion and medicinal, religious, and other uses (for example, medicinal or ceremonial) of aquatic and terrestrial plants by Native American and subsistence lifestyle receptors; ingestion and direct contact with surface and subsurface soil by Native American and recreational hunter and fisher receptors; direct contact with surface and subsurface soil by subsistence lifestyle receptors; and ingestion and direct contact with groundwater.

An explanation of the basis for concluding these exposure pathways contribute only a negligible part of the total dose to the receptor (qualitative analysis) is provided below.

- Ingestion and Direct Contact with Surface Water: Surface water is not used as a source of drinking or household water in the Resource Area. Therefore, ingestion of chemicals in surface water is expected to occur only infrequently (for example, while hiking or hunting in the area or through inadvertent ingestion while swimming in surface water bodies). Also, inorganic chemicals are not especially well absorbed through direct contact with surface water. As with ingestion, direct contact with surface water is expected to be infrequent; because of the cold-water temperatures, receptors fishing in area surface water bodies are expected to wear waders most, if not all, of the time. Therefore, ingestion of surface water was only evaluated by for the hunter scenario and not for subsistence lifestyle receptors.
- Ingestion and Direct Contact with Sediment: Exposure to chemicals through incidental ingestion of sediment is expected to be minimal primarily because most sediment to which receptors are infrequently exposed is expected to be washed off either deliberately or inadvertently with surface water. Exposure to inorganic chemicals present in sediment that does manage to adhere to receptor's skin is also expected to be minimal because these chemicals are poorly absorbed through the skin.
- Ingestion and Medicinal, Religious, and Other Uses of Aquatic and Terrestrial Plants by Subsistence Receptors: Subsistence receptors are expected to be exposed to chemicals in the tissues of aquatic and terrestrial plants primarily through ingestion, and potentially through medicinal, religious, and other uses of these plants. The contribution to total exposure for the subsistence receptor associated with exposures to terrestrial and aquatic plants relative to ingestion of homegrown produce was expected to be small. As necessary, however, risks and hazards associated with exposures to terrestrial and aquatic plants as calculated for Native American receptors provide a reasonable surrogate and were used to provide estimates of the contribution to total exposure associated with these exposure routes for the subsistence receptor.
- Ingestion and Direct Contact with Surface and Subsurface Soil by Recreational Hunter/Fisher and Native American Receptor: As noted in MW (1999b), the maximum observed concentrations of inorganic chemicals in soil are one or more orders of magnitude less than chemical-specific EPA Region 9 industrial soil PRGs. Also, the magnitude of exposure to soil by recreational hunter/fisher and Native American receptors in the Resource Area was expected to be less than was assumed in the development of the industrial PRGs. Also, inorganic chemicals are poorly absorbed through the skin. Therefore, exposure through ingestion and direct contact to chemicals present in surface and subsurface soil for recreational hunter/fisher and Native American receptors was expected to be minimal.
- Direct Contact with Surface and Subsurface Soil by Subsistence Receptors: The maximum observed concentrations of inorganic chemicals in soil (as presented in Table 5-1 in MW [1999b]) exceed their respective residential PRGs for cadmium, manganese, nickel, and vanadium (EPA 2001). As defined by EPA Region 9, residential PRGs are based on potential exposure through both ingestion and direct contact. However, inorganic chemicals in soil are poorly absorbed through the skin. Therefore, potential exposure through direct contact with surface and subsurface soil does not contribute significant to total exposure for subsistence receptors and was not quantitatively evaluated.

- Ingestion and Direct Contact with Groundwater: As noted in MW (1999b), groundwater samples were collected from 20 groundwater wells inventoried in the Resource Area. The maximum concentrations of six inorganic chemicals (selenium, cadmium, manganese, nickel, vanadium, and zinc) are between one-half and one order of magnitude (5 to 10 times) lower than the EPA Region 9 tap water PRG. The mean concentrations of these same chemicals are almost two orders of magnitude less than their respective PRGs. Therefore, exposure to chemicals present in groundwater was expected to be associated with minimal risks and hazards. However, additional samples were collected by the Idaho Department of Health and were evaluated to ensure that groundwater is not an exposure pathway of concern.
- Inhalation of Fugitive Dust: Inhalation of fugitive dusts is generally expected associated with minimal risks and hazards. However, in Southeastern Idaho, extensive, wide-open spaces are common and create the potential for strong air currents to occur. Therefore, wind erosion may be a significant mechanism of chemical transportation in the Resource Area, particularly at locations potentially frequented by recreational users and no longer actively managed by site operators. Therefore, potential exposure to hunters through inhalation of fugitive dusts at or near waste rock piles was evaluated.
- Ingestion of Surface Water by Recreational Receptors: Hunting, fishing, and camping are popular recreational activities in the Resource Area. Recreational receptors are expected to get some or all of their drinking water while engaged in these activities from Resource Area streams. Therefore, in order to be health protective, potential ingestion of surface water by receptors engaged in recreational activities (including hunting and fishing) were evaluated in the AWHHRA.

6.4.3 Human Receptors Evaluated Qualitatively

The Native American traditional and subsistence lifestyle is a specific and separate receptor group. This receptor group was identified to evaluate Shoshone Bannock Tribal resource usage on aboriginal territory, ceded and federal lands. While quantitative assessment is provided for this group within the scope of standard risk assessment protocols, additional qualitative evaluation is required to outline potential exposure pathways and address particular Tribal concerns that are not conducive to formal risk assessment practices due to the diversity and breadth of traditional uses and cultural confidentialities.

6.4.4 Tribal Exposure Pathways Evaluated Qualitatively

The following exposure pathways, identified by the Shoshone Bannock Tribal technical representatives, can be considered complete pathways that contain or may contain the four elements identified by EPA: (1) source or sources, (2) release and transport mechanisms, (3) exposure media, and (4) receptors. Conservative assumptions were used in the quantitative risk assessment approach to attempt to compensate for uncertainties and counterpoise unspecified exposure paths. However, due to the breadth and diversity of traditional practices and the proprietary nature of Tribal medicines, ceremonies, and

materials, etc., the following pathways are evaluated in qualitative and comparative terms. Therefore, the contribution to the total dose of an individual Tribal receptor from these pathways could have the potential for increased risk to this receptor group under varying conditions. Several of these pathways are also discussed in Section 7.3.2.2 of the Work Plan (TtEMI 2002a).

- Ingestion of Plants and Animals in Traditional and Ceremonial Practices: The quantitative risk estimates include calculations for ingestion of selected plants and animals based on common Tribal uses, as designated by Tribal representatives during the scoping process. While these ingestion estimates result in negligible human health risks, the plant and animal surrogate species lists used are not comprehensive enough to represent every potential traditional or ceremonial use or exposure. The existing quantitative risk estimate approach contains a high level of conservatism in the selection of ingestion rates, media concentrations, exposure durations and other parameters, thought to be protective of potential unspecified Tribal uses. However, an increased potential for risks could exist from this pathway under varying conditions.
- Ingestion of Homegrown Produce and Traditional Gardens: The quantitative risk assessment includes a model for ingestion of homegrown produce for subsistence receptors, and a scenario for ingestion of selected traditional plants by Native Americans. Both scenarios result in minimal Tier 1 risks using the highest observed plant concentrations and include conservative assumptions thought to be protective of potential unspecified Tribal uses. However, there could exist a potential for increased risks from plants or locations that were not subject to identification and testing.
- Ingestion of Surface Soil: The quantitative risk assessment includes an ingestion of surface soil pathway for subsistence lifestyle receptors that resulted in minimal Tier 1 risk using the highest observed concentrations. The EPA Region 9 Industrial Soil PRGs also indicate risk thresholds for incidental soil ingestion and contact that are well above those observed in the Resource Area. This pathway is not expected to provide a significant risk to the Native American receptor; however, a potential for increased risk may exist for any unspecified practices that could result in substantially higher soil ingestion rates than those modeled.
- Dermal Absorption from Plants used for Medicinal, Traditional and Ceremonial Purposes: The quantitative risk assessment provides risk estimates based on direct ingestion of impacted media, which is the most direct and complete route for the accumulation of inorganics. While dermal exposure can occur, inorganic chemicals are typically poorly absorbed through the skin and are not expected to present a significant health risk to the Tribal receptor. However, these effects can vary based on solvent carriers and constituents; therefore, a potential for increased risks may exist for unspecified uses.
- Inhalation of Fugitive Dust and Particulates by Native American Range Riders and Herders: The quantitative risk assessment includes inhalation of fugitive dust and particulates pathways for all receptors which resulted in minimal risks. While Native American range riders and herders may have longer exposure periods than those modeled, the Tier 1 risk estimates assumed the highest observed concentrations for particulates and are so low that an increased exposure duration would still result in an estimate below human health hazard thresholds. This pathway is not expected to present a significant risk to Native American receptors.

It should be acknowledged that the Shoshone Bannock Tribes do not endorse current risk assessment standard practices. Tribal representatives have indicated that a more holistic risk approach should be developed that considers spiritual health, cultural losses and other areas of concern for Native American receptors and is not solely based on comparisons with toxicological thresholds. The Tribes have provided IDEQ with a general concurrence on the regional risk assessment effort within the limitations of estimating the likelihood of direct physical human health effects but reserve their right to discuss other Tribal considerations in subsequent decision-making processes.

6.4.5 Equations Used to Quantify Exposures

Exposure is defined as the contact of an organism with a chemical or physical agent. The magnitude of potential chemical exposure, which depends on the amount of a chemical available at human exchange boundaries (skin, lungs, and gut) during a specified period of time, are quantitatively assessed for the human receptors discussed in Section 6.4.

Exposure dose equations that consider contact rate, receptor body weight, and frequency and duration of exposure were used to estimate the intake or dose of each COPC for each receptor. Under Tier 1, exposures were calculated using the maximum detected medium-specific concentration of each COPC under RME exposure parameters. Under Tiers 2 and 3, exposures were calculated under both RME and CTE conditions.

An exposure can occur over a period of time. The total exposure can be divided by time to calculate an average exposure per unit of time. An average exposure can be expressed in terms of body weight. All exposures quantified in the AWHHRA were normalized for time and body weight and presented in units of milligrams of chemical per kilogram of body weight per day (mg/kg/day). These exposures are termed "intakes." Equation 6-1 is a generic equation for calculating chemical intake (EPA 1989).

$$D = \frac{C \times CR \times EF \times ED}{BW \times AT} \tag{6-1}$$

where

D = Dose: the amount of chemical at the exchange boundary (mg/kg/day); to evaluate exposure to noncarcinogenic chemicals, the intake is referred to as the average daily dose (ADD); to evaluate exposure to carcinogenic chemicals, the intake is referred to as the lifetime average daily dose (LADD)

C = Chemical concentration: the average concentration (referred to as the EPC) contacted over the exposure period (for example, milligram per kilogram [mg/kg] fish tissue [fish tissue results are initially reported as dry weight and are converted to wet weight]). All other media, except surface water, chemical wet weight concentrations are provided in dry weight.

CR = Contact rate: the amount of contaminated medium contacted per unit of time or event (for example, g/day for fish ingestion)

EF = Exposure frequency: how often the exposure occurs (days per year)

ED = Exposure duration: how long the exposure occurs (years)

BW = Body weight: the average body weight of the receptor over the exposure period (kilogram [kg])

AT = Averaging time: the period over which exposure is averaged (days); for carcinogens, the averaging time is 25,550 days based on a lifetime exposure of 70 years; for noncarcinogens, the averaging time is calculated as exposure duration (years) times 365 days/year

Variations of Equation 6-1 were used to calculate pathway-specific exposures to COPCs. The equations used for each exposure pathway are presented in Figure 4 of the Work Plan (TtEMI 2002a). The exposure parameter values considered under RME and CTE conditions are presented in Tables 6-1 and 6-2. The EPC calculations, pathway-specific intake equations and parameters, and evaluation of background and supplemental exposures are discussed below.

The equations used to estimate receptor-specific exposures are presented in Figure 4. The exposure parameters used to estimate receptor-specific exposures under RME and CTE exposure conditions are presented in Tables 6-1 and 6-2, respectively. For both RME and CTE evaluations, LADD and ADD are quantified. The LADD defines a dose level that is distributed (averaged) over an entire lifetime rather than a specific incremental exposure period; LADDs are the measure of exposure used to characterize risks associated with exposure to potential carcinogens. Unlike the LADD, the ADD is averaged over specified exposure duration rather than over an entire lifetime; ADDs are the measure of exposure used to characterize hazards associated with exposure to noncarcinogens.

The intake equations and exposure parameter values used in the AWHHRA were taken or adapted from EPA guidance documents, including RAGS (EPA 1989); “Exposure Factors Handbook” (EPA 1997d); and “RAGS, Volumes I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors” (EPA 1991). These documents provide guidance for selecting exposure parameter values and were used, along with Resource Area- and state-specific information (such as fish and game regulations), information from peer-reviewed scientific literature, and professional judgment, to identify

appropriate parameter values. The basis for the value selected for each exposure parameter under RME and CTE conditions is detailed in the footnotes to Tables 6-1 and 6-2, respectively.

Equations used to calculate the LADD and ADD are presented in Figure 4. Tables 6-9 to 6-14 present the chemical-specific factors used in these equations.

6.4.6 Calculation of Medium-specific Exposure Point Concentrations

The EPC is defined as the concentration of a COPC that a human receptor is exposed to at an exposure point. This section summarizes how medium-specific EPCs were derived for use in the AWHHRA. Summaries of medium-specific EPCs are presented in Table 6-6 for Tier 1 and Tables 6-7 to 6-8 for Tier 2. Refer to Appendix E for tables specific to receptors and exposure pathways.

Duplicate analytical results were averaged and represented by a single value, and each analytical result reported as a nondetect was replaced with a value equal to one-half of the sample quantitation limit (SQL) to calculate background concentrations and EPCs. These procedures are consistent with EPA guidance (EPA 1989, 2000c). As discussed in EPA's "Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, QA00 Version," (EPA 2000c) replacement of a nondetect analytical result with a value equal to one-half the SQL is most appropriate for data sets in which the frequency of censored or nondetect values is less than 15 percent.

Under Tier 1 of the tiered approach (see Section 6.1.1), the maximum detected medium-specific concentration of each COPC, applicable to the specific scenario based on area-specific knowledge, was used as the EPC. Tier 1 EPCs are summarized in Table 6-6. Under Tiers 2 and 3, and in accordance with EPA's "Supplemental Guidance to RAGS: Calculating the Concentration Term" guidance, the UCL_{95} of the mean or the maximum medium-specific concentration (whichever is lower) was used as the EPC under RME conditions and the mean concentration was used as the EPC under CTE conditions (EPA 1992).

As discussed in Section 6.1.2 and summarized in Figure 4, EPCs were calculated under Tiers 2 and 3 on (1) a watershed-specific basis for Category 2a exposure pathways retained from Tier 1 (ingestion of fish and surface water), (2) a Resource Area-wide basis for ingestion of beef cattle and elk tissue, and (3) a riparian area-specific basis for ingestion of surface soil. As will be discussed in Section 6.6, risks and hazards associated with inhalation of particulates, ingestion of terrestrial and aquatic plants, ingestion of tea brewed from terrestrial and aquatic plants, and ingestion of homegrown produce were determined to

be insignificant under Tier 1; therefore, these exposure pathways were not retained for assessment under Tier 2.

Appendix C presents the equations, procedures, and assumptions used to calculate EPCs under Tiers 2 and 3. With the exception of EPCs for beef cattle and elk tissue (which were calculated based on data generated in 1999 [MW 2000]), Tier 2 EPCs were based entirely on medium-specific analytical data for samples collected in 2001. Under Tier 3, EPCs were calculated for surface water and fish tissue based on analytical data for samples collected in 1998 (MW 1999b). Medium-specific Tier 2 EPCs are presented in Tables 6-9 through 6-16 and are summarized in Tables 6-7 and 6-8. Medium-specific Tier 3 EPCs are presented in Tables 6-17 through 6-20.

6.4.7 Evaluation of Background and Supplemental Exposure

In addition to the intakes specific to exposure pathways associated with complete (or potentially complete) exposure pathways, receptors may also receive additional exposure to COPCs through background exposures and through ingestion of dietary supplements. As described in the "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP) (EPA 1990) and in EPA RAGS (EPA 1989), potential exposure to carcinogenic COPCs is evaluated in terms of incremental exposure. As interpreted by IDEQ, incremental exposure refers to exposures through complete (or potentially complete) exposure pathways, but does not include exposure through background exposures and ingestion of dietary supplements. However, characterization of hazards associated with exposures to noncarcinogenic COPCs is based on an assessment of whether the dose to a receptor has exceeded an exposure threshold (see Section 6.5.1). Background exposures and exposures through ingestion of dietary supplements must be considered in addition to exposures through complete exposure pathways to evaluate whether an exposure threshold has been exceeded.

As discussed in Section 6.4.5, for the purpose of assessing potential exposures to carcinogenic COPCs, the AWHHRA considered only exposures related to complete (or potentially complete) exposure pathways. However, for the purpose of characterizing hazards associated with exposure to COPCs, receptor-specific total exposures were estimated as the sum of (1) exposure related to complete (or potentially complete) exposure pathways, (2) background exposures, and (3) supplemental exposures.

As described in Section 6.1.1, the purpose of Tier 1 of the AWHHRA is to identify those exposure pathways and COPCs associated with potentially significant risks and hazards and to eliminate from further consideration, those exposure pathways and COPCs associated with insignificant risks and

hazards. Therefore, Tier 1 addresses exposures related only to complete (or potentially complete) exposure pathways and does not consider total exposures (e.g. factoring in background and supplemental exposure). Under Tier 2, receptor-specific total exposures, risks, and hazards including exposures, risks, and hazards associated with background and supplemental exposure to arsenic, cadmium, chromium, and selenium are considered (see Section 6.8.3.7). Similarly, as described in Section 6.1.3, the purpose of Tier 3 of the AWHHRA is to compare the impact of temporal variations in COPC concentrations on the calculated exposures associated with ingestion of fish tissue and surface water. Therefore, background and supplemental exposures are addressed indirectly as part of revised receptor-specific total exposures, risks, and hazards.

6.4.7.1 Background Exposure

The primary source of information on background exposure to COPCs was chemical-specific toxicity profiles prepared by the Agency for Toxic Substances and Disease Registry (ATSDR). However, the information provided in these profiles is insufficient to develop a precise estimate of background exposure (in addition to exposure through potentially complete exposure pathways – which in turn includes exposure to naturally occurring chemical concentrations). For example, information is available on estimates of average daily intake (ADI) and intake through ingestion of food in general. Information is also available on the concentration of specific COPCs in various foodstuffs (such as fish, beef, and dairy products). However, information is not available for all potential background exposures or for all potential foodstuffs.

The greatest receptor-specific exposures (and, therefore, risks and hazards) are associated with ingestion of fish and surface soil (see Section 6.6 and 6.7). For both of these exposure pathways, an FI value of 1 was used for all receptors under both RME and CTE conditions. Receptor-specific exposure through ingestion of fish was evaluated on a watershed-specific basis. Therefore, the use of a FI value of 1 assumes that receptors ingest fish only from watersheds within the Resource Area and that enough fish are present in each of the watersheds to meet the receptor-specific intake assumptions. Exposure through ingestion of soil was evaluated for subsistence lifestyle receptors on a residential area- (RA) specific basis. Therefore, the use of a FI value of 1 assumes that receptors (young children and the elderly) remain on residential property throughout the assumed period of exposure (exposure duration). The use of a FI value of 1 also assumes that these receptors do not receive any background exposure through these two pathways.

Therefore, in an effort to estimate the impact of background exposure, the ADI for each COPC was identified and summed with the ADD based on complete exposure pathways for each receptor. It is acknowledged that there is some degree of overlap (in some cases, significant overlap) in this approach because some portion of the ADI for a receptor is related to exposures associated with complete exposure pathways (such as ingestion of fish, elk, beef cattle, terrestrial and aquatic plants, homegrown produce, and surface water, and inhalation of particulates).

6.4.7.2 Supplement Exposure

Chromium and selenium are typically present in dietary supplements; however, arsenic and cadmium are not. Therefore, potential exposure to chromium and selenium through ingestion of dietary supplements was estimated and summed with the ADD and background exposure. Supplement exposure (such as exposure through dietary supplements) to selenium used was compared with the supplement exposure for selenium obtained from MW (1999b) and in IMA (2002). Supplement exposure to chromium was estimated by comparison to the selenium results.

Information on ADIs (obtained primarily from ATSDR toxicity profiles) and supplement exposure (obtained [or extrapolated] from MW [1999b]) is summarized below for each of the four core COPCs: arsenic, cadmium, chromium, and selenium.

Arsenic

As stated above, arsenic is not typically present in dietary supplements. The total mean daily intake of inorganic arsenic ranges from 0.3 to 2.4 micrograms per kilogram body weight per day (µg/kg/day) for children 0.5 to 4 years old (ATSDR 2000a; see Table 5-4). These children are assumed to weight about 13 kg, which is similar to the 15-kg body weight assumed in the AWHHRA. The midpoint of this range, 13.5 µg/kg/day (1.35E-02 mg/kg/day) was used as an estimate of the ADI for children. The total mean daily intake of inorganic arsenic ranges from 0.1 to 0.7 µg/kg/day for adults (ATSDR 2000a, see Table 5-4). The midpoint of this range, 0.4 µg/kg/day (4.0E-04 mg/kg/day) was used as an estimate of the ADI for adults.

Cadmium

As stated above, cadmium is not typically present in dietary supplements. Estimates of the total mean daily intake of cadmium were not identified. However, ATSDR notes that the adult intake of cadmium

from food in the U.S. was estimated to be about 30 µg/day based on the Total Diet Study (ATSDR 1999). The largest contribution to this intake was from grain, cereal products, potatoes, and other vegetables (Gartrell and others 1986, as cited in ATSDR 1999). Based on an assumed adult body weight of 70 kg, this daily intake from food can be converted to an intake of 4.3E-04 mg/kg/day. This value was used as a measure of the ADI for cadmium for both adult and child receptors.

Chromium

Estimates of the total mean daily intake of chromium were not identified. However, ATSDR notes that the adult intake of chromium from consumption of selected diets (diets with 25 and 43 percent fat) in the U.S. was estimated to be about 76 µg/day (with a range of 25 to 224 µg/day) (Kumpulainen and others 1979, as cited in ATSDR 2000b). Based on an assumed adult body weight of 70 kg, this daily intake from food can be converted to an intake of 1.1E-03 mg/kg/day. This value was used as a measure of the ADI for chromium for both adult and child receptors.

As discussed below, the ADI of selenium through ingestion of supplements is 1.4E-03 mg/kg/day. Based on a review at a typical pharmacy (Walgreens – 5002 Bellaire Boulevard in Bellaire, Texas), the concentration of chromium and selenium is similar in supplements and multivitamins. In addition, as with selenium, chromium is not present in all supplements and multivitamins. Therefore, based on these two observations, it was assumed that the ADI of selenium through ingestion of supplements could also be used as an estimate of the ADI of chromium through ingestion of supplements. Therefore, an ADI of selenium through ingestion of supplements of 1.4E-03 mg/kg/day was used for both adult and child receptors.

Selenium

As discussed in ATSDR's toxicity profile, estimates of selenium intake for Americans ranges from about 0.071 to 0.152 mg/day (ATSDR 1996). This range is based on a variety of studies that estimated intake from a review of concentrations of selenium in various foodstuffs (U.S. Food and Drug Administration [FDA] 1982; Levander 1987; Pennington and others 1989; Schrauzer and White 1978; Schubert and others 1987; and Welsh and others 1981, all as cited in ATSDR 1996). The midpoint of this range, 0.111 mg/day, compares favorably with the mean dietary intake of selenium (0.108 mg/day) presented in MW (1999b). For the AWHHRA, therefore, the daily intake of 0.111 mg/day for selenium was converted to a body-weight basis using the assumed adult body weight of 70 kg; this conversion resulted in an ADI of

1.6E-03 mg/kg/day. This value was used as a measure of the ADI for selenium for both adult and child receptors.

MW (1999b) presents a modeled lower exposure for a receptor taking a "low-dose, inorganic Se [selenium] multi-vitamin," of 0.0006 mg/day and an upper bound of 0.04 mg/day for an individual taking "two high-dose supplement tablets (200 µg) per day." MW also notes that, on average, only about 40 percent of adults "routinely take vitamins or mineral supplements and not all vitamins contain Se [selenium]" (MW 1999b). Based on probabilistic techniques, the mean ADI of selenium in supplements was calculated as 1.00E-01 mg/day (MW 1999b; see Attachment H-2). MW subsequently refined its analysis of selenium intake through ingestion of supplements and multivitamins (IMA 2002). The refined analyses considered additional information gathered regarding usage of mineral supplements containing selenium. When the two forms of supplementation (mineral supplements and multivitamins) were added together, and considering the likelihood of individuals taking these supplements, the total selenium intake has a distribution with a mean of 0.0188 mg/day. For the AWHHRA, therefore, this intake value was converted to a body-weight basis using the assumed adult body weight of 70 kg. The resulting intake value of 2.7E-04 mg/kg/day was used as a measure of the intake of selenium through ingestion of supplements for both adult and child receptors.

6.5 TOXICITY ASSESSMENT

This section identifies toxicity values used to quantify potential adverse effects on human health that are associated with potential exposure to COPCs. Toxicity profiles are prepared for each of the COPCs (see Appendix D). The toxicity profiles discuss the pathway-specific dose responses for each COPC focusing on the identification of no observed adverse effect levels (NOAEL) and lowest observed adverse health effect level (LOAEL) that were used to establish the pathway-specific toxicity values. Toxicity values include reference doses (RfD) for noncarcinogenic COPCs and slope factors (SF) for carcinogenic COPCs. Toxicity values used to assess the effects for noncarcinogenic and carcinogenic COPCs are discussed in Sections 6.5.1 and 6.5.2. Section 6.5.3 briefly discusses the toxicological profiles prepared for the COPCs.

6.5.1 Toxicity Values for Noncarcinogenic Chemicals of Potential Concern

Standard risk assessment models assume that noncarcinogenic effects, unlike carcinogenic effects, exhibit a threshold; that is, a level of exposure exists below which no adverse effects are observed. The potential for noncarcinogenic health effects to result from exposure to a COPC was assessed by comparing an

exposure estimate for intake with an RfD. The RfD represents an estimated daily intake rate for a noncarcinogenic COPC that is believed to pose no appreciable risk of adverse effects on human health, including sensitive populations, during a lifetime. RfDs also apply to the noncarcinogenic effects of potential carcinogens. An RfD is specific to a chemical and a route of exposure, such as ingestion or inhalation. The AWHHRA considered only exposure through ingestion and inhalation.

EPA workgroups review all human and animal studies relevant to a chemical and select the study or studies pertinent to derive the RfD. RfDs are often derived from a measured NOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that was administered during the toxicity study without inducing observable adverse effects. If a NOAEL cannot be established, the LOAEL is used. The LOAEL corresponds to the lowest daily dose administered in the toxicity study that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect."

The NOAEL or LOAEL is divided by uncertainty factors to ensure that the RfD derived will be protective of human health. Uncertainty factors usually occur in multiples of 10, and each factor represents a specific area of uncertainty inherent in the extrapolation from available data. Uncertainty factors account for (1) variations in the general population to protect sensitive subgroups such as child and the elderly, (2) extrapolation of data from animals to humans (interspecies extrapolation), (3) derivation of a chronic RfD based on a subchronic rather than a chronic study, and (4) derivation of an RfD based on a LOAEL instead of a NOAEL. Modifying factors may be applied to reflect additional uncertainties associated with the data. Modifying factors range from 0 to 10.

Additionally, chronic and subchronic RfDs are developed for different periods of exposure. Chronic RfDs are generally used to evaluate exposures that occur over periods of more than 7 years, and subchronic RfDs are used to evaluate exposures that occur over periods of 2 weeks to 7 years. Based on the exposure durations assumed, chronic RfDs were used to characterize the hazards associated with all receptor-specific exposures. COPC-specific chronic RfDs were identified from the following hierarchical list of sources:

- EPA's Integrated Risk Information System (IRIS) (EPA 2002)
- EPA's Health Effects Assessment Summary Tables (HEAST) (EPA 1997c)
- EPA's National Center for Environmental Assessment

Table 6-22 summarizes the RfDs used in the AWHHRA, along with the confidence level, critical effect, and source.

6.5.2 Toxicity Values for Carcinogenic Chemicals of Potential Concern

The potential for exposure to a specific chemical to result in carcinogenic effects is evaluated differently than for noncarcinogenic effects. The upper-bound excess lifetime cancer risk (ELCR) is calculated by multiplying the dose from a specific route of exposure by an SF. An SF is an upper-bound estimate of the probability of a carcinogenic response per unit dose of a chemical over a lifetime. SFs are derived through mathematical models based on a high-to-low dose extrapolation and assume that no threshold exists for initiation of cancer. Because of the use of the nonthreshold assumption and the UCL_{95} of the slope of the dose-response curve, SFs provide a conservative, upper-bound estimate of potential cancer risks. The actual response to a dose of a chemical is therefore probably less than the predicted response (EPA 1989).

EPA assigns weight-of-evidence designations to indicate the likelihood that a chemical agent is a carcinogen in humans. These designations are defined as (EPA 1989):

- "A" indicates that a chemical is considered a proven carcinogen in humans.
- "B" indicates that a chemical is considered a probable human carcinogen. "B1" indicates that suggestive but inconclusive evidence of carcinogenicity in humans is associated with the chemical, and "B2" indicates that conclusive evidence of a chemical's carcinogenicity is documented in repeated animal studies but that evidence of carcinogenicity in humans is inconclusive.
- "C" indicates that a chemical is a possible human carcinogen, either because a single high-quality animal study demonstrates carcinogenicity or because several low-quality animal studies indicate carcinogenicity.
- "D" indicates that evidence of a chemical's carcinogenicity in animals or humans is inconclusive.
- "E" indicates that no evidence of a chemical's carcinogenicity is available from adequate human or animal studies.

SFs are specific to a chemical and a route of exposure and are generally available for both the oral (ingestion or gavage) and inhalation routes. The potentially complete exposure pathways evaluated in the AWHHRA involve ingestion and inhalation exposures. In accordance with EPA guidance, SFs were identified using the same hierarchical list of sources presented in Section 6.5.1. Table 6-23 identifies the oral and inhalation SFs used in the AWHHRA.

6.5.3 Toxicity Profiles

A brief description of the toxic effects of each COPC is presented in the toxicological profiles in Appendix D of this report. The toxicological profiles focus on the effects most likely to be observed at environmental exposure levels that form the basis for the toxicity values. Toxic effects other than the carcinogenic and noncarcinogenic effects quantitatively assessed include reproductive, teratogenic, and mutagenic effects. The toxicity values, critical effects, and any uncertainty factors used in calculating the toxicity values are also summarized in the toxicological profiles.

6.6 CHARACTERIZATION OF RISK AND HAZARD

This section characterizes the carcinogenic risks and noncarcinogenic hazards associated with the exposure pathways identified in Section 6.4.2. Risks and hazards are characterized for individual COPCs, multiple COPCs within each exposure pathway, and exposures attributable to multiple exposure pathways, as appropriate. Sections 6.6.1 and 6.6.2 discuss the methodologies used to characterize noncarcinogenic hazards and carcinogenic risks.

6.6.1 Methodology for Hazard Characterization

The potential for receptors to develop noncancerous health effects is characterized by comparing an intake for a specific exposure period (the ADD) with an RfD developed for a similar exposure period. When performed for a single chemical, this comparison yields a ratio known as the hazard quotient (HQ), which is calculated as shown in Equation 6-2.

$$HQ = ADD/RfD \tag{6-2}$$

where

HQ	=	Hazard quotient
ADD	=	Average daily dose (mg/kg/day)
RfD	=	Reference dose (mg/kg/day)

Adverse health effects are not expected at an HQ of 1 or lower. An HQ greater than 1 indicates a potential for adverse noncarcinogenic health effects (EPA 1989). RfDs for chronic exposure were used in the AWHHRA to characterize noncarcinogenic hazards for all receptor-exposure pathway combinations.

Within a given exposure pathway, a receptor may be exposed to multiple chemicals associated with noncarcinogenic health effects. The procedures outlined in "Guidelines for the Health Risk Assessment of Chemical Mixtures" and RAGS (EPA 1986, 1989) were used in the AWHHRA to estimate the total noncarcinogenic hazards for each exposure pathway. The total noncarcinogenic hazard that can be attributed to exposure to multiple COPCs through a single pathway is calculated as shown in Equation 6-3.

$$HI_{EP} = HQ_1 + HQ_2 + \ldots + HQ_i \qquad (6\text{-}3)$$

where

HI_{EP} = Total hazard index for a given exposure pathway

HQ_i = Hazard quotient for the ith COPC

This methodology assumes that the effects of the various COPCs to which a receptor is exposed are additive.

Receptors may be exposed through a number of exposure pathways at specific exposure points (see the human health CSM, Figure 3). At each exposure point, the total exposure for a receptor equals the sum of the exposures through the various exposure pathways to which the receptor is exposed. Exposure pathway combinations were developed for each receptor under each exposure scenario. Initially, the combinations were based on the highest receptor-specific total HI for each exposure pathway regardless of their relative location. The total noncarcinogenic hazard posed to a receptor through a combination of exposure pathways is calculated as shown in Equation 6-4.

$$\text{Total HI} = HI\,(EP_1) + HI\,(EP_2) + \ldots + HI\,(EPj) \qquad (6\text{-}4)$$

where

$HI\,(EP_j)$ = Hazard index that results from the jth exposure pathway

As part of Tier 2, care was taken to ensure that the same receptor would consistently face multiple exposure pathways before summing the HIs associated with these different exposure pathways. Clearly, it is inappropriate to combine HIs that are associated with location-specific maxima calculated assuming that the entire exposure to a receptor takes place at each location. Summing location-specific maxima under Tier 1 is consistent with a screening-level approach.

In accordance with EPA guidance, all total HIs that exceed 1 were evaluated further (EPA 1989). In some cases, a refined assessment can include development of separate total HIs based on specific target organs and systems. Typically, target organs and systems affected by each COPC are identified based on (1) effects (termed "critical effects" by EPA) that occur at levels of exposure that correspond to LOAELs, or (2) effects at exposure levels that slightly exceed LOAELs, as appropriate. However, as discussed in Sections 6.6 through 6.8, receptor-specific total HIs greater than 1 are associated with at least 1 COPC-specific HI greater than 1; total HIs are driven by exposure to one or two COPCs. Therefore, segregated (or target organ-specific) HIs were not calculated as part of the AWHHRA. The uncertainty associated with this approach is discussed in Section 6.10.

The hazard characterization was completed following the tiered approach described in Section 6.1. Total hazards were estimated as described above for the exposure pathways that have been retained to that point under each step of this tiered approach. The Tier 1 assessment resulted in elimination of specific exposure scenarios and COPCs from further consideration because they were associated with hazards less than 1 (and risks less than 1E-06). In addition, specific COPCs were eliminated from further consideration because they were associated with HIs less than 0.1 (and risks less than 1E-07). Tiers 2 and 3 (as described in Sections 6.1.2 and 6.1.3) provide for more detailed assessment of exposure scenarios that are associated with hazards greater than or equal to 1 as calculated in Tier 1.

6.6.2 Methodology for Risk Characterization

For carcinogenic COPCs, risk estimates represent the incremental probability that an individual will develop cancer over a lifetime as a result of exposure to the COPC (EPA 1989). The ELCR is calculated as shown in Equation 6-5.

$$\text{ELCR (Risk)} = \text{LADD} \times \text{SF} \qquad (6\text{-}5)$$

where

LADD = Lifetime average daily dose (mg/kg/day)

SF = Slope factor $(\text{mg/kg/day})^{-1}$

Risk is expressed as a probability. For example, a risk of 1E-06 indicates one additional case of cancer in an exposed population of 1 million. The SF in almost all cases represents a UCL_{95} of the probability of a carcinogenic response based on experimental data used in a linear zed multistage model. The resulting

estimate therefore represents an upper-bound estimate of the carcinogenic risk. The actual risk probably does not exceed the estimate and is likely to be less (EPA 1989).

In the revised NCP (EPA 1990), EPA has established an "acceptable" range for carcinogenic risk associated with exposure at Superfund sites of 1E-06 to 1E-04 (one case of cancer in an exposed population of 10,000). In general, EPA uses a potential upper-bound risk of 1E-06 as a point of departure for setting remediation goals. Though the Resource Area is not a Superfund site, EPA's range is relevant and appropriate for use in evaluating risk levels.

Within a given exposure pathway, receptors may be exposed to more than one chemical. The total upper-bound risk associated with exposure to multiple chemicals through a single pathway is estimated as shown in Equation 6-6.

$$Risk_{EP} = Risk_1 + Risk_2 + \ldots + Risk_i \qquad (6\text{-}6)$$

where

$Risk_{EP}$ = Total risk for a given exposure pathway

$Risk_i$ = Risk estimate for the ith COPC

As discussed in Section 6.5.1 for noncarcinogenic COPCs, combinations of exposure pathways were initially developed for receptors by summing the maximum risks associated with each exposure pathway, regardless of the locations of these maximums. The total risk posed to a receptor through a combination of pathways is calculated as shown in Equation 6-7.

$$\text{Total Risk} = \text{Risk}\ (EP_1) + \text{Risk}\ (EP_2) + \ldots + \text{Risk}\ (EP_i) \qquad (6\text{-}7)$$

where

Total Risk = Risk resulting from multiple exposure pathways

Risk (EPj) = Risk resulting from the jth exposure pathway

The approach described above is consistent with the widely held belief that the total carcinogenic risk associated with exposure to multiple carcinogenic COPCs can be estimated as the sum of the carcinogenic risks posed by individual COPCs (EPA 1986). The risk characterization was completed following the

tiered approach described in Section 6.1. Total risks were estimated as described above for the exposure scenarios retained to that point under each step of this tiered approach. The Tier 1 assessment resulted in elimination of specific exposure scenarios from further consideration because they were associated with risks less than 1E-06. In addition, specific COPCs were eliminated from further consideration because they were associated with risks less than 1E-07 (and HIs less than 0.1). Tiers 2 and 3 (as described in Sections 6.1.2 and 6.1.3) provide more detailed analyses of exposure scenarios that were associated with risks greater than or equal to 1E-06 as calculated in Tier 1.

6.7 TIER 1 SCREENING ASSESSMENT

The Tier 1 methodology is presented in Section 6.1.1. This section presents cancer risks and noncancer hazards for all receptors. Tables 6-24 and 6-25 present summaries of noncancer hazards and cancer risks, respectively.

Section 6.7.1 presents the Tier 1 cancer risk and noncancer hazard results for all receptors. Section 6.7.2 presents an evaluation of the results.

6.7.1 Tier 1 Cancer Risk and Noncancer Hazard Results

This section presents the results of the Tier 1 calculations. RME exposure parameters (along with the maximum detected medium-specific concentrations) were used to calculate risks and hazards for each receptor including all COPCs at the entire site. These site-wide receptors include the recreational hunters and fishers (see Section 6.7.1.1), Native Americans (see Section 6.7.1.2), and the subsistence lifestyle receptors (see Section 6.7.1.3). Tier 1 hazard and risk summaries are listed in Tables 6-24 and 6-25.

6.7.1.1 Recreational Hunter and Fisher Receptors

Adult and child recreationalists hunting or fishing on or near the site are expected to be potential receptors. Tables E-16 to E-25 in Appendix E present Tier 1 results for exposure, hazard and risk for the adult and child recreationalist receptors.

Adult Recreationalist

The total HI of 1.0 for adult recreationalists equals an HI of 1.0. The total HI is driven by potential ingestion of aquatic life (0.81). All of the individual exposure pathways resulted in an HI less than 1.0 and generally do not warrant any further consideration in terms of the adult recreationalist:

- Ingestion of aquatic life (0.81)
- Ingestion of surface water (1.3E-01)
- Ingestion of beef cattle – skeletal (8.2E-02)
- Ingestion of beef cattle – offal (1.8E-02)
- Ingestion of elk and wild game – skeletal (5.6E-03)
- Ingestion of elk and wild game – offal (1.7E-03)
- Inhalation of particulates (1.2E-04)

The total risk of 4.3E-07, including all pathways for adult recreationalists, was less than 1E-06.

Child Recreationalist

The total HI of 2.0 for child recreationalists exceeds an HI of 1.0. The total HI is driven by potential ingestion of aquatic life (1.4) associated with selenium (0.93) and cadmium (0.42). This hazard resulted from data for fish samples collected from East Mill Creek. The following exposure pathways resulted in an HI less than 1.0 and, generally, do not warrant any further consideration:

- Ingestion of surface water (3.8E-01)
- Ingestion of beef cattle – skeletal (1.5E-01)
- Ingestion of beef cattle – offal (8.6E-02)
- Ingestion of elk and wild game – skeletal (8.1E-03)
- Ingestion of elk and wild game – offal (7.0E-03)
- Inhalation of particulates (4.2E-04)

The total risk of 3.0E-07, including all pathways for child recreationalists, was less than 1E-06. The grand total risk of 7.3E-07 (the sum of adult and child risks) is less than 1E-06.

6.7.1.2 Native American Receptors

Adult and child Native Americans who hunt, fish, and gather on or near the site are expected to be potential receptors. Tables E-1 to E-15 in Appendix E present Tier 1 results for exposure, hazard, and risk for adult and child Native American receptors.

Adult Native American

The total HI of 2.4 for adult Native Americans exceeds an HI of 1.0. The total HI is driven by potential ingestion of aquatic life (1.2) associated with selenium (0.83) and cadmium (0.38). This hazard resulted from data for fish samples collected from East Mill Creek.

The following exposure pathways resulted in an HI less than 1.0 and, generally, do not warrant any further consideration:

- Ingestion of tea (8.7E-01)
- Ingestion of surface water (1.3E-01)
- Ingestion of beef cattle – skeletal (1.0E-01)
- Ingestion of beef cattle – offal (5.1E-02)
- Ingestion of aquatic and terrestrial plants (2.0E-02)
- Ingestion of elk and wild game – skeletal (5.2E-04)
- Ingestion of elk and wild game – offal (4.2E-04)
- Inhalation of particulates (1.2E-04)

The total risk of 1.1E-06, including all pathways for adult Native Americans slightly exceeds 1E-06.

Child Native American

The total HI of 3.2 for child Native Americans exceeds an HI of 1.0. The total HI is driven by potential ingestion of aquatic life (2.0) associated with selenium (1.4) and cadmium (0.64). This hazard resulted from data for fish samples from East Mill Creek. The following exposure pathways resulted in HIs less than 1.0 and, generally, do not warrant any further consideration:

- Ingestion of surface water (3.8E-01)
- Ingestion of beef cattle – skeletal (1.9E-01)

- Ingestion of tea (4.8E-01)
- Ingestion of beef cattle – offal (9.2E-02)
- Ingestion of aquatic and terrestrial plants (2.0E-02)
- Ingestion of elk and wild game – skeletal (7.5E-04)
- Ingestion of elk and wild game – offal (6.1E-04)
- Inhalation of particulates (4.2E-04)

The total risk of 4.1E-07, including all pathways for child Native Americans, was less than 1E-06. The grand total risk of 1.5E-06 (the sum of adult and child risks) slightly exceeds 1E-06.

6.7.1.3 Subsistence Lifestyle Receptors

The adult and child subsistence lifestyle receptors include individuals who live near the site and maintain gardens and fish and hunt near the site for subsistence. Table E-26 to E-39 in Appendix E present Tier 1 results for exposure, hazard, and risk for adult and child subsistence lifestyle receptors.

Adult Subsistence Lifestyle Receptor

The total HI of 6.4 for adult subsistence lifestyle receptors exceeds an HI of 1.0. The total HI is driven by potential ingestion of aquatic life (5.5) associated with selenium (3.8) and cadmium (1.7). This hazard resulted from data for fish samples collected from East Mill Creek. All other pathways resulted in HIs less than 1.0, which are considered insignificant. They are listed below.

- Ingestion of surface water (3.6E-01)
- Ingestion of surface soil (3.5E-01)
- Ingestion of beef cattle – skeletal (8.2E-02)
- Ingestion of beef cattle – offal (1.8E-02)
- Ingestion of elk and wild game – skeletal (6.9E-02)
- Ingestion of aboveground produce (1.0E-02)
- Ingestion of elk and wild game – offal (1.7E-03)
- Ingestion of homegrown produce (1.1E-02)
- Inhalation of particulates (3.4E-04)

The total risk of 2.7E-05 for adult subsistence lifestyle receptors exceeds a risk of 1E-06. The risk is driven by potential exposure to arsenic through ingestion of surface soil. The following exposure

pathways resulted in risks that slightly exceed or are less than 1.0E-06 and do not warrant any further consideration:

- Inhalation of particulates (1.2E-06) – based on the conservative assumption that all chromium in waste piles is in the hexavalent form
- Ingestion of homegrown produce (2.0E-09)

Child Subsistence Lifestyle Receptor

The total HI of 14 for child subsistence lifestyle receptors is driven by several exposure pathways. The HI of 9.2 for child subsistence lifestyle receptors who ingest aquatic life is driven by selenium (6.3) and cadmium (2.9). This hazard resulted from data for fish samples collected from East Mill Creek. The HI of 3.2 for child subsistence lifestyle receptors who ingest surface soil is driven by cadmium (1.6) and arsenic (1.2). This hazard resulted from data for a single surface soil sample collected along Rasmussen Creek in the Blackfoot River/Little Blackfoot watershed. The total HI of 1.1 for child subsistence lifestyle receptors who ingest surface water is driven by selenium. This hazard resulted from data for surface water samples collected from East Mill Creek. The following exposure pathways resulted in HIs less than 1.0 and, generally, do not warrant any further consideration:

- Ingestion of beef cattle – skeletal (1.5E-01)
- Ingestion of beef cattle – offal (8.6E-02)
- Ingestion of elk and wild game – skeletal (1.8E-02)
- Ingestion of elk and wild game – offal (7.0E-03)
- Ingestion of homegrown produce (1.4E-02)
- Inhalation of particulates (1.2E-03)

The risk of 4.8E-05 for child subsistence lifestyle receptors that ingest surface soil exceeds a risk of 1.0E-06. The risk is driven by arsenic. All other pathways resulted in risks that slightly exceed or are less than 1E-06, which are considered insignificant. They are listed below.

- Inhalation of particulates (1.2E-06)
- Ingestion of homegrown produce (5.3E-10)

The grand total risk (the sum of adult and child risks) for subsistence lifestyle receptors is 7.6E-05.

6.7.2 Results of Tier 1 Assessment

This section lists the COPCs and exposure pathways that were eliminated from further assessment and that were retained for Tier 2 assessment. Only exposure pathways that result in an HI greater than 1.0 and a risk greater than 1E-06 and only the COPCs that drive these exposure pathways (associated with total HIs greater than or equal to 0.1 and risks greater than or equal to 1E-07) were retained. The COPCs and exposure pathways remain receptor-specific, whether they are eliminated or retained for further analysis.

6.7.2.1 Chemicals of Potential Concern and Exposure Pathways Eliminated from Further Consideration

As discussed in Section 6.1.1, all exposure pathways that result in an HI less than 1.0 and a risk less than 1E-06 were eliminated from further analysis. The exposure pathways that were eliminated from further consideration include:

- Inhalation of particulates
- Ingestion of aquatic and terrestrial plants
- Ingestion of tea
- Ingestion of homegrown produce

Ingestion of elk and beef cattle tissues (skeletal muscle and offal [represented by liver]) were found to be associated with risks less than 1E-06 and HIs less than 1. Nonetheless, these exposure pathways were retained for assessment under Tier 2 because hunting and ranching are common to the Resource Area. Therefore, it was assumed that these exposure pathways might be of particular concern to the public.

In addition, the COPCs that do not drive the exposure pathways retained were eliminated. COPCs that drive the exposure pathway pose a hazard or risk of greater than 0.1 or 1E-07. For the exposure pathways retained, the COPCs that were eliminated from further consideration include:

- Aluminum
- Antimony
- Barium
- Beryllium
- Boron
- Cobalt
- Copper
- Cyanide
- Iron
- Lead
- Magnesium
- Manganese

- Mercury
- Molybdenum
- Nickel
- Silver
- Thallium
- Uranium
- Vanadium
- Zinc

For all receptors, chromium resulted in an HI less than 1.0 and risks slightly greater than 1E-06 (associated with inhalation of particulates). The risks obtained were based on a worst-case scenario. Although no data on speciation are available, it was conservatively assumed that the concentrations consisted only of hexavalent chromium. EPA Region 9 assumes a ratio of 1 (hexavalent chromium) to 6 (trivalent chromium) when no speciation data are available. This assumption would further reduce the risk to all receptors.

6.7.2.2 Chemicals of Potential Concern and Exposure Pathways Retained for Tier 2 Assessment

As stated in Section 6.6.1, only exposure pathways associated with total risks and HIs equal to or greater than 1E-06 and 1 under Tier 1 were retained for consideration. This requirement was conservatively applied in that exposure pathways retained were considered for all three receptor groups even if receptor-specific risks and hazards were found to be insignificant for one or more of the receptor groups. It should be noted that risks associated with inhalation of particulates slightly exceeded 1E-06 for adult and child subsistence lifestyle receptors. These risks were calculated based on the conservative assumption that all chromium present in waste piles is in the hexavalent form. Because chromium is expected to be present almost entirely in the trivalent form, the actual risks associated with the inhalation of particulates is expected to be less than 1E-06. Therefore, inhalation of particulates was not retained for Tier 2 assessment. In addition, as discussed elsewhere, ingestion of elk and beef cattle were retained for Tier 2 because these exposure pathways may be of particular concern to the public.

Similarly, only COPCs associated with total risks greater than 1E-07 and HIs greater than or equal to 0.1 under Tier 1 were retained for consideration under Tier 2. Once again, this requirement was conservatively applied. That is, COPCs must be associated only with total risks and HIs greater than 1E-07 and 0.1 for a single receptor to be retained and considered under Tier 2 for all three receptor groups. The following exposure pathways and COPCs were retained for consideration under Tier 2:

Exposure Pathways

- Ingestion of aquatic life
- Ingestion of surface water
- Ingestion of surface soil
- Ingestion of elk tissue (skeletal muscle and offal [represented by liver])
- Ingestion of beef cattle tissue (skeletal muscle and offal [represented by liver])

COPCs

- Arsenic
- Cadmium
- Chromium
- Selenium

6.8 TIER 2 AREA WIDE HUMAN HEALTH RISK ASSESSMENT

The Tier 2 methodology is presented in Section 6.1.2. This section presents cancer risks and noncancer hazards for all receptors. Sections 6.8.1 and 6.8.2 present exposure pathways evaluated in Tiers 2a and 2b. Section 6.8.3 presents Tier 2 risk and hazard results. Section 6.8.4 presents an evaluation of Tier 2 results.

6.8.1 Tier 2a Exposure Pathways

Tier 2a evaluated exposure pathways that could extend beyond areas specific to streams. The pathways evaluated include (1) ingestion of aquatic life, (2) ingestion of wild game (represented by elk), (3) ingestion of beef cattle, (4) and ingestion of surface water.

The ingestion of fish and surface water exposure pathways were evaluated on watershed-specific basis. Results are discussed for the following three watersheds: Blackfoot/Little Blackfoot, Salt, and Georgetown. The ingestion of elk and beef cattle exposure pathways were evaluated on a Resource Area-wide basis.

6.8.2 Tier 2b Exposure Pathways

Tier 2b evaluated the single exposure pathway with exposure areas specific to riparian areas – ingestion of surface soil. The ingestion of surface soil exposure pathway was separated based on exposure areas specific to riparian areas. These exposure areas were labeled RA1 through RA8.

6.8.3 Tier 2 Cancer Risk and Noncancer Hazard Results

This section includes the results of the Tier 2 calculations. RME- and CTE-specific EPCs and exposure parameters were used to assess risks and hazards for each receptor for the exposure pathways and COPCs retained from Tier 1. Results are organized and presented as follows:

- Exposure pathways evaluated on a watershed-specific basis (ingestion of fish and surface water) – Sections 6.8.3.1 (Blackfoot/Little Blackfoot watershed), 6.8.3.2 (Salt watershed), and 6.8.3.3 (Georgetown watershed)
- Ingestion of beef cattle tissue – Section 6.8.3.4
- Ingestion of elk tissue – Section 6.8.3.5
- Results specific to riparian areas (ingestion of surface soil) – 6.8.3.6

RME and CTE results are presented for recreationalist, Native American, and subsistence lifestyle receptors in each section. For the purpose of the AWHHRA, COPCs contributing significantly to total risk and hazards are referred to as "risk and hazard drivers." Risk and hazard drives are defined for the AWHHRA as those COPCs that alone or in combination with other COPCs contribute about 90 percent or greater of the total calculated risk or hazard.

Tables 6-26 and 6-27 present summaries of the hazard results for all receptors under RME and CTE conditions, respectively. Table 6-28 presents a summary of the risk results for all receptors under both RME and CTE conditions. Appendix E presents receptor-, exposure pathway-, and COPC-specific exposure, risk, and hazard results.

6.8.3.1 Blackfoot/Little Blackfoot Watershed

Ingestion of aquatic life in the Blackfoot/Little Blackfoot watershed was associated with an HI of greater than 1.0 under RME conditions but not under CTE conditions (with the exception of the subsistence lifestyle child). EPCs for fish tissue in the Blackfoot/Little Blackfoot watershed are included in

Table 6-9. The hazards resulting from RME and CTE conditions are presented in Tables 6-26 and 6-27, respectively, and are listed below.

Adult Recreationalist

- RME (0.35)
- CTE (7.8E-02)

Child Recreationalist

- RME (0.58)
- CTE (0.13)

Adult Native American

- RME (0.52)
- CTE (0.12)

Child Native American

- RME (0.87)
- CTE (0.20)

Adult Subsistence Lifestyle Receptor

- RME (2.4) driven by selenium (2.0) and cadmium (0.35)
- CTE (0.68)

Child Subsistence Lifestyle Receptor

- RME (4.0) driven by selenium (3.4) and cadmium (0.59)
- CTE (1.1) driven by selenium (0.97)

Ingestion of surface water in the Blackfoot/Little Blackfoot watershed was not associated with an HI of greater than 1.0 for RME or CTE conditions. EPCs for surface water in the Blackfoot/Little Blackfoot

watershed are included in Table 6-10. The hazards are presented in Tables 6-26 and 6-27 under RME and CTE conditions, respectively, and are listed below.

- Adult recreationalist: RME (1.6E-03); CTE (2.3E-04)
- Child recreationalist: RME (4.8-03); CTE (5.7E-04)
- Adult Native American: RME (1.6E-03); CTE (2.3E-04)
- Child Native American: RME (4.8E-03); CTE (5.7E-04)
- Adult subsistence lifestyle receptor: RME (4.6E-03); CTE (6.2E-04)
- Child subsistence lifestyle receptor: RME (1.4E-02); CTE (1.5E-03)

Of the four COPCs retained for Tier 2 assessment, only arsenic is considered a potential carcinogen through ingestion. However, arsenic was not detected in either fish tissue or surface water samples. Therefore, risks were not calculated for these exposure pathways.

6.8.3.2 Salt Watershed

Ingestion of aquatic life in the Salt watershed was associated with an HI of greater than 1.0 under RME conditions only for subsistence lifestyle receptors but not under CTE conditions for any receptors. EPCs for fish tissue in the Salt watershed are included in Table 6-11. The hazards calculated under RME and CTE conditions are presented in Tables 6-26 and 6-27, respectively, and are listed below.

Adult Recreationalist

- RME (0.22)
- CTE (5.2E-02)

Child Recreationalist

- RME (0.37)
- CTE (8.7E-02)

Adult Native American

- RME (0.33)
- CTE (7.7E-02)

Child Native American

- RME (0.55)
- CTE (0.13)

Adult Subsistence Lifestyle Receptor

- RME (1.5) driven by selenium (1.3)
- CTE (0.45)

Child Subsistence Lifestyle Receptor

- RME (2.5) driven by selenium (2.3)
- CTE (0.76)

Ingestion of surface water in the Salt watershed was not associated with an HI of greater than 1.0 for RME or CTE conditions. Surface water EPCs in the Salt watershed are included in Table 6-12. The hazards are presented in Tables 6-26 and 6-27 under RME and CTE conditions, respectively, and are listed below.

- Adult recreationalist: RME (5.7E-04); CTE (6.4E-05)
- Child recreationalist: RME (1.7E-03); CTE (1.6E-04)
- Adult Native American: RME (5.7E-04); CTE (6.4E-05)
- Child Native American: RME (1.7E-03); CTE (1.6E-04)
- Adult subsistence lifestyle receptor: RME (1.6E-03); CTE (1.7E-04)
- Child subsistence lifestyle receptor: RME (4.8E-03); CTE (4.2E-04)

Of the four COPCs retained for Tier 2 assessment, only arsenic is considered a potential carcinogen through ingestion. However, arsenic was not detected in either fish tissue or surface water samples. Therefore, risks were not calculated for these exposure pathways.

6.8.3.3 Georgetown Watershed

Ingestion of aquatic life in the Georgetown watershed generally associated with an HI of greater than 1.0 under RME conditions for the Native American child and both adult and child subsistence lifestyle

receptors, but not under CTE conditions for any receptors. EPCs for fish tissue in the Georgetown watershed are included in Table 6-13. The hazards calculated under RME and CTE conditions are presented in Tables 6-26 and 6-27, respectively, and are listed below.

Adult Recreationalist

- RME (0.47)
- CTE (6.0E-02)

Child Recreationalist

- RME (0.79)
- CTE (0.10)

Adult Native American

- RME (0.70)
- CTE (9.0E-02)

Child Native American

- RME (1.2) driven by selenium (0.96) and cadmium (0.22)
- CTE (0.15)

Adult Subsistence Lifestyle Receptor

- RME (3.2) driven by selenium (2.6) and cadmium (0.58)
- CTE (0.52)

Child Subsistence Lifestyle Receptor

- RME (5.3) driven by selenium (4.4) and cadmium (0.98)
- CTE (0.88)

Ingestion of surface water in the Georgetown watershed was not associated with an HI of greater than 1.0 for RME or CTE conditions. EPCs for surface water in the Georgetown watershed are included in Table 6-14. The hazards are presented in Tables 6-26 and 6-27 under RME and CTE conditions, respectively, and are listed below.

- Adult recreationalist: RME (2.7E-04); CTE (5.8E-05)
- Child recreationalist: RME (7.9E-04); CTE (1.4E-04)
- Adult Native American: RME (2.7E-04); CTE (5.8E-05)
- Child Native American: RME (7.9E-04); CTE (1.4E-04)
- Adult subsistence lifestyle receptor: RME (7.5E-04); CTE (1.6E-04)
- Child subsistence lifestyle receptor: RME (2.2E-03); CTE (3.8E-04)

Of the four COPCs retained for Tier 2 assessment, only arsenic is considered a potential carcinogen through ingestion. However, arsenic was not detected in either fish tissue or surface water samples. Therefore, risks were not calculated for these exposure pathways.

6.8.3.4 Beef Cattle Tissue

Ingestion of beef cattle, both skeletal and offal, was not associated with an HI of greater than 1.0 for RME or CTE conditions. EPCs for beef cattle are included in Table 6-15. The hazards are presented in Tables 6-26 and 6-27 under RME and CTE conditions, respectively, and are listed below.

Adult Recreationalist

- Skeletal: RME (5.5E-02); CTE (5.4E-03)
- Offal: RME (2.2E-03); CTE (3.1E-04)

Child Recreationalist

- Skeletal: RME (0.1); CTE (1.0E-02)
- Offal: RME (1.0E-02); CTE (1.5E-03)

Adult Native American

- Skeletal: RME (6.7E-02); CTE (6.6E-03)
- Offal: RME (6.0E-03); CTE (6.1E-04)

Child Native American

- Skeletal: RME (0.12); CTE (1.2E-02)
- Offal: RME (1.1E-02); CTE (1.1E-03)

Adult Subsistence Lifestyle Receptor

- Skeletal: RME (5.5E-02); CTE (5.4E-03)
- Offal: RME (2.3E-03); CTE (3.1E-04)

Child Subsistence Lifestyle Receptor

- Skeletal: RME (0.1); CTE (1.0E-02)
- Offal: RME (1.0E-02); CTE (1.5E-03)

Of the four COPCs retained for consideration under Tier 2, only arsenic is considered potentially carcinogenic through ingestion. However, samples of beef cattle tissue were not analyzed for arsenic. Therefore, risks were not calculated for this exposure pathway.

6.8.3.5 Elk Tissue

Ingestion of elk and wild game, both skeletal and offal, was not associated with an HI of greater than 1.0 under RME or CTE conditions. Refer to Table 6-15 for elk EPCs. The hazards are presented in Tables 6-26 and 6-27 under RME and CTE conditions, respectively, and are listed below.

Adult Recreationalist

- Skeletal: RME (2.6E-03); CTE (9.4E-04)
- Offal: RME (5.8E-04); CTE (2.3E-03)

Child Recreationalist

- Skeletal: RME (3.8E-03); CTE (1.4E-03)
- Offal: RME (2.3E-03); CTE (8.6E-04)

Adult Native American

- Skeletal: RME (2.4E-04); CTE (8.6E-05)
- Offal: RME (1.4E-04); CTE (4.8E-05)

Child Native American

- Skeletal: RME (3.6E-04); CTE (1.4E-04)
- Offal: RME (2.0E-04); CTE (7.6E-05)

Adult Subsistence Lifestyle Receptor

- Skeletal: RME (3.2E-02); CTE (9.4E-04)
- Offal: RME (5.8E-04); CTE (2.3E-03)

Child Subsistence Lifestyle Receptor

- Skeletal: RME (8.4E-02); CTE (1.4E-03)
- Offal: RME (2.3E-03); CTE (8.6E-04)

Of the four COPCs retained for consideration under Tier 2, only arsenic is considered potentially carcinogenic through ingestion. However, samples of elk tissue were not analyzed for arsenic. Therefore, risks were not calculated for this exposure pathway.

6.8.3.6 Results Specific to Residential Areas

Hazards and risks were calculated for data on surface soil samples specific to RAs for the subsistence lifestyle receptor only. Ingestion of surface soil was not associated with an HI of greater than 1.0 under RME or CTE conditions, except for the child subsistence lifestyle receptor that ingests surface soil from RA1 (HI of 1.6) (see Tables 6-26 and 6-27). The hazard is driven by cadmium (0.73), arsenic (0.68), and

selenium (0.17). EPCs specific to soil in potential RAs are included in Table 6-16. The ranges of hazards for ingestion of surface soil are listed below for the subsistence lifestyle receptor.

Adult Subsistence Lifestyle Receptor

- RME (2.3E-02 - 0.17)
- CTE (1.1E-02 - 8.4E-02)

Child Subsistence Lifestyle Receptor

- RME (0.22 – 1.6)
- CTE (0.11 - 0.80)

Ingestion of surface soil resulted in risks greater than 1E-06 for all riparian areas sampled. The risks were all driven by arsenic. See Table 6-28 for a list of risks for each riparian area. It should be noted that the risk from ingestion of surface soil in the riparian areas was approximately the same as the risks associated with ingestion of arsenic in surface soil in unimpacted areas of the Resource Area and for the western U.S. (Table 6-28).

6.8.3.7 Receptor-specific Total Results

The total hazards for each receptor (without consideration of background and supplement exposures) are listed below. The range of total hazards presented for the subsistence lifestyle receptors represents the impact of the range of hazards associated with ingestion of surface soil (as presented in Section 6.7.1.3).

Adult Recreationalist

- Blackfoot/Little Blackfoot watershed: RME (0.41); CTE (8.7E-02)
- Salt watershed: RME (0.28); CTE (6.1E-02)
- Georgetown watershed: RME (0.53); CTE (6.9E-02)

Child Recreationalist

- Blackfoot/Little Blackfoot watershed: RME (0.71); CTE (0.15)
- Salt watershed: RME (0.49); CTE (0.10)

- Georgetown watershed: RME (0.91); CTE (0.12)

Adult Native American

- Blackfoot/Little Blackfoot watershed: RME (0.60); CTE (0.12)
- Salt watershed: RME (0.40); CTE (8.5E-02)
- Georgetown watershed: RME (0.78); CTE (9.7E-02)

Child Native American

- Blackfoot/Little Blackfoot watershed: RME (1.0); CTE (0.21)
- Salt watershed: RME (0.69); CTE (0.14)
- Georgetown watershed: RME (1.3); CTE (0.16)

Adult Subsistence Lifestyle Receptor

- Blackfoot/Little Blackfoot watershed: RME (2.5 to 2.6); CTE (0.71 to 0.78)
- Salt watershed: RME (1.6 to 1.8); CTE (0.47 to 0.55)
- Georgetown watershed: RME (3.3 to 3.4); CTE (0.54 to 0.62)

Child Subsistence Lifestyle Receptor

- Blackfoot/Little Blackfoot watershed: RME (4.4 to 5.8); CTE (1.3 to 2.0)
- Salt watershed: RME (2.9 to 4.3); CTE (0.88 to 1.6)
- Georgetown watershed: RME (5.8 to 7.1); CTE (1.0 to 1.7)

Background and supplement exposures to arsenic, cadmium, chromium, and selenium were estimated for adult and child receptors (see Section 6.4.7). Table 6-29 presents background and supplement exposures. These exposures were divided by the oral RfD to calculate the background and supplement HIs listed below.

<u>Arsenic</u>

- Adult background HI (1.33)
- Child background HI (45)

Cadmium

- Adult/child background HI (0.86)

Chromium

- Adult/child background HI (7.33E-04)
- Adult/child supplemental HI (9.33E-04)

Selenium

- Adult/child background HI (0.32)
- Adult/child supplemental HI (5.4E-02)

The most significant hazard associated with exposure through background and supplement sources is a hazard of 45 associated with background exposure to arsenic in soils by a child receptor. It is assumed that the background exposure to arsenic may be overestimated by taking the midpoint of the range of ADIs as the child background exposure. Watershed-specific risks were all driven by incidental soil ingestion.

Also, a hazard of 1.33 is associated with background exposure to arsenic by an adult receptor which is greater than 1. It should also be noted that background exposure to cadmium by adult and child receptors is nearly significant at 0.86. Finally, a hazard of 0.32 is associated with background exposure to selenium by adult and child receptors, which is notable. The hazards associated with background exposure to chromium and supplement exposure to both chromium and selenium are negligible.

The total hazards for each receptor including hazards associated with background and supplement exposure are listed below. The range of total hazards presented for the subsistence lifestyle receptors represents the impact of the range of hazards associated with ingestion of surface soil (as presented in Section 6.7.1.3).

Adult Recreationalist

- Blackfoot/Little Blackfoot watershed: RME (3.0); CTE (2.7)
- Salt watershed: RME (2.9); CTE (2.6)
- Georgetown watershed: RME (3.1); CTE (2.6)

Child Recreationalist

- Blackfoot/Little Blackfoot watershed: RME (46.9); CTE (46.4)
- Salt watershed: RME (46.7); CTE (46.3)
- Georgetown watershed: RME (47.1); CTE (46.3)

Adult Native American

- Blackfoot/Little Blackfoot watershed: RME (3.2); CTE (2.7)
- Salt watershed: RME (3.0); CTE (2.7)
- Georgetown watershed: RME (3.4); CTE (2.7)

Child Native American

- Blackfoot/Little Blackfoot watershed: RME (47.2); CTE (46.4)
- Salt watershed: RME (46.9); CTE (46.3)
- Georgetown watershed: RME (47.5); CTE (46.4)

Adult Subsistence Lifestyle Receptor

- Blackfoot/Little Blackfoot watershed: RME (5.1 to 5.2); CTE (3.3 to 3.4)
- Salt watershed: RME (4.2 to 4.4); CTE (3.0 to 3.1)
- Georgetown watershed: RME (5.9 to 6.0); CTE (3.1 to 3.2)

Child Subsistence Lifestyle Receptor

- Blackfoot/Little Blackfoot watershed: RME (50.6 to 52); CTE (47.5 to 48.2)
- Salt watershed: RME (49.1 to 50.5); CTE (47.1 to 47.8)
- Georgetown watershed: RME (52 to 53.3); CTE (47.2 to 47.9)

These totals are dominated by COPC-specific hazards greater than 1 associated with background exposure to arsenic and to a lesser extent cadmium.

The total risk was calculated for the subsistence lifestyle receptor based on results for both the watershed and RAs. The risk was the same for each watershed. The range of risks based on data for the RAs is listed below. See Table 6-28 for the risk calculated for each RA.

Adult Subsistence Lifestyle Receptor

- RME (3.8E-06 – 1.4E-05)
- CTE (5.7E-07 – 2.1E-06)

Child Subsistence Lifestyle Receptor

- RME (7.2E-06 – 2.6E-05)
- CTE (3.6E-06 – 1.3E-05)

Again, the risks calculated for each RA are similar to the risks calculated based on the concentration of arsenic in uncontaminated soil in the Resource Area and in soil from the western U.S. (see Table 6-28).

6.8.4 Evaluation of Tier 2 Results

This section includes a summary of the results for each receptor, a comparison of the RME and CTE results, and the exposure pathways that were evaluated under the Tier 3 assessment.

6.8.4.1 Summary of Receptor-specific Results

Total hazards in each watershed for receptors that include the recreationalist, Native American, and adult subsistence lifestyle are driven by background exposure to arsenic and, to a lesser extent, cadmium. Resource Area-related hazards (that is, hazards without consideration of background and supplement exposures) are driven by selenium, and to a lesser extent, cadmium through ingestion of aquatic life (and ingestion of soil for subsistence lifestyle receptors). The hazard in each watershed for the child subsistence lifestyle receptor is driven by data for selenium and cadmium through ingestion of aquatic life; and by selenium, cadmium, and arsenic through ingestion of surface soil. The selenium EPCs in fish tissue are similar to the concentration of selenium found in fish from uncontaminated reaches (see Table 6-30).

It should be noted that the only hazards greater than 1.0 for receptors other than subsistence lifestyle receptors are for the child Native American receptor. Specifically, the child Native American receptor has a total hazard (not considering background and supplement exposures) of 1.0 and 1.3 for the Blackfoot/Little Blackfoot and Georgetown watersheds, respectively.

For the Blackfoot/Little Blackfoot watershed, no COPC-specific hazard is greater than 1.0. The total hazard of 1.0 is driven by selenium (0.88) and cadmium (0.13). Therefore, this total was further evaluated focusing on the target organs and systems affected by these two COPCs. As noted in Appendix D, both cadmium and selenium are known to impact the gastrointestinal system. Therefore, it is appropriate to sum the COPC-specific hazards for these two COPCs. However, for the Georgetown watershed, the total hazard associated with selenium alone is 1.1. Since a single constituent caused the HQ to exceed 1.0, no further assessments necessary to establish that a potential risk exists. Therefore, the total hazard for Georgetown watershed was not subjected to detailed analysis of affected target organs and systems consistent with EPA guidance (EPA 1989).

With regard to the subsistence lifestyle receptors, all total hazards under RME conditions are associated with a COPC-specific hazard greater than 1.0. Under CTE conditions, no adult hazards are greater than 1.0. However, total hazards in all three watersheds are greater than 1.0 for the child subsistence lifestyle receptor.

In the Blackfoot/Little Blackfoot watershed, the total hazard is driven by a COPC-specific total for selenium greater than 1.0; therefore, this total was not further evaluated. In both the Salt and Georgetown watersheds, the totals are associated with no COPC-specific hazards greater than 1.0; therefore, these totals were further evaluated. As discussed above for the child Native American receptor, cadmium and selenium both affect the gastrointestinal system (among other organs and systems). Therefore, it is appropriate to sum the hazards for cadmium and selenium. Summing only the hazards for cadmium and selenium, the total hazards exceed 1.0 only when considering exposure of RA1; 1.2 (Salt watershed) and 1.3 (Georgetown watershed).

The risk in each watershed for the subsistence lifestyle receptor is driven by arsenic through ingestion of surface soil. Riparian area-specific concentrations of arsenic are similar to background levels found in the Resource Area specifically and in the western U.S. in general (see Table 6-28).

6.8.4.2 Comparison of Reasonable Maximum Exposure and Central Tendency Exposure Results

The hazard and risk RME results were approximately 4 to 6 times higher than the CTE results. For example, the HI for the adult subsistence lifestyle receptor through ingestion of aquatic life from the Blackfoot/Little Blackfoot watershed was 2.4 under RME conditions and 0.68 under CTE conditions. This difference resulted in several pathways with significant hazards and risks under RME conditions but not under CTE conditions. The pathways with an HI greater than 1.0 or a risk greater than 1.0E-06 under RME conditions include:

Ingestion of Aquatic Life

- Blackfoot/Little Blackfoot watershed – adult and child subsistence lifestyle receptors
- Salt watershed – adult and child subsistence lifestyle receptors
- Georgetown watershed – child Native American and adult and child subsistence lifestyle receptors

Ingestion of Surface Soil

- All riparian areas – subsistence lifestyle receptors

The pathways with an HI greater than 1.0 or a risk greater than 1.0E-06 under CTE conditions are listed below.

Ingestion of Aquatic Life

- Blackfoot/Little Blackfoot watershed – child subsistence lifestyle

Ingestion of Surface Soil

- Residential area 1 – adult subsistence lifestyle receptor (1.4E-05) driven by arsenic
- All residential areas – child subsistence lifestyle receptor (1.1E-05 – 7.2E-06) – driven by arsenic

There are no pathways with an HI greater than 1.0 or a risk greater than 1.0E-06 under CTE conditions for the recreational or Native American receptor.

TtEMI believes that the CTE results associated with watershed-specific exposure pathways are more representative of the receptors' exposure because:

(1) The large size of the unimpacted areas of the watersheds in the Resource Area. Receptors are most likely to spend much more time in the unimpacted areas of the watershed as compared to the impacted areas simply due to large difference in size between these areas. Impacted stream reaches represent only about 27 percent of the total stream reaches in the Blackfoot/Little Blackfoot watershed, and less than 10 percent in the other two watersheds. As such, receptors will most likely be exposed under conditions that more closely resemble CTE, rather than RME conditions.

(2) The small sample sizes in unimpacted areas and the EPC calculation methodology confound the magnitude of exposure of each receptor in Resource Area. For example, there was a relatively small fish sample size in unimpacted areas as compared to impacted areas. As such, all unimpacted reaches were considered as a single area represented by a single mean concentration. The representation of data from the unimpacted reaches in the statistical derivation of EPCs, therefore, was disproportionately lower than the representation of data from impacted areas. As such, EPCs for RME conditions in most cases represented the maximum detected concentration or concentrations near maximum detected concentrations. Maximum detected concentrations were invariably located in impacted areas of the watershed. Therefore, RME conditions represented exposures that occurred mostly within impacted areas, which, in turn, represent a small percentage of the overall Resource Area. Receptors are more likely to spend time in unimpacted rather than impacted areas due to the differences in sizes between these areas.

6.8.4.3 Exposure Pathways Retained for Tier 3 Assessment

The pathways evaluated under Tier 3 include ingestion of aquatic life and ingestion of surface soil. Each receptor was evaluated under these pathways.

6.9 TIER 3 ASSESSMENT – WATERSHED-SPECIFIC ANALYSES BASED ON HISTORICAL DATA

Tier 3 methodology was presented in Section 6.1.3. This section presents cancer risks and noncancer hazards for all receptors exposed to COPCs by ingestion of aquatic life and surface soil. Section 6.9.1 presents Tier 3 cancer risk and noncancer hazard results. Section 6.9.2 presents an evaluation of Tier 3 results.

6.9.1 Tier 3 Cancer Risk and Noncancer Hazard Results

This section includes the results from the Tier 3 calculations. The ingestion of aquatic life and ingestion of surface water pathways were evaluated, accounting for the temporal variation in concentration and

length of contaminated reaches for all receptors using both RME and CTE conditions. Tables E-134 to E-169 in Appendix E present the results.

6.9.1.1 Reasonable Maximum Exposure Case

The total exposure in the Blackfoot/Little Blackfoot watershed resulted in an HI less than 1.0 for adult (0.46) and child (0.80) subsistence lifestyle receptors under RME conditions. EPCs for fish tissue and surface water used for the Tier 3 evaluation of the Blackfoot/Little Blackfoot watershed are presented in Tables 6-17 and 6-18, respectively.

In the Salt watershed, ingestion of surface water resulted in an HI less than 1.0 for adult (2.9E-02) and child (8.7E-02) subsistence lifestyle receptors. EPCs for surface water used for the Tier 3 assessment of the Salt watershed are included in Table 6-19.

In the Georgetown watershed, ingestion of surface water resulted in an HI less than 1.0 for adult (4.2E-03) and child (1.3E-02) subsistence lifestyle receptors. EPCs for surface water used for the Tier 3 assessment of the Georgetown watershed are included in Table 6-20.

The total exposure in each watershed resulted in an HI less than 1.0 for all other receptors under RME conditions. The range of hazards is listed below. See Tables E-140 to E-145, E-152 to E-157, and E-164 to E-169 in Appendix E for Native American, recreational, and subsistence lifestyle receptor-specific results, respectively.

- Adult recreational receptor (1.5-03 to 7.2E-02)
- Child recreational receptor (4.4E-03 to 0.13)
- Adult Native American receptor (1.5E-03 to 0.10)
- Child Native American receptor (4.4E-03 to 0.18)

6.9.1.2 Central Tendency Exposure Case

The total exposure in each watershed resulted in an HI less than 1.0 for all receptors under CTE conditions. See Tables E-134 to E-139, E-146 to E-151, and E-158 to E-163 in Appendix E for individual results.

The range of hazards is listed below.

- Adult recreational receptor (3.5E-04 to 1.3E-02)
- Child recreational receptor (8.6E-04 to 2.2E-02)
- Adult Native American receptor (3.5E-04 to 1.9E-02)
- Child Native American receptor (8.6E-04 to 3.1E-02)
- Adult subsistence lifestyle receptor (9.4E-04 to 1.1E-03)
- Child subsistence lifestyle receptor (4.6E-03 to 7.0E-03)

6.9.2 Evaluation of Tier 3 Results

This section includes a summary of receptor-specific results and a comparison of the results based on 2001 and historical data.

6.9.2.1 Summary of Receptor-specific Results

No exposure pathway-specific or total hazards or risks for any of the three receptor groups equaled or exceeded an HI of 1.0 or a risk of 1E-06.

6.9.2.2 Comparison of Results Based on 2001 and Historical Data

Table 6-30 shows fish tissue EPCs based on data collected in 2001. Table 6-17 shows fish tissue EPCs based on data collected in 1998. The 2001 data has concentrations that are approximately 5 to 6 times greater than the 1998 data for both cadmium and selenium. For example, the UCL_{95} concentration of cadmium in fish tissue is 7.29E-02 mg/kg wet weight (WW) based on the 2001 data and 1.26E-02 mg/kg WW based on the 1998 data.

Tables 6-10, 6-12, and 6-14 show surface water EPCs based on data collected in 2001 for the Blackfoot/Little Blackfoot, Salt, and Georgetown watersheds, respectively. Tables 6-18, 6-19, and 6-20 show surface water EPCs based on data collected in 1998 for the Blackfoot/Little Blackfoot, Salt, and Georgetown watersheds, respectively. Generally, the 2001 data are approximately one order of magnitude lower than the 1998 data for cadmium. The cadmium area-weighted average concentration (AWAC) in the Blackfoot/Little Blackfoot watershed was 0.27 micrograms per liter (µg/L) in 2001 and 1.9 µg/L in 1998 for the Blackfoot/Little Blackfoot and Salt watersheds and about one-fourth the 1998 data for the Georgetown watershed. For chromium, the 2001 data is approximately two orders of

magnitude higher than the 1998 data. The chromium AWAC in the Blackfoot/Little Blackfoot watershed was 1.07 µg/L in 2001 and 6.21E-03 µg/L in 1998. For selenium, the 2001 data is similar to the 1998 data. The selenium AWAC in the Blackfoot/Little Blackfoot watershed was 11.97 µg/L in 2001 and 4.37 µg/L in 1998.

6.10 UNCERTAINTY ASSESSMENT

The estimates of exposure, risk, and hazard presented in the AWHHRA are subject to varying degrees of uncertainty from a variety of sources. The potential sources of uncertainty are discussed for each step in the risk assessment. Uncertainties associated with data evaluation and selection of COPCs; exposure assessment; toxicity assessment; and risk and hazard characterization are discussed in the following sections.

6.10.1 Data Evaluation and Chemical of Potential Concern Selection

Uncertainties associated with data evaluation and selection of COPCs result from a variety of sources. This section briefly discusses some of the more significant sources of uncertainty, including the assumption of steady-state conditions, the number and type of samples collected, and the methodology for selection of COPCs. The uncertainties may result in overestimation or underestimation of risks and hazards, as discussed in the following sections.

6.10.1.1 Assumption of Steady-state Conditions

Medium-specific concentrations are used to select COPCs and to calculate EPCs based on the assumption of steady-state conditions. That is, the concentrations measured from about 1998 through 2001 are assumed to remain constant and representative of exposure throughout the receptor-specific durations of exposure. This assumption ignores the variable introduction of additional contamination into the environment in the future. The introduction of contamination from mine-specific waste rock piles into the environment is expected to be variable and depend in large part on annual precipitation and subsequent runoff. The use of data for surface water and fish tissue collected in 1998 (a year of high precipitation and runoff) under Tier 3 and comparison to Tier 2 results based data for surface water and fish tissue collected in 2001 (a year of lower precipitation and runoff) was an attempt to quantify the impact of variable medium-specific concentrations.

In general, metals do not degrade substantially in the environment and are not significantly metabolized in biological systems. Selenium, on the other hand, can significantly metabolize and be incorporated into proteins. Therefore, the concentration of COPCs in waste rock, surface soil, the tissues of plants growing in contaminated surface soil, and fish tissue may not vary significantly over time for individual sample locations. However, the concentration of COPCs in surface water can clearly vary significantly over time. It is expected that the variability of medium-specific COPC concentrations may be affected to a greater extent by the number and location of medium-specific samples as compared with the assumption of steady-state conditions. Therefore, the potential magnitude and direction of the uncertainty associated with the assumption of steady-state conditions is likely to vary by medium and over time.

6.10.1.2 Number and Type of Samples Collected

The Resource Area as a whole and the individual watersheds considered in the AWHHRA are very large. For all media, attempts were made to collect samples from both impacted and unimpacted stream reaches and riparian areas. Given the relatively small number of impacted locations as compared with unimpacted locations in the Resource Area and throughout each watershed, a greater percentage of samples were collected from impacted locations than from unimpacted locations. However, even for impacted locations, limited numbers of samples were collected. For example, limited numbers of fish tissue samples were collected for some stream stretches based on a concern that collection of a greater number of samples could impair the stream's fish population.

The use of area-weighted concentrations factored in the relative sizes of impacted and unimpacted areas throughout the Resource Area and individual watersheds. However, the inputs to these area-weighted concentrations depend on the limited number of samples. In general, the variability of medium-specific concentrations within both unimpacted and impacted locations may not be adequately characterized in some cases.

In addition, samples were not collected from some media to which receptors may be exposed. For example, no samples were collected of homegrown produce. Soil-to-plant uptake factors were used to extrapolate concentrations in plant tissue from concentrations in soil. An undetermined level of uncertainty is associated with the use of these generalized literature values.

In general, the low number of medium-specific samples means that there is uncertainty associated with characterization of COPC-specific concentrations for each medium. The direction and magnitude of the uncertainty (for example, were medium-specific EPCs over- or underestimated) is unknown.

6.10.1.3 Chemical of Potential Concern Selection Methodology

In general, the methodology for selection of COPCs (see Appendix B) is expected to be conservative. This means that it is unlikely that that COPC selection methodology would overlook a chemical that should be a COPC. The conservatism in the COPC selection process is illustrated as follows:

(1) At all steps in the process, the maximum detected medium-specific concentration of each chemical is compared with either a measure of background or a screening criterion. If that concentration exceeds both the background measure and screening criterion, the chemical is retained as a COPC.

(2) The background used to compare against these maximum detected medium-specific concentrations was set equal to twice the mean background concentration. As noted in Section 7.2.3.1 of the Work Plan (TtEMI 2002a), similar nonstatistical methods have been accepted for background comparisons for EPA Region 4 and FS Region 3 using higher numerical multipliers (such as 3 times background) in some cases. In addition, the common industry practice for establishing background levels for industrial sites under the Resource Conservation and Recovery Act (RCRA) consists of collecting three to five directed samples in areas assumed to represent pre-industry conditions to calculate UCL_{95} concentrations. A UCL_{95} typically results in a background comparison level that is 1.5 to 3 times the mean value of the data set, depending on variability in the data. Therefore, use of a numerical multiplier of 2 is expected to be conservative in most cases.

(3) A chemical retained as a COPC in one medium was retained as a COPC for all media. Therefore, a chemical that may not be present at elevated concentrations in a specific medium was considered to be a COPC because the concentration of the chemical was elevated in another medium (possibly on the basis of a single sample).

Therefore, it is expected that, in general, the COPC selection methodology may (1) include chemicals as COPCs that may be detected at elevated concentrations at only a limited number of locations within the Resource Area, and (2) is unlikely to overlook a chemical that should be a COPC.

6.10.2 Exposure Assessment

Uncertainties associated with exposure assessment result from a variety of sources. This section briefly discusses some of the more significant sources of uncertainty, including development of EPCs, identification of exposure pathways, exposure parameters and assumptions, calculating total exposures, and incorporating background and supplemental exposure. The uncertainties may result in overestimation or underestimation of risks and hazards as discussed below.

6.10.2.1 Exposure Point Concentrations

The uncertainty associated with the calculation of EPCs varies by medium. For example, riparian area-specific EPCs for surface soil are based on the results from a single impacted soil sample and a limited number of unimpacted soil samples. Therefore, the uncertainty associated with these COPCs depends on the relative lack of information on the variability of COPC-specific concentrations in that riparian area. In addition, as discussed in Appendix C, EPCs for surface soil were calculated assuming that a 0.5-acre residential area was located in part within the riparian zone. This assumption is expected to be conservative, especially along larger streams, because residents are not expected to develop heavily within flood plains. However, in the end, the uncertainty associated with concentrations in surface soil is not significant because the calculated EPCs (especially for arsenic, which drives the risks associated with exposure to surface soil) are similar to the concentration of COPCs in unimpacted portions of the Resource Area and in soils from the western U.S. in general.

The EPCs for fish tissue and surface water are affected by the limited number of medium-specific samples. Under CTE conditions, the EPCs were calculated as area-weighted concentrations. This approach took into account the lack of impact to much of the Resource Area and the individual watersheds from mining-related activities. Therefore, EPCs calculated under CTE conditions for fish tissue and surface water largely reflect the concentrations of COPCs from unimpacted portions of the Resource Area and the individual watersheds.

However, under RME conditions, the EPCs for fish tissue and surface water were calculated as UCL_{95} incorporating a number of simplifying assumptions. These simplifying assumptions include: (1) it was assumed that an arithmetic mean is appropriate to represent the true average concentration of each chemical in each reach (in cases where only a single measurement is available, this measurement is used as a surrogate for the mean concentration); (2) possible spatial or serial correlations in the data were ignored; (3) the distribution of the means for all reaches follows a normal distribution (note that this assumption applies to the distribution of means, rather than individual measurements within each reach); and (4) potential complications introduced by nondetect data were ignored. The overall impact (direction and magnitude) of these assumptions on the calculated EPCs cannot be readily qualified. Beyond these assumptions, the greatest amount of uncertainty is probably introduced by the limited number of samples used to represent each watershed (particularly for fish tissue). For example, concentrations in fish tissue for the Salt and Georgetown watersheds were each based on two reach-specific concentrations (one impacted reach and one unimpacted reach). The concentration of COPCs in impacted and unimpacted reaches was different for some COPCs. This result led to significant variation which, coupled with the

low number of samples, resulted in calculated UCL_{95} concentrations that exceeded the maximum detected concentration. Therefore, in these cases, the maximum detected medium-specific concentration was selected as the EPC consistent with EPA guidance (EPA 1992).

As described in Appendix C, EPCs were calculated substituting a value equal to one-half the detection limit for results reported as nondetect. This process is consistent with EPA guidance (EPA 1989, 2000c) as well as industry practices. However, this process does introduce uncertainty into the calculation of EPCs. The magnitude of the uncertainty increases with the percentage of nondetect results in a data set.

In response to the lack of fish tissue data from particular watersheds (for example, no fish tissue samples were collected by TtEMI for streams in the Georgetown watershed in 2001), an additional assumption was made. Specifically, in the absence of watershed-specific fish tissue data, EPCs for these watersheds were estimated as the average of the fish tissue concentrations for watersheds with fish tissue data, weighted by the relative presence of impacted and unimpacted streams in the watershed to which the assumption was applied (for example, the Georgetown watershed in the example above).

This assumption introduces uncertainty about the calculation of EPCs because data from outside a particular watershed are being used to represent that watershed. However, the impact of the uncertainty is expected to be tempered by two factors: (1) average concentrations were applied; this will reduce the impact of particularly high or low concentrations that might not be representative and (2) the surrogate concentrations were weighted by the relative presence of impacted and unimpacted reaches in the subject watershed.

Additional uncertainty is introduced by the decision to not use analytical results associated with fish tissue and surface water samples collected by IMA in September 1999 and May 2000. The IMA data were not included for two primary reasons. First, the 2000 data represents the most recent analytical data, while the 1998 data represents data from a “high flow” year and is useful for evaluation of temporal concentration changes. Second, the 1999 and 2001 data collected by IMA represents a relatively small data set that did not provide results substantially different from the data used in the AWHHRA. Therefore, the uncertainty introduced by not using the 1999 and 2001 IMA data is not expected to be significant.

Therefore, in general, the EPCs for fish tissue and surface water calculated under RME conditions are expected to be artificially elevated. This assumption must be interpreted in the context that, while unlikely, it is possible that individual receptors may fish from or draw drinking water from individual

impacted stream reaches a significant amount of the time, rather than being exposed throughout individual watersheds. Overall, TtEMI believes that the EPCs calculated under CTE conditions for fish tissue and surface water provide a more reasonable estimate of the medium-specific COPC concentrations to which receptors may be exposed.

EPCs for beef cattle and elk tissue are calculated based on the results of 14 beef cattle samples and 26 elk samples. These numbers in general should provide a reasonable amount of confidence on the variability of chemical concentrations in individual tissues. However, the results for beef cattle tissue are from a single depuration study when cattle were grazed on a single seleniferous pasture near the Henry Mine. Concentration of COPCs in cattle that are grazed on other impacted pastures or that graze at least partially on unimpacted pastures may be different. Use of analytical data from beef cattle that have undergone depuration does not account for potential exposure to COPCs in beef cattle tissue from animals taken directly from the pasture. This practice is not considered to be widely used, but can occur and may result in somewhat higher tissue concentrations.

The data for elk tissue were collected from animals taken throughout much of the Resource Area. Therefore, the analytical results from these animals are expected to provide a reasonable estimate of the concentrations of COPCs in elk tissue.

The concentration of COPCs in aquatic and terrestrial plant tissue depends on a limited number of samples. Specifically, the EPCs for COPCs in aquatic plants are based on two impacted samples and one unimpacted sample, and the EPCs for COPCs in terrestrial plants are based on four impacted and four unimpacted samples. Both of these pathways were eliminated after Tier 1. It is uncertain whether the maximum detected COPC-specific concentrations used in Tier 1 calculations adequately represent actual concentrations in plant tissue.

Finally, the concentration of COPCs in homegrown produce were calculated based on soil-to-plant uptake factors from the literature and a single surface soil sample from each impacted riparian area. Uncertainties associated with the concentration of COPCs from the individual surface samples and the use of literature-based uptake factors have already been discussed. These uncertainties also apply to the concentration of COPCs in homegrown produce, an exposure pathway that was dropped after Tier 1.

6.10.2.2 Exposure Pathway Identification

Relatively little uncertainty is associated with identification of potentially complete exposure pathways considered in the AWHHRA, with the exception of ingestion of homegrown produce and the ingestion by Native American receptors of aquatic and terrestrial plants and tea brewed from terrestrial plants. All other exposure pathways considered in the AWHHRA have been observed within the Resource Area.

Currently, TtEMI is unaware of any residences located along or within riparian areas in the Resource Area. In addition, for evaluation of the ingestion of homegrown produce exposure pathway it was assumed that a home garden was located within the riparian area. This assumption is considered very conservative because the size of the riparian area, along many streams within the Resource Area, may not be large enough to support a home garden. Furthermore, residents may not develop gardens within the riparian area for fear that they may be flooded. Nonetheless, the ingestion of homegrown produce exposure pathway was retained and was eliminated after Tier 1.

Details on the precise nature of exposure scenarios specific to Native Americans are limited. In general, all that is known is that it is possible that Native American receptors use aquatic and terrestrial plants from the Resource Area. It is also known that some Native American populations ingest native plants and also brew teas from native plants. Therefore, because the precise nature of exposure pathways for Native Americans was unknown, exposure pathways related to the ingestion of native aquatic and terrestrial plants were considered in the AWHHRA because they could be quantified and for completeness. However, significant uncertainty is associated with the actual presence of these exposure pathways in the Resource Area.

6.10.2.3 Exposure Parameters and Assumptions

Standard assumptions on exposure parameters were made for population characteristics such as body weight, life expectancy, and exposure duration. Uncertainties associated with these assumptions on exposure parameters are likely to be insignificant when the entire potentially exposed population is considered because population characteristics used in the AWHHRA are based on national averages of large samples.

However, assumptions associated with exposure characteristics such as exposure frequency and contact rate may not represent actual exposure conditions. In other words, the characteristic values used in the AWHHRA may not accurately represent all individuals who may be exposed at or near the Resource

Area. For example, beef tissue EPCs were based on a study of cattle raised exclusively on a seleniferous pasture. The number of cattle in the Resource Area that are raised exclusively on seleniferous pastures is not expected to be large. Therefore, the use of tissue concentrations from beef cattle raised exclusively on a seleniferous pasture may overestimate receptor-specific exposures.

In general, parameter values for exposure characteristics under RME conditions are selected to represent some of the most highly exposed individuals. Therefore, receptor-specific exposure estimates calculated under RME conditions are expected to overestimate the exposure of the majority of receptors potentially exposed in the Resource Area. However, consistent with EPA guidance (EPA 1989), RME exposure parameters do not typically represent the most exposed receptors. For example, it is possible that some receptors, primarily Native American receptors, but also individual subsistence lifestyle and recreational receptors may live in or near the Resource Area for a period of time greater than the allowed 30 years. Exposure, risk, and hazard estimates for these individuals may be underestimated (at least with regard to this specific parameter). However, any underestimation is expected to relatively small because of the impact of other exposure parameter assumptions. Primary among these additional assumptions is the use of conservative fraction ingested values. For example, the AWHHRA assumed all fish ingested were caught from a particular watershed. This is a conservative assumption. To further assume that a receptor would ingest all of his or her fish from a single watershed over an entire estimated lifetime of 70 years is unwarranted. Parameter values selected to represent CTE conditions are intended to be less conservative and better represent average exposure conditions.

6.10.2.4 Estimating Total Exposures

Total site-related exposures are estimated by summing exposure pathway-specific exposures. It is unlikely that any individual is actually exposed at RME levels to all potentially complete exposure pathways. Therefore, total site-related exposures (and, subsequently, total site-related hazards and risks) calculated under RME conditions are likely to overestimate actual values. The degree of uncertainty (and overestimation) is less under CTE conditions. Receptor-specific risks are driven almost entirely by a single exposure pathway – ingestion of surface soil. Therefore, the amount of overestimation resulting from summing risks related to all potentially complete exposure pathways is not considered insignificant. Similarly, receptor-specific hazards are driven by two exposure pathways: ingestion of fish tissue and surface water. Of these two exposure pathways, ingestion of fish tissue contributes the majority of the total hazard. Therefore, the amount of overestimation is not expected to be significant.

6.10.2.5 Incorporation of Background and Supplemental Exposure

As discussed in Section 6.4.7, background and supplemental exposures were conservatively estimated due to a lack of specific information regarding COPC exposure from background dietary and supplemental sources. As a result, a degree of double counting (in some cases significant) is associated with summing total site-related exposures with background and supplemental exposures. However, as discussed in Section 6.8.4.1, with the exception of background exposure to arsenic for children, COPC-specific background and supplemental exposures are generally insignificant and do not contribute much to total exposures and hazards.

It is very likely that the estimated background exposure to arsenic for children overestimates the actual degree of background exposure for the entire exposed population. There may be some individuals with this amount of background exposure, but it is very unlikely that the majority of the population is exposed to this level. In addition, the hazard associated with the estimated background exposure to arsenic for children so outweighs the site-related total hazard as to render site-related hazards meaningless. In summary, the estimated background and supplemental exposures are either low enough or so high as to have little bearing on the interpretation of site-related exposures and hazards.

6.10.3 Toxicity Assessment

Uncertainties associated with the toxicity assessment resulted primarily from the methodology used to quantify various toxicological effects. In most instances, these uncertainties may result in overestimation of risk and hazard. Sources of uncertainty include (1) extrapolation of animal data to humans, (2) limited availability of chemical-specific data, and (3) modeling of SFs. Each of these sources of uncertainty is discussed in the following sections.

6.10.3.1 Extrapolation of Animal Data to Humans

EPA makes several assumptions to develop toxicity values that may result in overestimation of the actual hazard or risk to human health that results from exposure to a COPC. One assumption involves the use of animal study data to extrapolate high doses administered to laboratory animals to much lower doses expected to be experienced by humans. The dose-response relationship may not be the same at these lower doses and their extrapolation may therefore result in overestimation of risk and hazard. EPA acknowledges the limitations associated with current evaluation procedures and plans to revise the procedures for estimating the carcinogenic effects of chemicals. EPA plans to evaluate a broader range of

health effects than those addressed by the current procedures, which are based on observations of tumors in animals exposed to large doses of chemicals in laboratory experiments. The additional health effects to be evaluated are the effects on human cells and genetic material.

6.10.3.2 Limited Availability of Chemical-specific Data

Overestimation of risks and hazards may result from the use of SFs to derive RfDs when data from animal studies are used to predict adverse health effects in humans. The limited availability of toxicity information on some chemicals affects the use of uncertainty and modifying factors in development of the RfDs. In some cases, only limited data are available; in others, a greater number of data are available but are to some degree contradictory.

6.10.3.3 Modeling of Safety Factors

An upper confidence limit on the dose-response relationship is calculated to develop an SF and is used as the final toxicity value. Use of this mathematical model results in a conservative estimate of the potential carcinogenic response and may overestimate the true health effects associated with exposure to a chemical.

6.10.4 Risk and Hazard Characterization

The risk and hazard estimates presented in the AWHHRA are subject to various degrees of uncertainty from a variety of sources. Uncertainties related to data evaluation and selection of COPCs, the exposure assessment, and the toxicity assessment (see above) contribute to the overall uncertainty associated with risk and hazard results. In general, it is unlikely that the AWHHRA risk and hazard results underestimate the true receptor-specific risks and hazards.

Two specific areas of uncertainty were raised in comments received on the draft AWHHRA. These areas of uncertainties are (1) the assumption that chromium is present entirely as hexavalent chromium and (2) the process used to calculate hazard indexes.

First, the assumption that chromium is present entirely as hexavalent chromium (Cr^{+6}) is very conservative. In the environment, chromium is expected to be present almost entirely in the trivalent form (Cr^{+3}). This form of chromium is not carcinogenic (hexavalent chromium is considered a potential

inhalation carcinogen) and is less toxic than the hexavalent form. Therefore, this assumption contributes to an overestimation of the risks and hazards associated with exposure to chromium.

Second, consistent with EPA guidance (EPA 1989), HIs are initially calculated by summing chemical- and exposure pathway-specific HQs. If a single chemical is associated with a HQ of greater than 1.0, the HI is not further evaluated. However, in the case where no single chemical is associated with a HQ greater than 1.0, than the HI is reviewed focusing on the target organ or system impacted by each COPC.

Revised HIs are calculated as sums of HQs for COPCs having similar target organs or systems.

Uncertainty is introduced by the fact that HIs with at least one COPC-specific HQ greater than 1.0 are not refined to look at target organs or systems. Therefore, these HIs are likely to overestimate the hazard associated with exposure to multiple COPCs because the COPCs may impact different target organs or systems.

6.11 SUMMARY AND CONCLUSIONS

The AWHHRA for the Resource Area was prepared to evaluate potential exposures to COPCs in multiple media and characterize the associated risks and hazards across the entire Resource Area for several receptor groups. The AWHHRA was completed following a tiered approach (see below) with two primary objectives:

- Identify exposure scenarios (receptor and exposure pathway combinations), locations (for example, particular watersheds or stream segments), and COPCs which are associated with or contribute significantly to cancer risks and hazards greater than acceptable levels
- Focus ongoing and subsequent field investigations on the exposure scenarios, locations, and COPCs associated with or contributing significantly to unacceptable risks and hazards

The AWHHRA was completed in accordance with the final Work Plan TtEMI submitted to IDEQ in April 2002 (TtEMI 2002a). The remainder of this section summarizes the tiered approach followed in completing the AWHHRA (Section 6.11.1), selection of COPCs (Section 6.11.2), the human health CSM and associated receptor groups and complete (or potentially complete) exposure pathways considered quantitatively in the AWHHRA (Section 6.11.3), tier-specific results (Section 6.11.4), and final conclusions (Section 6.11.5).

6.11.1 Tiered Risk Assessment Approach

The risk assessment was completed following a three-step tiered approach (see Figure 2). The purpose of each of the tiers is briefly summarized below.

- Tier 1 was designed as a screening step and used maximum detected medium-specific COPC concentrations and RME exposure parameters to screen out exposure pathways associated with risks less than 1E-06 and HIs less than 1; and COPCs associated with risks less than 1E-07 and HIs less than 0.1.
- Tier 2 focused on the exposure pathways and COPCs retained from Tier 1 and calculated receptor-specific exposures, risks, and hazards under both RME and CTE conditions to provide risk managers with a range of results that can be used to make decisions.
- Tier 3 evaluated two exposure pathways – ingestion of fish tissue and surface water – that were considered to be altered by temporal variations in medium-specific COPC concentrations as a result of varying environmental conditions related to total precipitation and the mass of COPCs introduced into the environment. The Tier 3 assessment employed historical data (from 1998 and 1999) to contrast with the more analytical data for fish tissue and surface water from 2001 that were used in Tier 2. As with Tier 2, Tier 3 was designed to give risk managers a range of results that can be used to make decisions.

6.11.2 Selection of Chemicals of Potential Concern

COPCs were selected following a conservative process in which the maximum detected medium-specific concentration of each chemical was compared against a value equal to twice the average medium-specific background concentration and a medium-specific screening criterion. Chemicals that were found to exceed the background and toxicity screening (if available) concentrations in at least one sample for at least one medium were retained as COPCs in all media with some exceptions. These exceptions are summarized below:

- All chemicals found to be present in waste rock at concentrations that exceeded a value equal to twice the average concentration in soil for the western U.S. were retained as COPCs for waste rock (only)
- Chemicals found to be present at concentrations in aquatic and terrestrial plants greater than twice the mean concentrations in unimpacted aquatic and terrestrial plants and were found at concentrations greater than twice the mean background concentration in the base medium (soil for terrestrial plants and sediment for aquatic plants) were retained as COPCs for terrestrial and aquatic plants
- Chemicals identified as COPCs for terrestrial plants were also selected as COPCs for homegrown produce

COPCs retained for the AWHHRA were:

- Aluminum – Aquatic plants only
- Antimony – Aquatic plants only
- Arsenic – All media
- Cadmium – All media
- Chromium – All media
- Cobalt – Aquatic plants only
- Copper – Aquatic plants only
- Nickel – Terrestrial plants only
- Selenium – All media
- Uranium – Terrestrial plants only
- Vanadium – Aquatic and terrestrial plants
- Zinc – Aquatic and terrestrial plants

6.11.3 Human Health Conceptual Site Model

The human health CSM links potential or actual releases of chemicals from waste rock piles to potential human exposures. Figure 3 presents the human health CSM for the AWHHRA. Three receptor groups were considered as potential receptors in the AWHHRA: (1) recreational hunters and fishers; (2) Native Americans; and (3) subsistence lifestyle. Both adults and children were considered for each receptor group. Only those exposure pathways that are considered complete (or potentially complete) were retained for quantitative evaluation in the AWHHRA. These exposure pathways are identified in Figure 3 and are summarized below:

- Inhalation of particulates – all three receptor groups
- Ingestion of beef cattle tissue (skeletal muscle and offal) – all three receptor groups
- Ingestion of elk tissue (skeletal muscle and offal) – all three receptor groups
- Ingestion of fish tissue – all three receptor groups
- Ingestion of surface soil – subsistence lifestyle receptors only
- Ingestion of aquatic and terrestrial plants – Native American receptors only
- Ingestion of tea brewed from terrestrial plants – Native American receptors only
- Ingestion of homegrown produce – subsistence lifestyle receptors only

6.11.4 Tier-specific Results

The tiered risk assessment approach summarized in Section 6.11.1 was completed for the COPCs selected as summarized in Section 6.11.2, for the complete (or potentially complete) exposure pathways identified in Section 6.11.3 following standard exposure assessment, toxicity assessment, and risk characterization algorithms and procedures. The tier-specific results are summarized in Sections 6.11.4.1 through 6.11.4.3.

6.11.4.1 Tier 1 Results

Based on Tier 1 calculations, the following exposure pathways were identified as being potentially associated with risks greater than or equal to 1E-06 and HIs greater than or equal to 1 and were retained for consideration under Tier 2:

- Ingestion of fish tissue
- Ingestion of surface water
- Ingestion of surface soil

In addition to these three exposure pathways, ingestion of elk and beef cattle tissue were retained for consideration under Tier 2 because hunting and ranching are common and popular activities in the Resource Area and these exposure pathways may be of particular concern to the public.

Also, based on Tier 1 calculations, the following four COPCs were identified as being potentially associated with risks greater than or equal to 1E-07 and HIs greater than or equal to 0.1 and were retained for consideration under Tier 2:

- Arsenic
- Cadmium
- Chromium
- Selenium

6.11.4.2 Tier 2 Results

Under Tier 2, potential exposures to the four COPCs retained from Tier 1 were evaluated under both RME and CTE conditions for the exposure pathways retained from Tier 1. Receptor-specific hazards

calculated under RME and CTE conditions are summarized in Tables 6-26 and 6-27. Receptor-specific risks are summarized in Table 6-28 for both RME and CTE conditions. The Tier 2 results are discussed below as follows: RME results first, followed by CTE results.

RME Results

RME hazards are discussed first, followed by risks. Under RME conditions, significant hazards were identified associated with two exposure pathways: ingestion of fish tissue, and ingestion of surface soil. Hazards associated with ingestion of beef cattle and elk tissues remained insignificant and did not exceed 1.0E-01 (beef cattle) and 8.4E-02 (elk) for any receptor. Significantly, no significant hazards were identified associated with ingestion of surface water for any receptor; all hazards were less than 0.1 for the Blackfoot/Little Blackfoot watershed and less than 1E-02 for the other two watersheds.

Hazards associated with potential ingestion of fish tissue are significant only for adult and child subsistence lifestyle receptors for all three watersheds, with one exception. Significant hazards associated with potential exposure to the child Native American were identified only in the Georgetown watershed. Hazards associated with potential ingestion by all receptors were driven by selenium and cadmium, with about 75 percent of the hazard posed by selenium and most of the remaining 25 percent attributable to cadmium. The greatest receptor-specific hazards were identified associated with potential ingestion of fish from the Georgetown watershed, followed by the Blackfoot/Little Blackfoot watershed, and the Salt watershed; however, the watershed-specific hazards did not exceed 7.1 (maximum for the child subsistence lifestyle receptor for the Georgetown watershed) and did not vary by more than a factor of 2.

Hazards associated with ingestion of surface soil were found to be significant (1.6) only for the child subsistence lifestyle receptor at a single location (RA1) near the Rasmussen Mine.

Consistent with these results, the total receptor-specific hazards (based on exposure to all complete [or potentially complete] exposure pathways) are driven almost entirely by ingestion of fish tissue.

Finally, the most significant hazard associated with exposure to background and supplement exposure is the hazard associated with background exposure to arsenic by a child receptor (45). It is assumed that this value may be an overestimate associated with selecting the midpoint of the range of ADIs as the child background exposure. Also, a hazard of 1.33 is associated with background exposure to arsenic by an adult receptor and is greater than 1.0. Hazards associated with background exposure to cadmium by adult and child receptors (0.86) and selenium by adult and child receptors (0.32) are also notable. The hazards

associated with background exposure to chromium and supplement exposure to chromium and selenium are negligible.

Significant risks were identified only associated with ingestion of surface soil. The risks ranged about three-fold across the eight locations evaluated: 3.8E-06 to 1.4E-05 for the subsistence lifestyle adult and 7.2E-06 to 2.6E-05 for the child subsistence lifestyle receptor. However, these receptor-specific risks are similar to the risks calculated based on potential exposure to arsenic at concentrations present in unimpacted Resource Area soil and in soil from the western U.S.

CTE Results

Under CTE conditions, no significant hazards or risks were identified for adult and child recreationalists, Native American receptors, or adult subsistence lifestyle receptors. Significant total hazards were identified only for the child subsistence lifestyle receptor (1.6 to 2.0) and were driven by ingestion of fish tissue and soil. Based on a comparison of the watershed-specific EPCs for fish tissue to the concentration of COPCs in fish from unimpacted reaches and the concentration of COPCs in riparian areas to unimpacted Resource Area soils, these receptor-specific hazards are similar to those that would be calculated if it were assumed that receptors ingested only fish from unimpacted reaches or soil from unimpacted areas.

Significant risks were identified only associated with ingestion of surface soil. The risks ranged about three-fold across the seven locations evaluated: 5.7E-07 to 2.1E-06 for the subsistence lifestyle adult and 3.6E-06 to 1.3E-05 for the child subsistence lifestyle receptor. Again, these receptor-specific risks are similar to the risks calculated based on potential exposure to arsenic at concentrations present in unimpacted Resource Area soil and in soil from the western U.S.

6.11.4.3 Tier 3 Results

Under Tier 3, two exposure pathways – ingestion of fish tissue and ingestion of surface water – were reevaluated based on medium-specific EPCs developed from samples collected in 1998 (as compared to Tier 2 in which these exposure pathways were evaluated based on medium-specific EPCs developed from samples collected in 2001). Risks and hazards were characterized based on 1998 analytical data to evaluate any impacts from temporal variations in medium-specific COPC concentrations. Annual precipitation was higher in 1998 than in 2001, and it was postulated that the higher precipitation might

have released a greater mass of chemicals from waste rock piles to the environment. The increased chemical loading may have resulted in changes in COPC concentrations in fish tissue and surface water.

Based on the limited amount of data on fish tissue collected in 1998, only ingestion of fish from the Blackfoot/Little Blackfoot watershed was evaluated under Tier 3. Under RME conditions, hazards based on 1998 analytical data were 5 to 6 times lower than calculated in Tier 2 and were determined to be insignificant. Similarly, under CTE conditions, all hazards were determined to be insignificant. It is unclear how the increased precipitation in 1998 may have altered (if at all) the concentration of COPCs in fish tissue. Although similar species of fish were caught and analyzed in 1998 and 2001, the difference in concentrations of COPCs may result more from the collection and analysis of tissue samples from different subpopulations of fish. In any case, comparison of the results under Tiers 2 and 3 illustrate the variability in results over time.

All hazards associated with ingestion of surface water remained insignificant under Tier 3 for all three watersheds.

6.11.5 Final Conclusions

Ingestion of surface soil and fish tissue were the only two exposure pathways associated with risks and hazards greater than acceptable levels.

Hazards associated with ingestion of surface soil were found to exceed 1 only slightly (1.6) at a single location (RA1, near Rasmussen Mine) for the child subsistence lifestyle receptor. No single COPC contributing to this hazard was found to be associated with an HI greater than or equal to 1 (cadmium [0.73], arsenic [0.68], and selenium [0.17]). These three COPCs affect different target organs (see Appendix D). Therefore, it is appropriate to sum only the hazards for cadmium and selenium for the COPC-specific HIs. Because the total HI based on cadmium and selenium (0.90) and each COPC-specific HI is less than 1, the hazard associated with ingestion of surface soil at location RA1 is considered to be insignificant.

The receptor-specific risks associated with ingestion of surface soil were found to be significant (greater than or equal to 1E-06) but within EPA's acceptable risk range (1E-06 to 1E-04) (EPA 1990). In addition, these risks were found to be comparable to risks associated with exposure to concentrations of arsenic in unimpacted Resource Area soil and in soil from the western U.S. Therefore, the arsenic

concentrations in riparian area soils do not contribute significantly to incremental cancer risks for all receptors evaluated in the AWHHRA.

No cancer risk was associated with ingestion of fish because arsenic (the only COPC considered potentially carcinogenic through ingestion) was not detected in any samples of fish tissue. Ingestion of fish tissue was found to be associated with hazards greater than 1 only for subsistence lifestyle receptors (all three watersheds) and the child Native American receptor for the Georgetown watershed, based on 2001 data. All hazards associated with ingestion of fish tissue were determined to be less than 1.0 based on 1998 data.

CTE conditions more accurately reflect receptor-specific hazards due to the following reasons:

(1) The large size of the unimpacted area of watersheds in the Resource Area. Receptors are most likely to spend much more time in the unimpacted areas of the watershed as compared to the impacted areas simply due to large difference in size between these areas. Impacted stream reaches represent only about 27 percent of the total stream reaches in the Blackfoot/Little Blackfoot watershed, and less than 10 percent in the other two watersheds. As such, receptors will most likely be exposed under conditions that more closely resemble CTE, rather than RME conditions.

(2) The small sample sizes in unimpacted areas and the EPC calculation methodology confound the magnitude of exposure of each receptor in Resource Area. For example, there was a relatively small fish sample size in unimpacted areas as compared to impacted areas. As such, all unimpacted reaches were considered as a single area represented by a single mean concentration. The representation of data from the unimpacted reaches in the statistical derivation of EPCs, therefore, was disproportionately lower than the representation of data from impacted areas. Therefore, EPCs for RME conditions in some cases represented the maximum detected concentration or concentrations near maximum detected concentrations. Maximum detected concentrations were invariably located in impacted areas of the watershed. Therefore, RME conditions represented exposures that occurred mostly within impacted areas, which, in turn, represent a small percentage of the overall Resource Area. Receptors are more likely to spend time in unimpacted rather than impacted areas due to the differences in sizes between these areas.

It is possible that individual receptors may selectively fish only from impacted stream reaches and catch only fish with elevated concentrations of COPCs in tissue. However, it is considered unlikely that this situation will persist for long or occur in many individuals. Accordingly, the hazards calculated under CTE conditions (based on COPC-specific EPCs calculated entirely on a area-weighted basis that takes into account that the majority of all three watersheds appear to be unimpacted by mining activities) more accurately reflect actual receptor-specific hazards.

As noted above, the receptor-specific hazards calculated under CTE range were found to be significant only for the child subsistence lifestyle receptor and range from 1.6 to 2.0. Although still significant, these hazards are similar to the hazards associated with ingestion of fish only from unimpacted reaches and soil for unimpacted areas. Therefore, ingestion of fish tissue and soil are expected to be associated with only a limited hazard that can be expected to increase to the extent that receptors fish more frequently in impacted stream reaches or are exposed to soil in unimpacted areas.

7.0 AREA WIDE ECOLOGICAL RISK ASSESSMENT

Typically, the ERA conducted by MW (1999b) would be equivalent to a screening-level ERA. This assessment is equivalent to a baseline ERA. However, EPA (EPA 1997b) guidance on ERA is based on evaluating single waste sites or areas of relatively limited aerial extent. This process was adapted to allow assessment of a site the size of the Resource Area.

The risk assessment process uses multiple tiers of assessment that represent different bounding conditions to provide adequate information for the risk managers. The process used is discussed in the following sections.

7.1 AREA WIDE ECOLOGICAL RISK ASSESSMENT APPROACH

The aerial extent of the Resource Area is large, with multiple mine sites across the area. Chemicals from mining may impact a wide variety of habitats and receptors. No single line of evidence will adequately assess the potential risks to ecological receptors in the area from mining-related releases. Therefore, multiple lines of evidence were used to assess the potential risk to ecological receptors. These lines of evidence are described fully in Section 7.5.2 but consist of: (1) development of HQs for various receptors based on modeled doses; (2) comparison of concentrations in tissue to literature data on effects; (3) comparisons of chemical concentrations between impacted and reference areas; and (4) comparison of concentration on media to accepted benchmarks. The primary line of evidence was development of HQs for the representative receptors and effects. Because of issues concerning the quality and comparability of historical data, only data collected during calendar year 2001 was used to develop the HQs. This primary line of evidence was supplemented by information from the other lines of evidence. The strategy for evaluating HQs for various receptors for the Resource Area is described in the following sections and shown in Figure 5.

7.1.1 Tier 1 Assessment

The first tier is a “worst-case” screening-level activity directed at eliminating any chemicals that present negligible risks, chemicals that occur at background levels with no increased concentrations associated with mining, or chemicals that occur near or below the detection limits of laboratory instrumentation. In this step, the highest observed concentration for each medium and chemical and the most conservative exposure parameters (see Table 7-4) were used to calculate an HQ for each target species and COPEC.

Any chemicals that do not present a potential risk using this worst-case scenario can then be safely removed from further consideration on a receptor-specific basis (see Figure 5).

7.1.2 Tier 2 Assessment

In the second tier, chemicals and receptors that were not eliminated in Tier 1 were evaluated on an area-wide basis using area-weighted EPCs for each medium and mean exposure parameters for each receptor intended to represent an estimate of the average population-level exposures (see Figure 5). IDEQ chose to use a targeted sampling approach to support development of area-weighted EPCs. IDEQ deemed this approach scientifically valid and it provides a cost-effective method within the accepted tolerances of typical risk assessment processes without collecting the excessive number of samples associated with purely statistical approaches.

Each medium was represented by average values from impacted and unimpacted data sets for the riparian areas (examining the aquatic and riparian receptors restricted to this ecosystem) and the overall area (including both riparian and terrestrial areas) for wide-ranging receptors (all other receptors that may be found in both the aquatic and riparian and terrestrial areas). These values were area-weighted based on surface area ratios, lengths of stream segments other applicable weighting criteria (see Appendix C). HQs were developed based on NOAEL benchmarks as will be discussed in Section 7.6.3. The dose calculation and development of HQs for each species was conducted as described in Section 7.6.

Although the mines occupy a large area, the combined area of the mine sites is about only 3 percent of the total Resource Area. Therefore, HQs were calculated for the following data sets to place the results in the appropriate context.

- Aquatic and Riparian Areas – All data were used to calculate EPCs using an area-weighted approach for both impacted and background areas. HQs developed from this data set represent the potential risk to overall populations of the selected receptors (red-winged blackbird, great blue heron, mallard duck, and mink).
- Overall Aquatic, Riparian, and Terrestrial Areas – All data were used to calculate EPCs using an area-weighted approach for both impacted and background areas for the aquatic, riparian, and terrestrial ecosystems. HQs developed from this data set represent the potential risk to overall populations of the selected receptors (all other receptors that are not included above).

The HQs derived from these data sets provide sufficient information to place the calculated risks in an appropriate context to represent the average risk in the Resource Area.

7.1.3 Tier 3 Assessment

For an area the size of the Resource Area, the data available for the risk assessment are limited in nature and extent. Therefore, significant uncertainties are inherent in the risk assessment. These uncertainties include temporal components of chemical releases to surface water, EPCs used in the calculations, and actual exposure experienced by the various receptors. Tier 3 provided additional assessment to assess the uncertainties of various parameter values used in the risk assessment calculations (see Figure 5). This included running separate calculations based on the mean concentrations of COPECs from historical data and assessing uncertainties in the exposure parameters to evaluate their effects on the HQ values calculated in Tier 2. The results of the risk characterization were also analyzed in terms of other lines of evidence described in Section 7.5.2.

7.2 IDENTIFICATION AND PRIORITIZATION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

Chemicals detected in the various media sampled were subjected to a screening process to focus the ERA on chemicals that are site-specific and that pose the greatest risk to ecological receptors (see Figure 5). Screening factors consist of the following:

Surface Water

- Frequency of detection
- EPA. 1999. "National Recommended Water Quality Criteria – Corrected." EPA/822/2-99/001. April.
- For background screening comparisons, an average concentration was calculated for each chemical using data collected from streams upgradient to and in the undisturbed region of the Resource Area (considered to be representative of pre-mining conditions). Average and single-point concentrations that are more than 2 times the calculated background average were considered impacted and were evaluated in the risk assessment process.

Freshwater Sediments

- Frequency of detection
- Comparison to background concentrations
- Consensus-Based Freshwater Sediment Quality Guidelines (MacDonald and others 2000)
- Selected freshwater threshold effects levels from National Oceanic and Atmospheric Administration (NOAA) Screening Quick-Reference Tables (SQuiRT) (EPA 1999)

- Suggested toxicity threshold for selenium taken from Van Derveer and Canton (1997), San Joaquin Valley Drainage Program (1990), and Lemly and Smith (1990, all as cited in Skorupa 1998)

Soils

- Frequency of detection
- Comparison to background concentrations
- Soil screening criteria as provided for limited inorganics from Ecological Soil Screening Level Guidance (EPA 2000a); Kapustka and others (2000); and EPA (2001)

Table 7-1 presents the screening benchmarks and criteria for surface water, sediment, and soil. The screening process is summarized in Section 5.0 and is described in detail in Appendix B. The method used for weighting of the data is presented in Appendix C. Retained chemicals are referred to as COPECs.

7.3 ECOLOGICAL FOOD WEB IN RESOURCE AREA

Food webs are organized by class guilds, which are linked based on dietary relationships. Food webs are meant to illustrate how chemicals have the potential to be transferred within an ecosystem. The various food chains represent potential exposure pathways to COPECs. The importance of a food chain as a dietary exposure pathway depends on dietary habits of the receptor. The boxes in the ecological CSM represent the expected feeding guilds in each of the ecosystems in the Resource Area (see Figure 6). Feeding guilds are groups of organisms that exploit similar resources for food.

7.3.1 Terrestrial Food Web

Figure 6 illustrates the food web interactions for the terrestrial food web for the Resource Area. The primary producers include wheatgrass (*Agrophyron* spp.), alfalfa (*Medicago sativa*), and brome grass (*Bromus* spp.).

The primary consumers are composed of terrestrial invertebrates and herbivorous birds and mammals. Diets of birds can vary greatly, and numerous bird species may also be considered herbivorous either all or part of the year, depending on conditions such as availability of prey and life stage. Terrestrial invertebrates include plant-eating insects such as grasshoppers, insect larvae, and beetle larvae. Other

primary consumers include herbivorous mammals and herbivorous birds. Specific species of each of these guilds are presented in Figure 6, and the assessment endpoints are highlighted.

The secondary consumers consist of terrestrial omnivorous birds and mammals and reptiles. Omnivorous birds and mammals may consume both plants and animals and may feed almost exclusively on one or the other, depending on season and population of the prey. Specific species of each of these guilds are presented in Figure 6, and the assessment endpoints are highlighted.

Tertiary consumers include carnivorous mammals and raptors. These species feed exclusively by preying on other animals. Specific species of each of these guilds are presented in Figure 6, and the assessment endpoints are highlighted.

7.3.2 Aquatic and Riparian Food Web

Figure 6 illustrates the interactions within the food web for freshwater and riparian areas. Primary producers include phytoplankton and aquatic macrophytes. These organisms represent the basis of the food chain. Emergent and riparian primary producers also provide shelter and habitat for higher trophic level species. Specific species of each of these guilds are presented in Figure 6, and the assessment endpoints are highlighted.

Primary consumers include zooplankton, benthic invertebrates, benthic-feeding fish, and riparian herbivorous birds and mammals. Zooplankton feed primarily on phytoplankton and other zooplankton. Benthic invertebrates, which have the potential to be present in the Resource Area, include insect larvae and freshwater oligochaetes. These organisms feed on detritus composed of dead animals and plants, suspended particulates, and microscopic invertebrates. These organisms are closely associated with the sediments and are exposed to the contamination in the sediment dermally and through direct and incidental ingestion. Benthic-feeding fish tend to be omnivorous and feed on both benthic invertebrates and aquatic plants. Aquatic and riparian herbivorous birds and mammals consume vegetation found in the aquatic or riparian environment. Specific species of each of these guilds are presented in Figure 6, and the assessment endpoints are highlighted.

Secondary consumers include fish, amphibians, aquatic and riparian omnivorous birds and mammals, aquatic and riparian piscivorous birds, aquatic and riparian benthic-feeding birds, and aquatic and riparian carnivorous mammals. Specific species of each of these guilds are presented in Figure 6, and the assessment endpoints are highlighted.

7.4 ECOLOGICAL EFFECTS, COMPLETE EXPOSURE PATHWAYS, AND ECOSYSTEMS POTENTIALLY AT RISK

This section discusses the fate and transport and the complete exposure pathways for the COPEC, and the ecosystems potentially at risk. Based on the initial, the COPECs are cadmium, chromium, copper, nickel, selenium, vanadium, and zinc.

7.4.1 Ecological Effects of Chemicals of Potential Ecological Concern

An understanding of how the COPECs adversely affect ecological receptors is required to identify significant potential exposure pathways that should be evaluated in the ERA. This understanding facilitates identification of the most sensitive receptors. Toxicity profiles for each of these COPECs are presented in Appendix F.

7.4.2 Complete Exposure Pathways

For ecological receptors, the potential exposure pathways for movement of chemicals that results from phosphate mining in southeastern Idaho include the following:

- Ingestion of windblown particles and dust
- Incidental ingestion of surface soil, sediment, and surface water during grooming, foraging, or feeding
- Dermal uptake of metals
- Dietary uptake of metals through contaminated forage or prey items and surface water ingestion

Some of these exposure pathways are more important than others. The most important exposure pathways for ecological receptors are:

- Incidental ingestion of surface soil, surface water, and sediment during grooming, foraging, or feeding (assumed to include incidental ingestion of windblown particles and dust)
- Dietary uptake of metals through contaminated forage and prey items

These pathways are believed to be the most significant because a high probability exists that ecological receptors will receive direct-contact doses from soils and sediments (given that these are the most contaminated media), as well as potentially contaminated terrestrial and benthic invertebrates that may

accumulate selenium. These two pathways are likely to contribute the greatest percentage of the overall ecological risks.

The other pathways (although potentially complete) were deemed less likely to contribute to the exposure of ecological receptors. Of the potentially complete exposure pathways, dermal absorption was excluded because of a lack of data to assess the effect of dermal adsorption of selenium, which may be negligible because of normal grooming. In addition, it was already taken into account through incidental ingestion by the ingestion pathway. Inhalation exposures are also poorly understood in an ecological risk context because no toxicity data are available for comparison.

7.4.3 Ecosystems Potentially at Risk

An important part of the problem formulation process is to identify the environmental setting and the ecosystems that are potentially at risk. A detailed discussion of the Resource Area is presented in MW (1999b). Using this information and other studies, the following discussion describes the ecosystems potentially at risk.

The vegetation in the project area is transitional between the Great Basin vegetation to the south and the Rocky Mountain vegetation to the north (MW 1999b). Six vegetation types are found within the project area and are a result of elevation, moisture, temperature, soil type, slope, and aspect:

- Conifer-Aspen Community
- Mountain Brush Community
- Sagebrush-Grass Community
- Riparian Community
- Marshland Community
- Agricultural and urban lands
- Lotic Aquatic Community

Based on previous investigations, 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 FS 1977; FS 1985, 1997; Idaho Conservation Center Data Base [(ICCDB) 1999; all as cited in MW 1999b]. A list of species known to occur in the Resource Area is presented in MW (1999b). All species identified as potential receptors for the ERA are taken from these lists.

The Resource Area is divided into two major riverine systems: the Bear River, and the Snake River (MW 1999a). Other major streams in the Resource Area include the Blackfoot, Portneuf, and Salt Rivers, all tributaries of the Snake River. The southern portion of the Resource Area is located in the Bear River watershed. The Blackfoot, Portneuf, and Ross Fork, and Salt River watersheds drain the remainder of the Resource Area. All of these streams support abundant aquatic populations of periphyton, benthic macro-invertebrates, and fish.

Several plant and animal species that are classified as threatened or endangered may be present or are thought to be present as seasonal migrants in the Resource Area and are listed in MW (1999b).

The ecological CSM, presented in Figure 6, was developed to assist in identifying specific receptors that might be directly or indirectly exposed to COPECs and to carry out the exposure assessment. The ecological CSM illustrates the following:

- The abiotic media (that is, soil, sediment, and water)
- Trophic levels, primary producers, and primary, secondary, and tertiary consumers
- Trophic-level compartments represented by guilds (that is, a group of species from similar classes that occupy a particular trophic level and exploit similar resources)
- Major dietary relationships between compartments

The ecological CSM illustrates the interlocking patterns of the various inclusive food chains. A food chain is a straight line from a food source to a series of organisms that feed on the source or other organisms that feed on the source. A food web shows how energy or, in this case, chemicals, may be transferred within an ecosystem. A food chain represents a potential exposure pathway to a COPEC. The importance of the exposure pathway depends on the dietary habits of the receptor and the COPEC.

Food webs are organized by class guilds, which are linked based on dietary relationships. Food webs are meant to illustrate how chemicals have the potential to be transferred within an ecosystem. The various food chains represent potential exposure pathway to a COPEC. The importance of a food chain as a dietary exposure pathway depends on the dietary habits of the receptor. The boxes in the ecological CSM represent the expected feeding guilds in each of the ecosystems in the Resource Area. Feeding guilds are groups of organisms that exploit similar resources for food.

7.5 ASSESSMENT AND MEASUREMENT ENDPOINTS

To assess ecological risks, identification of potential assessment and measurement endpoints are presented as one of the components of problem formulation. Assessment endpoints represent potentially significant ecological impacts and are selected based on the ecosystems, communities, and species that are of particular concern at the site under study. For each assessment endpoint, one or more measurement endpoints are selected to integrate modeled or field data with the individual assessment endpoint. Measurement endpoints are measurable responses to a stressor that are related to the valued assessment endpoint (Suter 1993). Table 7-2 presents the assessment endpoints for each guild in the terrestrial and aquatic and riparian ecosystems and the associated assessment receptor.

7.5.1 Assessment Endpoints

Assessment endpoints should be accepted depending on whether the exposure pathway is complete, whether the metal is bioavailable, and whether the assessment endpoint is expected to be the most toxicological sensitive to exposure to the metal.

7.5.1.1 Assessment Endpoints for the Terrestrial Food Web Ecosystem

Using the terrestrial habitat-specific food web, assessment endpoints may be selected to focus the risk assessment and characterization (see Figure 6 and Table 7-2). Herbaceous plant abundance, habitat, and productivity are attributes to be preserved in a terrestrial ecosystem. As food, herbaceous plants provide an important pathway for energy and nutrient transfer from soil to herbivorous and omnivorous receptors. Herbaceous plants also provide critically important habitat for terrestrial animals. Woody plant habitat and productivity are critical attributes to be protected. Herbivore productivity is an attribute to be protected in the terrestrial ecosystem because herbivores incorporate energy and nutrients from plants and transfer it to higher trophic levels. Herbivores are integral to the success of terrestrial plants, because they disperse plants seeds.

Productivity and function of soil invertebrates as decomposers are attributes to be preserved in a terrestrial ecosystem. They provide a mechanism for the physical breakdown of detritus for microbial decomposition, which is a vital function. Soil invertebrates function as a major source of food for omnivorous birds and mammals and reptiles.

Productivity of omnivores is an important attribute to be protected because omnivores incorporate energy and nutrients from lower trophic levels and transfer them to higher-level omnivores and carnivores.

Based on knowledge of the toxicity of metals and metalloids, site-specific terrestrial assessment endpoints would include the following terrestrial guilds:

- Terrestrial plants
- Terrestrial invertebrates
- Terrestrial herbivorous birds
- Terrestrial herbivorous mammals
- Terrestrial omnivorous birds
- Terrestrial omnivorous mammals
- Reptiles
- Terrestrial carnivorous mammals
- Terrestrial carnivorous birds

Although some individual receptors exhibit a greater potential for exposure than others, each assessment endpoint is toxicologically sensitive to metals and is expected to have a complete exposure pathway.

Terrestrial Plants

Some terrestrial plants are highly effective in removing various metals from contaminated soil. Some metals are not essential for plant growth, but in some plants can cause toxicity, as exemplified by chlorosis, stunting, and yellowing of leaves. Plants that bioaccumulate metals may transform them into organic forms that become highly bioavailable when the plant is eaten or dies. Terrestrial invertebrates, terrestrial herbivorous birds and mammals, and terrestrial omnivorous birds and mammals that consume plants are potentially at risk. Terrestrial plants were not directly assessed; however, protection of terrestrial plants will be afforded through the protection of the guilds that use this resource, as defined below.

Terrestrial Invertebrates

The terrestrial invertebrates include soil invertebrates, such as earthworms, and other invertebrates, such as various insects that feed directly on plants. These receptors are important in stabilization of the soil and are an important source of food for omnivorous birds and mammals, thereby providing for the

transfer of energy to higher trophic levels. Significant exposure is predicted for terrestrial insects that feed on plants. However, metals may not be directly toxic to terrestrial invertebrates, but consumers of these terrestrial invertebrates are highly susceptible to toxic effects of accumulated metals. For example, there is no data on the toxicity of selenium for terrestrial invertebrates, and the toxic effects of directly consuming selenium-contaminated invertebrates are more important than any indirect ecological effects. Omnivorous birds and mammals are most at risk from consuming terrestrial invertebrates. Terrestrial invertebrates were not directly assessed; however, protection of terrestrial invertebrates will be afforded through the protection of the guilds that use this resource, as defined below.

Terrestrial Herbivorous Birds and Associated Assessment Endpoints

Terrestrial herbivorous birds are expected to be highly exposed to metals based on their expected diet requirements and through incidental ingestion of soil contaminated by metals. As an example, exposure to selenium in the diet of terrestrial herbivorous birds is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation. The following assessment endpoint was defined for terrestrial herbivorous birds.

- Protection of terrestrial herbivorous birds that may ingest contaminated plants and surface water and incidental ingestion of associated soil from potentially lethal, reproductive, systemic, or general toxic effects of metals that result from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Terrestrial Herbivorous Mammals and Associated Assessment Endpoints

Excessive metals in the herbivorous mammal's food source may cause systemic or general toxic effects. The following assessment endpoint was defined for terrestrial herbivorous mammals.

- Protection of terrestrial herbivorous mammals that may ingest contaminated plants and surface water and incidental ingestion of associated soil from potentially systemic or general toxic effects of metals that result from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Terrestrial Omnivorous Birds and Associated Assessment Endpoints

Terrestrial omnivorous birds are expected to be highly exposed to metals based on their expected dietary requirements (terrestrial plants and invertebrates) and through incidental ingestion of soil contaminated by metals. As an example, exposure to selenium in the diet of terrestrial omnivorous birds and incidental ingestion of associated soil is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation.

The following assessment endpoint was defined for terrestrial omnivorous birds.

- Protection of terrestrial omnivorous birds that may ingest contaminated food and surface water and associated soil or sediment from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Terrestrial Omnivorous Mammals and Associated Assessment Endpoints

Excessive metals in the omnivorous mammal's food source may cause systemic or general toxic effects. As an example, there have been no well-documented cases of widespread selenosis reported for wild mammals, including terrestrial omnivorous mammals, and selenium does not biomagnify at this level in the food chain. Terrestrial omnivorous mammals are a potential assessment endpoint as follows:

- Protection of terrestrial omnivorous mammals that may ingest contaminated plants, prey, and surface water and incidental ingestion of associated soil and sediment from potentially systemic or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Reptiles

Mortality in reptiles caused by metal intoxication has not been reported (Linder and Grillitsch 2000). Ambient levels of metals in free-ranging reptiles have rarely been reported in the literature. Ingestion of food is the major cause of exposure to metals in reptiles. Based on the available data, reptiles do not seem to biomagnify metals to the extent that would correspond to their trophic level (Linder and Grillitsch 2000). Reptiles will not be directly assessed because of the indication that this guild is not affected by the presence of excess levels of metals nor is an adequate database available for proper comparison to assess

risk. It is assumed that protection of the terrestrial ecosystem for the other guilds will confer some protection for reptiles.

7.5.1.2 Assessment Endpoints for the Aquatic or Riparian Food Web Ecosystem

As in the terrestrial ecosystem, phytoplankton and aquatic macrophytes transfer energy from the sediments to herbivorous invertebrates, herbivorous birds and mammals, and omnivorous birds and mammals. Productivity and function of benthic invertebrates as decomposers are attributes to be preserved in an aquatic ecosystem. They provide a mechanism for the physical breakdown of detritus for microbial decomposition, which is a vital function. Benthic invertebrates function as a major source of food for benthic-feeding fish, amphibians, and omnivorous birds. Omnivore productivity is an important attribute to be protected because omnivores incorporate energy and nutrients from lower trophic levels and transfer it to higher-level omnivores and carnivores.

Based on knowledge of the toxicity of various metals, site-specific aquatic or riparian assessment endpoints would include the following:

- Phytoplankton and aquatic macrophytes
- Zooplankton and benthic invertebrates
- Aquatic and riparian herbivorous birds
- Aquatic and riparian herbivorous mammals
- Benthic fish
- Aquatic and riparian omnivorous birds
- Aquatic and riparian omnivorous mammals
- Aquatic and riparian piscivorous birds
- Aquatic and riparian benthic-feeding birds
- Aquatic and riparian omnivorous mammals
- Aquatic and riparian carnivorous mammals
- Fish
- Amphibians

Although some individual receptors exhibit a greater potential for exposure than others, each assessment endpoint is toxicologically sensitive to various metals and is expected to have a complete exposure pathway.

Phytoplankton and Aquatic Macrophytes

Phytoplankton and aquatic macrophytes are highly effective at removing metals from sediment contaminated by metals. As an example, selenium is not essential for plant growth. Plants that bioaccumulate selenium transforms the selenium into organic forms that become highly bioavailable when the plant is eaten or dies. Benthic invertebrates, herbivorous birds and mammals, and terrestrial omnivorous birds and mammals that consume plants are potentially at risk from contamination by metals. Phytoplankton and aquatic macrophytes will not be directly assessed; however, protection of phytoplankton and aquatic macrophytes will be afforded through the protection of the guilds that use this resource, as defined below.

Zooplankton and Benthic Invertebrates

Significant exposure is predicted for zooplankton and benthic invertebrates. Invertebrates are an important source of protein for various fish and omnivorous and benthic-feeding birds. As an example of toxicity of the metals, selenium appears to affect the survival of zooplankton (rotifers and cladocerans) and benthic invertebrates (midge larvae) (Jarvinen and Ankley 1999), and consumers of these invertebrates are highly susceptible to toxic effects of accumulated selenium. There is some data on the toxicity of selenium for benthic invertebrates, and the toxic effects that occur from directly consuming selenium-contaminated invertebrates are important. Amphibians, benthic-feeding fish, fish, and benthic-feeding birds are most at risk from the toxicity of metals from consuming benthic invertebrates. Zooplankton and benthic invertebrates will not be directly assessed; however, protection of zooplankton and benthic invertebrates will be afforded through the protection of the guilds that use this resource, as defined below.

Aquatic and Riparian Herbivorous Birds and Associated Assessment Endpoints

Aquatic and riparian herbivorous birds are expected to be highly exposed to metals based on their expected dietary requirements and through incidental ingestion of metal-contaminated sediment or soil. As an example, selenium exposure in the diet and drinking water of aquatic and riparian herbivorous birds is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation.

Aquatic and riparian herbivorous birds are a potential assessment endpoint as follows:

- Protection of riparian herbivorous birds that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, and surface water from potentially lethal, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Aquatic and Riparian Herbivorous Mammals and Associated Assessment Endpoints

Excessive metals in the aquatic and riparian herbivorous mammal's food source may cause systemic or general toxic effects. As an example, there have been no well-documented cases of widespread selenosis reported for wild mammals, and selenium does not biomagnify at this level in the food chain. Aquatic and riparian herbivorous mammals are a potential assessment endpoint as follows:

- Protection of aquatic and riparian herbivorous mammals that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or surface water from potentially systemic or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Benthic Fish and Associated Assessment Endpoints

Protection of benthic fish is imperative since aquatic and riparian piscivorous birds, aquatic and riparian benthic-feeding birds, aquatic and riparian omnivorous mammals and birds, and amphibians feed on adult and young benthic fish. As an example, elevated levels of selenium can cause reproductive failure in fish, anemia, reduced hatch, reduced growth, reduced swimming rate, and chromosomal aberrations (Hodson and others 1980; Adams 1976; Bovee and O'Brien 1982; and Krishnaja and Rege 1982; all as cited Eisler 1985). Lemly (1993a and 1996a, as cited in Skorupa 1998) concluded that the most precise way to assess risk associated with exposure of fish to selenium was to measure the selenium levels in gravid ovaries. Benthic fish are a potential assessment endpoint as follows:

- Protection of benthic fish from contaminated food and associated sediments form potentially lethal, mutagenic, reproductive, systemic or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Aquatic and Riparian Omnivorous Birds and Associated Assessment Endpoints

Aquatic and riparian omnivorous birds are expected to be highly exposed to metals based on their expected diet requirements (aquatic and terrestrial plants and invertebrates) and through incidental ingestion of soil, sediment, or water contaminated by metals. As an example, exposure to selenium in the diet and drinking water of aquatic and riparian omnivorous birds is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation. Aquatic and riparian omnivorous birds are a potential assessment endpoint as follows:

- Protection of aquatic and riparian omnivorous birds that may ingest contaminated food and associated soil, sediment, or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Aquatic and Riparian Piscivorous Birds and Associated Assessment Endpoints

Aquatic and riparian omnivorous birds are expected to be highly exposed to metals based on their expected diet requirements (benthic fish and other fish species) and through incidental ingestion of sediment or water contaminated by metals. As an example, exposure to selenium in the diet and drinking water of aquatic and riparian piscivorous birds is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation.

Aquatic and riparian piscivorous birds are a potential assessment endpoint as follows:

- Protection of aquatic and riparian piscivorous birds that may ingest contaminated food and associated sediment or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Aquatic and Riparian Benthic-Feeding Birds and Associated Assessment Endpoints

Aquatic and riparian benthic-feeding birds are expected to be highly exposed to metals based on their expected dietary requirements (benthic invertebrates) and through incidental ingestion of sediment or water contaminated by metals. As an example, exposure to selenium in the diet and drinking water of

aquatic and riparian benthic-feeding birds is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation.

Aquatic and riparian benthic-feeding birds are a potential assessment endpoint as follows:

- Protection of aquatic and riparian benthic-feeding birds that may ingest contaminated food and associated sediment or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Aquatic and Riparian Omnivorous Mammals and Associated Assessment Endpoints

Excessive metals in the omnivorous mammal's food source may cause systemic or general toxic effects. As an example, there have been no well-documented cases of widespread selenosis reported for wild mammals, including aquatic and riparian omnivorous mammals, and selenium does not magnify at this level in the food chain. Aquatic and riparian omnivorous mammals are a potential assessment endpoint as follows:

- Protection of aquatic and riparian omnivorous mammals that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Riparian Carnivorous Mammals and Associated Assessment Endpoints

Excessive ingestion of metals by aquatic and riparian carnivorous mammals may cause systemic or general toxic effects. Aquatic and riparian carnivorous mammals are a potential assessment endpoint as follows:

- Protection of aquatic and riparian carnivorous mammals that may ingest contaminated prey and incidental ingestion of associated soil, sediment, and water from potentially systemic or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Fish and Associated Assessment Endpoints

Protection of fish is imperative since aquatic and riparian piscivorous birds, benthic-feeding birds, aquatic and riparian omnivorous mammals and birds, and amphibians feed on adult and young fish. As an example, elevated levels of selenium can result in reproductive failure, anemia, reduced hatch, reduced growth, reduced swimming rate, and chromosomal aberrations (Hodson and others 1980; Adams 1976; Bovee and O'Brien 1982; and Krishnaja and Rege 1982; all as cited Eisler 1985). Lemly (1993a and 1996a, as cited in Skorupa 1998) concluded that the most precise way to assess risk associated with exposure of fish to selenium was to measure the selenium levels in gravid ovaries. Fish are a potential assessment endpoint as follows:

- Protection of fish from contaminated food and associated sediments or water from potentially lethal, mutagenic, reproductive, systemic or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Amphibians

Amphibians may be an important source of food for riparian omnivorous birds and mammals and riparian carnivorous mammals. There are little data on the toxicity of metals to amphibians (Sparling and others 2000). As an example of the toxicity of metals, Skorupa (1998) suggests that based on the similarity of the toxic threshold values for fish and bird eggs (two other classes of egg-laying vertebrates) it is probably safe to assume the following for amphibians:

- Reproductive impairment is among the most sensitive response variables
- Populations producing eggs with equal to or greater than 10 mg/kg selenium are reproductively impaired

Amphibians will not be directly assessed because of the paucity of data on the toxicity of metals; however, protection to amphibians will be afforded through the protection of the guilds that use this resource as defined above.

There may be some overlap between the habitat requirements of the species listed for the aquatic and riparian ecosystem and the terrestrial ecosystem.

7.5.1.3 Assessment Endpoints for Tertiary Consumers

Productivity of carnivores is an attribute to be protected because they provide food to other carnivores, omnivores, scavengers, and microbial decomposers. In addition, carnivores affect the abundance, reproduction, and recruitment of lower trophic levels, such as herbivores and omnivores, through predation.

Based on knowledge of the toxicity of metals, site-specific tertiary consumer endpoints include the following:

- Carnivorous mammals
- Raptors

Although some individual receptors exhibit a greater exposure potential than others, each assessment endpoint is toxicologically sensitive to metals and is expected to have a complete exposure pathway.

Carnivorous Mammals and Associated Assessment Endpoints

Excessive metals in the carnivorous mammal's food source may cause systemic or general toxic effects. However, there have been no well-documented cases of widespread selenosis reported for wild mammals, including carnivorous mammals, and selenium does not magnify at this level in the food chain. Carnivorous mammals are a potential assessment endpoint as follows:

- Protection of carnivorous mammals that may ingest contaminated prey and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

Raptors and Associated Assessment Endpoints

Raptors are expected to be exposed to metals based on their expected dietary requirements and through incidental ingestion of contaminated soil, sediment, or water. As an example, exposure to selenium in the diet and drinking water of raptors is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation (Eisler 1985).

Raptors are a potential assessment endpoint as follows:

- Protection of raptors that may ingest contaminated prey and associated soil, sediment, or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining.

Assessment endpoints and associated receptors are presented in Table 7-2.

7.5.2 Measurement Endpoints

After assessment endpoints are identified for each guild, possible measurement endpoints can be established. Measurement endpoints are measurable responses to a stressor that are related to the valued assessment endpoint (Suter 1993).

Multiple lines of evidence, which serve as measurement endpoints, have been considered for integration to assess ecological risk for the various identified guilds:

- Collect, analyze, and evaluate data on residues in tissue
- Compare concentrations of COPECs in tissues with levels that are reported in scientific literature to be harmful
- Measure concentrations of COPECs in selected food items
- Compare concentrations in food items to levels from areas not impacted by phosphate mining
- Model chemical levels in food items to calculate a potential dose and compare this dose with appropriate toxicity threshold values

Table 7-3 presents the list of measurement endpoints used to evaluate each assessment endpoint receptor.

The tissues of terrestrial plants, aquatic macrophytes, terrestrial invertebrates, benthic invertebrates, small herbivorous and omnivorous mammals, and benthic and other fish have been collected and analyzed. Data on residues in tissue are a strong indicator of chemical bioavailability. These concentrations in tissue can then be compared with similar concentration levels in the literature to ascertain if there is a potential risk to these respective guilds. In addition, these data can be used to model a daily dose ingested by higher-level mammals and birds.

The exposure dose was compared with a toxicity reference value (TRV). TRVs are available for birds and mammals. There are some uncertainties associated with this measurement endpoint:

- The assumption that the chosen receptor adequately represents the guild of interest
- The assumption that food items chosen for collection and analysis of tissues are those most commonly consumed by the receptor
- May be difficult to find adequate area free of impacts from phosphate mining for comparison
- TRVs are developed from laboratory data and may not be accurate surrogates for wildlife

There are adequate TRVs that can be used to assess risk to birds and mammals. Therefore, the use of tissue residue data was to model doses to upper trophic level receptors.

7.6 METHODOLOGY FOR EVALUATION OF EXPOSURE AND EFFECTS TO VERTEBRATE RECEPTORS

The total exposure from ingestion for each receptor of concern was calculated as the sum of the estimates of the dietary and soil, sediment, or surface water exposure for each COPEC. The resultant exposure dose was compared with a TRV to assess whether there is a hazard to the receptor for a COPEC.

7.6.1 Development of Exposure Estimates

The following generic equation was customized for each terrestrial and aquatic and riparian assessment endpoint:

$$Dose_{Total} = (SUF) \times \frac{\left[(C_{media} \times IR_{media}) + (C_{prey})(IR_{prey})\right]}{BW} \qquad (7\text{-}1)$$

where

$Dose_{Total}$	=	Daily dose resulting from ingestion of terrestrial or riparian soil and or sediment and prey (milligrams COPEC per kilogram body weight per day [mg COPEC/kg BW/Day])
C_{media}	=	Concentration of chemical in terrestrial or riparian soil, sediment, or surface water (mg/kg or milligram per liter [mg/L]) during incidental ingestion of that media
C_{prey}	=	(C_{prey}), prey may consist of aquatic invertebrates, riparian insects, riparian insects and worms, terrestrial insects, fish, riparian mammals, terrestrial mammals

		(mg/kg). Actual concentrations were used since no BTF was calculated for these prey types (see Section 7.6.2).
C_{prey}	=	(C_{media}) (BTF), tissue concentration factor used for aquatic plants, riparian plants, and terrestrial plants where a BTF was calculated, see Section 7.6.2.
BTF	=	Biotransfer factor, calculated for sediment to aquatic plants, riparian soil to riparian plants, and terrestrial soil to terrestrial plants (see Section 7.6.2)
IR	=	Ingestion rate (the amount of prey items, surface water, sediment, and soil ingested per day) (kg/day, kg/kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA based on the size of the Resource Area

The resulting dose is then compared with a dose that serves as the TRV, and the ratio (presented as an HQ) is indicative of potential risks to ecological receptors.

For the AWERA, the same equation was used to calculate an exposure dose for each assessment endpoint. A dose that represents the most conservative exposure was used for the Tier 1 assessment (see Table 7-4). For the Tier 2 assessment, a dose that represents a site-specific exposure scenario was calculated using mean exposure parameters along with area-weighted EPCs of COPECs in soil; sediment; surface water; terrestrial, riparian, or aquatic plants; terrestrial or riparian insects; and tissues of aquatic invertebrates; fish, and riparian and terrestrial small mammals (see Table 7-5). General procedures and assumptions used for development of EPCs for use in the dose equations for the AWERA are presented and discussed in Appendix C.

The Tier 1 assessment presents a worst-case scenario (using conservative exposure parameters), and the Tier 2 assessment presents a more site-specific scenario (using mean exposure parameters), which then can be used in a risk management process to arrive at a risk value that can be applied to manage levels of metals in appropriate media that resulted from phosphate mining in the Resource Area.

The following sections present the dose models specific to each of the assessment endpoints based on the general model equation presented above.

7.6.1.1 Terrestrial Herbivorous Birds – Northern Bobwhite

The dose equation for the terrestrial herbivorous birds is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[(C_{soil} \times IR_{soil}) + \begin{Bmatrix} 83.8\%(C_{terrestrial\ plants} \times IR_{prey}) + \\ 14.1\%(C_{terrestrial\ insects} \times IR_{prey}) \end{Bmatrix} \right]}{BW} \quad (7\text{-}2)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{terrestrial\ insects}$	=	Concentration of chemical in terrestrial invertebrates (mg/kg)
$C_{terrestrial\ plants}$	=	($C_{terrestrial\ soil}$) x ($BTF_{terrestrial\ plants}$) (mg/kg)
C_{soil}	=	Concentration of chemical in soil (mg/kg)
$BTF_{terrestrial\ plant}$	=	BTF of terrestrial soil to terrestrial plant calculated as indicated in Section 7.6.2
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for terrestrial soils, terrestrial plants, and terrestrial insects. It is assumed that the water requirement for the northern bobwhite is obtained from its food source. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.2 Terrestrial Herbivorous Mammals – Eastern Cottontail

The dose equation for the terrestrial herbivorous mammal is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[(C_{soil} \times IR_{soil}) + 97.6\%(C_{terrestrial\ plants} \times IR_{prey}) \right]}{BW} \quad (7\text{-}3)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{terrestrial\ plants}$	=	($C_{terrestrial\ soil}$) x ($BTF_{terrestrial\ plants}$) (mg/kg)
C_{soil}	=	Concentration of chemical in soil (mg/kg)
$BTF_{terrestrial\ plant}$	=	BTF of terrestrial soil to terrestrial plant calculated as indicated in Section 7.6.2
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for terrestrial soils and terrestrial plants. It is assumed that the water requirement for the eastern cottontail is obtained from its food source. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.3 Terrestrial Omnivorous Birds – American Robin

The dose equation for terrestrial omnivorous birds is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[(C_{soil} \times IR_{soil}) + \begin{Bmatrix} 49.0\%(C_{terrestrial\ plants} \times IR_{prey}) + \\ 49.0\%(C_{terrestrial\ insects} \times IR_{prey}) \end{Bmatrix} \right]}{BW} \qquad (7\text{-}4)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{terrestrial\ insects}$	=	Concentration of chemical in terrestrial invertebrates (mg/kg)
$C_{terrestrial\ plants}$	=	($C_{terrestrial\ soil}$) x ($BTFT_{terrestrial\ plants}$) C_{soil} = Concentration of chemical in soil (mg/kg)
$BTF_{terrestrial\ plant}$	=	BTF of terrestrial soil to terrestrial plant calculated as indicated in Section 7.6.2
IR_{soil}	=	Ingestion rate of soil (kg/day)

IR_{prey}	=	Ingestion rate of prey (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for terrestrial soils, terrestrial plants, and terrestrial insect data. It is assumed that the water requirement for the American robin is obtained from its food source. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.4 Terrestrial Omnivorous Mammals – Deer Mouse

The dose equation for terrestrial omnivorous mammals is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[(C_{soil} \times IR_{soil}) + \begin{Bmatrix} 53.4\%(C_{terrestrial\ plants} \times IR_{prey}) + \\ 44.6\%(C_{terrestrial\ insects} \times IR_{prey}) \end{Bmatrix} \right]}{BW} \qquad (7\text{-}5)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{terrestrial\ insects}$	=	Concentration of chemical in terrestrial invertebrates (mg/kg)
$C_{terrestrial\ plants}$	=	($C_{terrestrial\ soil}$) x ($BTF_{terrestrial\ plants}$) (mg/kg)
C_{soil}	=	Concentration of chemical in soil (mg/kg)
$BTF_{terrestrial\ plant}$	=	BTF of terrestrial soil to terrestrial plant calculated as indicated in Section 7.6.2
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for terrestrial soils, terrestrial plants, and terrestrial insect data. It is assumed that the water requirement for the deer mouse is obtained from its food source. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.5 Aquatic and Riparian Herbivorous Birds – Song Sparrow

The dose equation for aquatic and riparian omnivorous birds is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[\left(C_{riparian\,soil} \times IR_{soil}\right) + 98.0\%\left(C_{riparian\,plants} \times IR_{prey}\right)\right]}{BW} \qquad (7\text{-}6)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{riparian\ plants}$	=	($C_{riparian\ soil}$) x ($BTF_{riparian\ plants}$) (mg/kg)
$C_{riparian\ soil}$	=	Concentration of chemical in riparian soil (mg/kg)
$BTF_{riparian\ plant}$	=	BTF of riparian soil to riparian plants calculated as indicated in Section 7.6.2
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for riparian soils and riparian plants. It is assumed that the water requirement for the song sparrow is obtained from its food source. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.6 Aquatic and Riparian Herbivorous Mammals – Meadow Vole

The dose equation for aquatic and riparian herbivorous mammals is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[\begin{array}{l}(C_{riparian\,soil} \times IR_{soil}) + 95.6\%(C_{riparian\,plants} \times IR_{prey}) \\ +1.96\%(C_{riparian\,invertebrates} \times IR_{prey})\end{array}\right]}{BW} \quad (7\text{-}7)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{riparian\ invertebrates}$	=	Concentration of chemical in riparian invertebrates (mg/kg)
$C_{riparian\ plants}$	=	($C_{riparian\ soil}$) x ($BTF_{riparian\ plants}$) (mg/kg)
$C_{riparian\ soil}$	=	Concentration of chemical in riparian soil (mg/kg)
$BTF_{riparian\ plant}$	=	BTF of riparian soil to riparian plants calculated as indicated in Section 7.6.2
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for riparian soils, riparian plants, and riparian insects. It is assumed that the water requirement for the meadow vole is obtained from its food source. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.7 Aquatic and Riparian Omnivorous Birds – Red-winged Blackbird

The dose equation for aquatic and riparian omnivorous birds is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[(C_{riparian\,soil} \times IR_{soil}) + \left\{\begin{array}{l}78.4\%(C_{riparian\,plants} \times IR_{prey}) + \\ 21.5\%(C_{riparian\,invertebrates} \times IR_{prey})\end{array}\right\}\right]}{BW} \quad (7\text{-}8)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{riparian\ invertebrates}$	=	Concentration of chemical in riparian invertebrates (mg/kg)
$C_{riparian\ plants}$	=	($C_{riparian\ soil}$) x ($BTF_{riparian\ plants}$) (mg/kg)
$C_{riparian\ soil}$	=	Concentration of chemical in riparian soil (mg/kg)
$BTF_{riparian\ plant}$	=	BTF of riparian soil to riparian plants calculated as indicated in Section 7.6.2
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for riparian soils, riparian plants, and riparian insects. It is assumed that the water requirement for the red-winged blackbird is obtained from its food source. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.8 Aquatic and Riparian Piscivorous Birds – Great Blue Heron

The exposure assumptions for prey items for the great blue heron were varied between the Tier 1 and Tier 2 assessment. The following sections discuss each tier.

Tier 1

The dose equation for aquatic and riparian piscivorous birds is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[\begin{array}{l}(C_{\text{sediments}} \times IR_{sediments}) + (C_{surface\ water} \times IR_{water}) \\ + 99.3\%(C_{fish} \times IR_{prey})\end{array}\right]}{BW} \qquad (7\text{-}9)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)

C_{fish}	=	Concentration of chemical in fish (mg/kg)
$C_{sediments}$	=	Concentration of chemical in sediments (mg/kg)
$C_{surface\ water}$	=	Concentration of chemical in surface water (mg/kg)
$IR_{sediments}$	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
$IR_{surface\ water}$	=	Ingestion rate of surface water (kg per day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for aquatic sediments, surface water, and fish. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, which were adjusted to kg.

Tier 2

The dose model was modified to include a mixed diet that included invertebrates:

$$Dose_{Total} = (SUF) \times \frac{\left[\begin{array}{l}(C_{\text{sediments}} \times IR_{sediments}) + (C_{surface\ water} \times IR_{water}) \\ +82.4\%(C_{fish} \times IR_{prey}) + 16.9\%(C_{triparian\ invertebrates} \times IR_{prey})\end{array}\right]}{BW} \quad (7\text{-}10)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
C_{fish}	=	Concentration of chemical in fish (mg/kg)
$C_{riparian\ invertebrates}$	=	Concentration of chemical in riparian invertebrates (mg/kg)
$C_{sediments}$	=	Concentration of chemical in sediments (mg/kg)
$C_{surface\ water}$	=	Concentration of chemical in surface water (mg/kg)
$IR_{sediments}$	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
$IR_{surface\ water}$	=	Ingestion rate of surface water (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for aquatic sediments, surface water, fish, and riparian insects. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.9 Aquatic and Riparian Benthic-feeding Birds – Mallard Duck

The dose equation for aquatic and riparian benthic-feeding birds is as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[\begin{array}{l} (C_{\text{sediments}} \times IR_{sediment}) + (C_{surface\ water} \times IR_{water}) \\ + \left\{ \begin{array}{l} 24.5\% (C_{aquatic\ plants} \times IR_{prey}) \\ + 72.2\% (C_{aquatic\ invertebrates} \times IR_{prey}) \end{array} \right\} \end{array} \right]}{BW} \qquad (7\text{-}11)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{aquatic\ plants}$	=	($C_{sediments}$) x ($BTF_{aquatic\ plants}$) x ($C_{aquatic\ invertebrates}$) = Concentration of chemical in aquatic invertebrates (mg/kg)
$C_{sediments}$	=	Concentration of chemical in sediments (mg/kg)
$C_{surface\ water}$	=	Concentration of chemical in surface water (mg/kg)
$BTF_{aquatic\ plant}$	=	BTF of sediment to aquatic plants calculated as indicated in Section 7.6.2
$IR_{sediment}$	=	Ingestion rate of sediment (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
$IR_{surface\ water}$	=	Ingestion rate of surface water (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for sediments, surface water, aquatic plants, and aquatic invertebrates. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.10 Aquatic and Riparian Omnivorous Mammals– Raccoon

The dose equation for aquatic and riparian omnivorous mammals as follows:

$$Dose_{Total} = (SUF) \times \frac{\left[\begin{array}{l} (C_{\text{sediments}} \times IR_{sediment}) + (C_{surface\,water} \times IR_{water}) \\ + \left\{ \begin{array}{l} 24.0\%(C_{aquatic\,plants} \times IR_{prey}) \\ + 24.0\%(C_{riparian\,plants} \times IR_{prey}) \\ + 31.7(C_{aquatic\,invertebrates} \times IR_{prey}) \\ + 9.1\%(C_{small\,mammals} \times IR_{prey}) \\ + 1.8\%(C_{fish} \times IR_{prey}) \end{array} \right\} \end{array} \right]}{BW} \tag{7-12}$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{aquatic\ plants}$	=	($C_{sediment}$) x ($BTF_{aquatic\ plants}$) x ($C_{aquatic\ invertebrates}$) = Concentration of chemical in aquatic invertebrates (mg/kg)
$C_{riparian\ plants}$	=	($C_{riparian\ soil}$) x ($BTF_{riparian\ plants}$) x ($C_{sediments}$) = Concentration of chemical in sediments (mg/kg)
$C_{small\ mammals}$	=	Concentration of chemical in small mammals (mg/kg)
$C_{surface\ water}$	=	Concentration of chemical in surface water (mg/kg)
$BTF_{riparian\ plant}$	=	BTF of riparian soil to riparian plants calculated as indicated in Section 7.6.2
$BTF_{aquatic\ plant}$	=	BTF of sediments to aquatic plants calculated as indicated in Section 7.6.2
$IR_{sediment}$	=	Ingestion rate of sediment (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
IR_{water}	=	Ingestion rate of surface water (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for sediments, surface water, aquatic and riparian plants, aquatic invertebrates, riparian mammals, and fish. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.11 Aquatic and Riparian Carnivorous Mammals – Mink

The basic equation for aquatic and riparian carnivorous mammals is as follows:

$$Dose_{Total} = (SUF)(TTC) \times \frac{\left[\begin{array}{l} (C_{\text{sediments}} \times IR_{sediment}) + (C_{surface\,water} \times IR_{water}) + (C_{ripariansoil} \times IR_{soil}) \\ + \left\{ \begin{array}{l} 3.86\%(C_{aquatic\,plants} \times IR_{prey}) \\ 3.86\%(C_{riparian\,plants} \times IR_{prey}) \\ + 6.4\%(C_{aquaticinvertebrates} \times IR_{prey}) \\ + 4.7\%(C_{small\,mammals} \times IR_{prey}) \\ + 62.4\%(C_{fish} \times IR_{prey}) \end{array} \right\} + \end{array} \right]}{BW} \quad (7\text{-}13)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{aquatic\ plants}$	=	($C_{sediment}$) x ($BTF_{aquatic\ plants}$) x ($C_{aquatic\ invertebrates}$) = Concentration of chemical in aquatic invertebrates (mg/kg)
C_{fish}	=	Concentration of chemical in fish (mg/kg)
$C_{riparian\ plants}$	=	($C_{riparian\ soil}$) x ($BTF_{riparian\ plants}$) x ($C_{riparian\ soil}$) = Concentration of chemical in riparian soil (mg/kg)
$C_{sediments}$	=	Concentration of chemical in sediments (mg/kg)
$C_{small\ mammals}$	=	Concentration of chemical in small mammals (mg/kg)
$C_{surface\ water}$	=	Concentration of chemical in surface water (mg/kg)
$BTF_{riparian\ plant}$	=	BTF of riparian soil to riparian plants calculated as indicated in Section 7.6.2
$BTF_{aquatic\ plant}$	=	BTF of sediments to aquatic plants calculated as indicated in Section 7.6.2
$IR_{sediment}$	=	Ingestion rate of sediment (kg/day)
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
IR_{water}	=	Ingestion rate of surface water (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for sediments, surface water, aquatic and riparian plants, aquatic invertebrates, riparian mammals, and fish. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.12 Carnivorous Mammals – Coyote

The dose equation for carnivorous mammals is as follows:

$$Dose_{Total} = (SUF)(TTC) \times \frac{\left[\begin{array}{l} (C_{\text{soils}} \times IR_{soils}) + (C_{surface\,water} \times IR_{water}) \\ + \left\{ \begin{array}{l} 9.7\%(C_{terrestrid\ plants} \times IR_{prey}) \\ + 87.5\%(C_{small\ mammals} \times IR_{prey}) \end{array} \right\} \end{array} \right]}{BW} \quad (7\text{-}14)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{small\ mammals}$	=	Concentration of chemical in small mammals (mg/kg)
$C_{terrestrial\ plants}$	=	($C_{terrestrial\ soil}$) x ($BTF_{terrestrial\ plants}$) x ($C_{soil}$) = Concentration of chemical in soil (mg/kg)
$C_{surface\ water}$	=	Concentration of chemical in surface water (mg/kg)
$BTF_{terrestrial\ plant}$	=	BTF of terrestrial soil to terrestrial plants calculated as indicated in Section 7.6.2
IR_{prey}	=	Ingestion rate of prey (kg/day)
IR_{soil}	=	Ingestion rate of soil (kg/day)
IR_{water}	=	Ingestion rate of surface water (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for terrestrial soils, surface water, terrestrial plants, and terrestrial mammal. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.1.13 Carnivorous Birds - Northern Harrier

The dose equation for carnivorous birds is as follows:

$$Dose_{Total} = (SUF)(TTC) \times \frac{\left[\begin{array}{l} (C_{\text{soils}} \times IR_{soils}) \\ + \left\{ \begin{array}{l} 2.5\%(C_{terrestrial\ invertebrates} \times IR_{prey}) \\ + 96.8\%(C_{small\ mammals} \times IR_{prey}) \end{array} \right\} \end{array} \right]}{BW} \quad (7\text{-}15)$$

where

$Dose_{Total}$	=	Total quantity of a chemical received by a receptor from all sources (mg/kg/day)
$C_{small\ mammals}$	=	Concentration of chemical in small mammals (mg/kg)
$C_{terrestrial\ invertebrates}$	=	Concentration of chemical in terrestrial invertebrates (mg/kg)
C_{soil}	=	Concentration of chemical in soil (mg/kg)
IR_{prey}	=	Ingestion rate of prey (kg/day)
IR_{soil}	=	Ingestion rate of soil (kg/day)
BW	=	Body weight of receptor species (kg)
SUF	=	Site use factor to account for the amount of time that the organism spends using the site, always set as 1.0 for this AWERA due to the size of the Resource Area

Input consists of data for terrestrial soils, terrestrial invertebrate, and terrestrial mammal. Exposure parameters used in the dose model are presented in Tables 7-4 and 7-5, and were adjusted to kg.

7.6.2 Biotransfer Factor Calculations

Actual concentrations of COPECs in the tissues invertebrates and plants were collected and analyzed. This information was used to develop BTFs that can be used to model from one trophic level to the next.

Site-specific BTFs for soil-to-plant and soil-to-invertebrate transfer factors were originally intended to be calculated using data for collocated samples of soil, plants, and invertebrates. However, based on difficulties in collecting soil-dwelling invertebrates in various areas, only soil-to-plant BTFs were developed. Actual tissue concentration levels were used in the dose equation for all other tissue types. Calculation of the actual EPC is presented in Appendix C.

BTFs were calculated for plants using the following ratio:

$$BTF_{plant} = \frac{C_{plant}}{C_{soil\,or\,sediment}} \tag{7-16}$$

where

BTF_{plant}	=	Chemical specific soil-to-plant BTF
C_{plant}	=	Concentration in plant tissues (mg/kg)
$C_{sediment}$	=	Concentration of chemical in sediment (mg/kg)
C_{soil}	=	Concentration of chemical in soil (mg/kg)

The following BTFs were calculated for plants:

- Sediment to aquatic plants
- Riparian soil to riparian plants
- Terrestrial soil to terrestrial plants

Each calculated BTF is used as a multiplier for the concentration in the respective media, thus providing for a measure of the fraction of the contaminant that is absorbed by the receptor from the consumed media.

7.6.3 Toxicity Reference Values and Associated Uncertainty

TRVs are screening-level, benchmark values for higher-trophic-level receptors such as birds and mammals. In general, a TRV is a dose at which a specific biological effect may occur in an organism based on the results of laboratory toxicological investigations. For bird and mammal receptors, TRVs are compared with estimates of site-specific, daily chemical doses ingested from food and media in the HQ approach to model potential risk. All TRVs used in the assessments were based on NOAELs reported in the literature. The proposed TRVs for both mammals and birds that are being used for this project are presented in Table 7-6. The TRVs were taken from two sources, primarily the U.S. Department of the Navy (Navy) (1998) "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California, Interim Final Technical Memorandum" and secondarily from Sample and others (1996) "Toxicological Benchmarks for Wildlife: 1996 Revision." There was one exception, lead. There have been inherent problems with the use of the published TRV for lead

(Navy 1998). Presently the EPA Region 9 Biological Technical Assistance Group is considering revising the lead TRV. In an effort to minimize these problems, the lead TRVs published by Sample and others (1996) were used. In all other cases, preference was given to the values found in Navy 1998.

Published methods for conducting ecological assessments differ in the way they address uncertainty, including the magnitude and type of uncertainty factors recommended (Opresko and others 1993; Suter 1993; and Calabrese and Baldwin 1993; all as cited in Navy 1998). One method of accounting for the uncertainty inherent in the derivation of TRVs is to use uncertainty factors (UF). The TRV is divided by the UF to overlay a level of conservatism to data that are, for one reason or another, incomplete. For example, uncertainty that results from the lack of data on chronic exposure has been addressed traditionally by dividing the proposed TRV by a number, usually 10. UFs were applied originally to the TRVs used for this ERA (Navy 1998). No TRVs were developed specifically for this assessment.

7.6.4 Allometric Conversions

In cases where the species that represents the measurement endpoint was different from the species used to develop the TRV, dietary concentrations were converted to dose (that is, mg COPEC/kg BW/day) for comparison with estimated ingestion rates of COPEC in receptor species. All TRVs were adjusted based on the difference in body weights between the study organisms used as the basis for the literature values and the body weight of the measurement endpoint receptor. For example, when toxicological data and dose levels were available for laboratory rats but were needed for the deer mouse, an allometric conversion estimates a similar dose level for the deer mouse. The underlying assumption of allometric conversion is that a given effect on a species of small mammal is similar to the effect on a species of larger mammal, per unit body weight, and vice versa.

The recommendations of Sample and Arenal (1999) were followed for allometric conversions. Sample and Arenal (1999) investigated the allometric relationships for acute avian and mammalian toxicity data across a wide variety of chemicals to assess the applicability of existing allometric factors and to evaluate whether allometric relationships differ between birds and mammals. A total of 194 chemicals for birds and 167 chemicals for mammals were reviewed. The range of chemicals included alkaloids, inorganics, organochlorines, and drugs. The mean, chemical-specific scaling factor calculated was 1.20 for birds and 0.94 for mammals (Sample and Arenal 1999).

These scaling factors were expressed as follows:

For mammals:

$$TRV_{receptor} = TRV_{test\ organism}\left(body\ weight_{test\ organism} / body\ weight_{receptor}\right)^{1-0.94} \qquad (7\text{-}17)$$

For birds:

$$TRV_{receptor} = TRV_{test\ organism}\left(body\ weight_{test\ organism} / body\ weight_{receptor}\right)^{1-1.2} \qquad (7\text{-}18)$$

7.7 TIER 1 SCREENING ASSESSMENT

Tier 1 is a "worst-case" screening-level activity directed at eliminating any chemicals that present negligible risks. In this step, the highest concentration observed for each medium and chemical and the most conservative exposure parameters were used to calculate an HQ for each target species and COPEC.

The first tier of the AWERA focused on the assessment endpoints identified in Section 7.5 and evaluated exposure through the ingestion pathway. Target receptors evaluated that may range the entire Resource Area included the northern bobwhite, eastern cottontail, American robin, northern harrier, deer mouse, raccoon, and coyote. Target receptors that range only in the aquatic and riparian habitat included the song sparrow, meadow vole, red-winged black bird, great blue heron, mallard, mink, and raccoon.

Based on life history and foraging habits, an estimated daily dose for each COPEC (cadmium, chromium, copper, nickel, selenium, vanadium, and zinc [see Appendix B for COPEC selection]) was calculated for each receptor. Estimated doses were calculated for each COPEC and target receptor. Doses were based on maximum site-specific concentrations in media and prey collected from mining impacted areas, regardless of the habitat range of the receptor.

Estimated daily doses for each COPEC and target receptor were compared to the respective TRVs to calculate an HQ; calculations are presented in their entirety in Appendix G. The following sections discuss the results of the risk calculations by COPEC and for each target receptor.

7.7.1 Evaluation of Potential Risk to Birds and Mammals from Exposure to Cadmium

Target receptors for which HQs for cadmium were greater than 1.0, are presented in Table 7-7. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the food chain model (FCM) indicated potential risk resulting from exposure to maximum concentrations of cadmium to both avian and mammalian receptors. Potential risk was highest to avian receptors that range in the riparian habitat, with a maximum HQ of 419 for the song sparrow and 321 for the red-winged blackbird. The maximum mammalian HQ of 212 was for the meadow vole in the riparian habitat. Potential risk was also significant to mammalian receptors that range the overall habitat with a HQ of 147 for the deer mouse. The HQs for the northern harrier, great blue heron, and mallard duck were all less than 1.0, which indicated minimal potential risk to these receptors. Receptors for which HQs were less than 1.0 were not carried forward to Tier 2. The receptors listed in Table 7-7 were further evaluated in Tier 2 for potential risk resulting from exposure to cadmium.

7.7.2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Chromium

Target receptors for which HQs for chromium were greater than 1.0, are presented in Table 7-8. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk to avian receptors from exposure to maximum concentrations of chromium. Potential risk was highest in the riparian habitat, with a HQ of 44 for the song sparrow. The HQs for all mammalian receptors and the great blue heron were less than 1.0, which indicated minimal potential risk. Receptors for which the HQ was less than 1.0 were not carried forward to Tier 2. All receptors listed in Table 7-8 were further evaluated in Tier 2 for potential risk resulting from exposure to chromium.

7.7.3 Evaluation of Potential Risk to Birds and Mammals from Exposure to Copper

Target receptors for which HQs for copper were greater than 1.0, are presented in Table 7-9. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to maximum concentrations of copper to both avian and mammalian receptors. Potential risk was highest to receptors that range the riparian habitat with a maximum HQ of 18.8 for the song sparrow. The maximum mammalian HQ was

6.4 for the meadow vole, also in the riparian habitat. The HQs for the northern harrier, coyote, great blue heron, and mallard duck were less than 1.0, which indicated minimal potential risk to these receptors. Receptors for which the HQ was less than 1.0 were not carried forward to Tier 2. All receptors listed in Table 7-9 were further evaluated in Tier 2 for potential risk resulting from exposure to copper.

7.7.4 Evaluation of Potential Risk to Birds and Mammals from Exposure to Nickel

Target receptors for which HQs for nickel were greater than 1.0, are presented in Table 7-10. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to maximum concentrations of nickel to both avian and mammalian receptors. Potential risk was highest to small mammalian receptors that range in the riparian habitat, with a maximum HQ of 48.4 for the meadow vole. The maximum HQ for an avian receptor was 13 for the song sparrow. The HQs for the American robin, northern harrier, and great blue heron were less than 1.0, which indicated minimal potential risk to these receptors. Receptors for which the HQs were less than 1.0 were not carried forward to Tier 2. The receptors listed in Table 7-10 were further evaluated in Tier 2 for potential risk resulting from exposure to nickel.

7.7.5 Evaluation of Potential Risk to Birds and Mammals from Exposure to Selenium

Target receptors for which HQs for selenium were greater than 1.0, are presented in Table 7-11. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to maximum concentrations of selenium to both avian and mammalian receptors. Potential risk was highest to small mammalian receptors, with a maximum HQ of 2,302 for the meadow vole in the riparian habitat and 1,423 for the eastern cottontail in the overall habitat. The maximum HQ for an avian receptor was 1,442 for the song sparrow. The HQs for all receptors were greater than 1.0. The receptors listed in Table 7-11 were further evaluated in Tier 2 for potential risk resulting from exposure to selenium.

7.7.6 Evaluation of Potential Risk to Birds and Mammals from Exposure to Vanadium

Target receptors for which HQs for vanadium were greater than 1.0, are presented in Table 7-12. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to maximum concentrations of vanadium to mammalian receptors, the song sparrow, and the red-winged blackbird. Potential risk was highest to small mammalian receptors that range in the riparian habitat, with a maximum HQ of 45 for the meadow vole. The HQs for the song sparrow and red-winged blackbird were 2.4 and 2.3, respectively. The HQs for all other avian receptors (northern bobwhite, American robin, great blue heron, mallard, and northern harrier) were all less than 1.0, which indicated minimal potential risk to these receptors. Receptors for which the HQs were less than 1.0 were not carried forward to Tier 2. The receptors listed in Table 7-12 were further evaluated in Tier 2 for potential risk resulting from exposure to vanadium.

7.7.7 Evaluation of Potential Risk to Birds and Mammals from Exposure to Zinc

Target receptors for which HQs for zinc were greater than 1.0, are presented in Table 7-13. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to maximum concentrations of zinc to both avian and mammalian receptors. Potential risk was highest to the song sparrow, with a maximum HQ of 28. The maximum HQ for a mammalian receptor was 18.3 for the meadow vole. The HQs for the northern harrier, coyote, mallard, and great blue heron were less than 1.0, which indicated minimal potential risk to these receptors. Receptors for which the HQs were less than 1.0 were not carried forward to Tier 2. The receptors listed in Table 7-13 were further evaluated in Tier 2 for potential risk resulting from exposure to zinc.

7.7.8 Summary of Tier 1 Risk Evaluation for Birds and Mammals

Tier 1 was a “worst-case” screening-level activity that used the highest observed concentration in media and prey, and the most conservative exposure parameters to calculate an HQ for each target species and COPEC. Table 7-14 summarizes the results of the Tier 1 assessment. COPECs and target receptors for which a potential risk was indicated in Tier 1 are represented with a check (✓). Blank cells represent target species and COPECs that did not present a potential risk, and were therefore removed from further consideration in Tier 2. Target species and COPECs removed from further consideration in Tier 2 were those for which HQs calculated using maximum COPEC concentrations in media and prey were less than 1.0.

For cadmium, Tier 1 results indicated potential risk resulting from exposure to maximum concentrations of cadmium to both avian and mammalian receptors. Potential risk was highest to avian receptors, with a maximum HQ of 419 for the song sparrow.

For chromium, Tier 1 results indicated potential risk to avian receptors that was highest for the song sparrow with an HQ of 44. The HQs for all mammalian receptors were less than 1.0.

For copper, Tier 1 results indicated potential risk resulting from exposure to maximum concentrations of copper to both avian and mammalian receptors. Potential risk was highest to the song sparrow, with a maximum HQ of 18.8. The maximum mammalian HQ was 6.4 for the meadow vole.

For nickel, Tier 1 results indicated potential risk to both avian and mammalian receptors. Potential risk was highest to small mammalian receptors, with a maximum HQ of 48.4 for the meadow vole. The maximum HQ for an avian receptor was 13 for the song sparrow.

For selenium, Tier 1 results indicated potential risk to both avian and mammalian receptors. Potential risk was highest to small mammalian receptors, with a maximum HQ of 2,302 for the meadow vole. The maximum HQ for an avian receptor was 1,442 for the song sparrow.

For vanadium, Tier 1 results indicated potential risk to mammalian receptors, song sparrow, and red-winged blackbird. Potential risk was highest to small mammalian receptors, with a maximum HQ of 45 for the meadow vole. The maximum HQ for avian receptors was 2.4 for the song sparrow.

For zinc, Tier 1 results indicated potential risk to both avian and mammalian receptors. Potential risk was highest to the song sparrow, with a maximum HQ of 28. The maximum HQ for a mammalian receptor was 18.3 for the meadow vole.

7.8 TIER 2 AREA WIDE ECOLOGICAL RISK ASSESSMENT

In Tier 2, receptors not eliminated in Tier 1 were evaluated on an area-wide basis using approximated EPCs for each media and mean exposure parameters for each receptor to represent average population-level exposures. While the mines occupy a large area, the combined area of the mine sites is about only 3 percent of the total Resource Area. Therefore, development of HQs for the Resource Area as a whole was based on a watershed approach. EPCs were calculated for three watersheds (1) the Blackfoot/Little Blackfoot, (2) Georgetown, and (3) Salt. Background EPCs were also calculated using data collected

from non-mining impacted areas. The EPCs are area-weighted based on surface area ratios, stream segment lengths and other applicable weighting criteria as described in Appendix C. The dose calculation and development of HQs for each species was conducted as described in Section 7.6.

Target receptors evaluated in Tier 2 that range in the riparian habitat included the song sparrow, red-winged blackbird, great blue heron, mallard duck, meadow vole, mink, and raccoon. Receptors that range the overall habitat included the northern Bobwhite, American robin, northern harrier, deer mouse, eastern cottontail, and coyote.

Based on life history and foraging habits, an estimated daily dose for each COPEC (cadmium, chromium, copper, nickel, selenium, vanadium, and zinc [see Appendix B for COPEC selection]) was calculated for each receptor and watershed area. The following sections discuss the results of the risk calculations, by COPEC for each target receptor and watershed area.

7.8.1 Tier 2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Cadmium

Target receptors for which HQs for cadmium were greater than 1.0 are presented in Table 7-15. A complete list of HQs for all Tier 2 target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to AWACs of cadmium to both avian and mammalian receptors. Potential risk was highest to avian receptors in the riparian habitat, with a maximum HQ of 9.2 for the red-winged blackbird in the Georgetown watershed. In general, avian HQs were only slightly elevated above background, with ratios of watershed HQs divided by background HQs ranging from 1 to 1.42. For mammalian receptors the maximum HQ was 8.0 for the deer mouse in the Blackfoot/Little Blackfoot watershed. As with avian receptors, mammalian HQs were only slightly elevated above background, with ratios of impacted to background HQs ranging from 1 to 1.38.

7.8.2 Tier 2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Chromium

Target receptors for which HQs for chromium were greater than 1.0 are presented in Table 7-16. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to AWACs of chromium to avian receptors. Potential risk was highest to the song sparrow in the Georgetown watershed, and American robin in the Blackfoot/Little Blackfoot watershed, both with a HQ of 1.9. Overall, avian HQs were only

slightly elevated above background, with ratios of impacted to background HQs ranging from 1 to 1.20. HQs for mammalian receptors were all less than 1.0.

7.8.3 Tier 2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Copper

Target receptors for which HQs for copper were greater than 1.0 are presented in Table 7-17. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to average concentrations of copper to both avian receptors. However, watershed HQs were similar to background HQs, indicating negligible incremental risk from mining related copper. The maximum ratio of impacted to background HQs, was 1.04 for the song sparrow in the Georgetown watershed. HQs for mammalian receptors were all less than 1.0.

7.8.4 Tier 2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Nickel

Target receptors for which HQs for nickel were greater than 1.0, are presented in Table 7-18. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to AWACs of nickel to mammalian receptors and the song sparrow. Potential risk was highest to the meadow vole in the Georgetown watershed with a HQ of 3.3. The Georgetown watershed HQ for the song sparrow was equal to one. The two other watershed HQs for the song sparrow were less than one. Overall, HQs were only slightly elevated above background with impacted to background ratios for all watersheds ranging from 1.0 to 1.15.

7.8.5 Tier 2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Selenium

Target receptors for which HQs for selenium were greater than 1.0 are presented in Table 7-19. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to AWACs of selenium to both avian and mammalian receptors. Potential risk was highest to small mammalian receptors, with a maximum HQ of 19.4 for the deer mouse. The maximum HQ for an avian receptor was 9.1 for the American robin. Risk to both avian and mammalian receptors was highest in the Blackfoot/Little

Blackfoot watershed. In general, HQs for selenium are elevated above background more than the other COPECs. Impacted to background HQ ratios ranged from 1.0 to 2.62 for mammals and from 1.0 to 3.2 for avian receptors.

7.8.6 Tier 2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Vanadium

Target receptors for which HQs for vanadium were greater than 1.0 are presented in Table 7-20. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to AWACs of vanadium to mammalian receptors. Potential risk was highest to the deer mouse, with a maximum HQ of 5.5. However, all watershed HQs were similar to background HQs, indicating negligible incremental risk from mining related vanadium. The maximum ratio of impacted to background HQs was 1.05 for the raccoon in the Salt watershed. HQs were all less than 1.0 for avian receptors.

7.8.7 Tier 2 Evaluation of Potential Risk to Birds and Mammals from Exposure to Zinc

Target receptors for which HQs for zinc were greater than 1.0 are presented in Table 7-21. A complete list of HQs for all target receptors is provided in Appendix G.

The results of the FCM indicated potential risk resulting from exposure to average concentrations of zinc to avian receptors and the deer mouse. Potential risk was highest to the American robin, with a maximum HQ of 2.2. However, all watershed HQs for avian receptors were similar to background HQs, indicating negligible incremental risk to birds from mining related zinc. The maximum ratio of impacted to background HQs for birds was 1.12 for the song sparrow in the Georgetown watershed. For the deer mouse, the maximum HQ was 1.9 in all watersheds. The background HQ was 1.0 indicating no potential risk from mining related zinc to the deer mouse. HQs for other mammalian receptors were all less than 1.0.

7.8.8 Summary of Tier 2 Risk Evaluation for Birds and Mammals

Tier 2 was an evaluation on an area-wide basis using approximated EPCs for each medium and mean exposure parameters for each receptor to represent average population-level exposures. EPCs were evaluated for the three watersheds (1) Blackfoot/Little Blackfoot, (2) Georgetown, and (3) Salt. Background EPCs were also calculated using non-mining impacted data.

Sections 7.8.1 through 7.8.7 discuss all COPECs and receptors for which HQs exceed 1.0. Table 7-22 summarizes the results of the Tier 2 assessment while taking background HQs into consideration. HQs greater than 1.0 for the COPECs and receptors shown on Table 7-22 are likely associated with some increased level of risk due to mining related activities in the watershed. COPECs and receptors were selected based on the watershed specific HQ being at least 0.5 higher than the background HQ(an arbitrary, yet conservative value). Receptors for which the difference was less than 0.5 were not included in the summary table.

Tier 2 results indicated potential risk to avian and mammalian receptors resulting from exposure to cadmium and selenium. Selenium by far affects the greatest number of receptors throughout the three watersheds. Potential risk from exposure to selenium was highest to small mammalian receptors with watershed HQs ranging from 18.5 to 19.4 for the deer mouse. For mammalian receptors, the highest ratio of impacted to background HQs was 2.62 for the eastern cottontail in the Blackfoot/Little Blackfoot watershed. For avian receptors, the highest impacted to background HQ ratios were for the song sparrow and the mallard duck (2.8 and 3.2, respectively).

For cadmium, potential risk was indicated to the song sparrow, red-winged blackbird, and meadow vole. Potential risk was highest to the red-winged blackbird in the Georgetown watershed with a HQ of 9.2. The ratios of impacted to background HQs was 1.4 for the song sparrow, 1.2 for the red-winged blackbird, and 1.4 for the meadow vole.

7.9 TIER 3 ASSESSMENT – ADDITIONAL LINES OF EVIDENCE

An evaluation of the data collected by the IMA and TtEMI indicates that significant variations occur in the concentrations of COPECs in surface water not only from year-to-year but also from month-to-month. Current data indicate that COPEC release from the mining areas is related to the volume of water released. Therefore, data collected in previous years was evaluated to determine variations in risk from year-to-year.

The Tier 1 and Tier 2 assessments in this AWERA only address higher trophic levels of aquatic and riparian and terrestrial mammals and birds. While some of these receptors are mainly found around and feed primarily from the benthic and fishery guilds, assessment of these higher trophic level receptors does not directly provide information concerning potential risks to aquatic receptors such as fish or benthic invertebrates. Because of limited scientific information, the dose assessment approach used for aquatic and riparian and terrestrial higher trophic level receptors is not usable with an acceptable degree of

certainty. Therefore, other approaches must be used to evaluate potential risks to benthic and fish guilds. For this AWERA, the selected additional lines-of-evidence were compared to media-specific benchmarks for surface water and sediment and fish tissue concentrations were compared to literature reported tissue concentrations at which effects have been documented.

7.9.1 Comparison to Historical Data Concentrations

This section addresses variations of the data analysis based on different data sets, such as those collected by IMA prior to 2001 in comparison to the data collected by IMA and TtEMI in 2001. An arbitrary definition of impacted areas was developed for surface water based on an evaluation of the 1998 and 2001 data sets. Any stream segment with selenium concentrations that exceeded AWQC for selenium (the most widespread COPEC) at any time during the year was considered to be impacted. Based on this definition, extreme variation in the extent of impacted surface water occurs from year-to-year. For example, based on 1998 data, 27 percent of the Blackfoot/Little Blackfoot watershed would have been classified as impacted; whereas, based on 2001 data, only 0.7 percent would have been classified as impacted. To evaluate this temporal fluctuation in COPEC concentrations, an additional set of risk calculations was conducted using the surface water results from 1998.

The Tier 2 and Tier 3 assessments were conducted using area weighting for impacted areas based on the extent of impact defined by the 1998 data. The only difference in the calculations was the input parameter for the area-weighted surface water concentrations. The results indicated little difference in potential risk between 1998 and 2001 based on the assumptions used. The results of these Tier 2 and 3 assessments are presented in Appendix G.

A sensitivity analysis of the assessment indicates that the dose contributed by surface water is a minor portion of the dose for most receptors. The major contributors to dose for all terrestrial receptors were sediment or soil ingestion and concentrations of COPECs in prey. The more transitory surface water changes are less important than the residual COPECs in soils, sediments, and prey.

7.9.2 Comparison of Surface Water and Sediment Concentrations to Benchmarks

The detected concentrations of COPECs in surface water and sediment samples were compared to media specific benchmarks. The primary benchmark selected for surface water comparisons was the National AWQC continuous chronic criterion (CCC) for freshwater. These benchmarks have been developed to be

protective of sensitive aquatic life. The following sections discuss the surface water concentrations of each COPEC. Detailed information is provided in Appendix B.

7.9.2.1 Cadmium

The selected ecological screening criterion was based on the CCC as reported in the NOAA SQuiRT tables (EPA 1999). The reported CCC was 2.20 micrograms per liter (µ/L) but the actual benchmark is based on a hardness-adjusted value. The maximum detected concentration of cadmium in impacted off-site surface water during the 2001 sampling was 1.25 µ/L. During the IMA sampling conducted in 1998 (MW 1999b), a maximum concentration of 4.70 µ/L was reported. Based on these comparisons, the maximum detected concentrations in the impacted areas did not exceed the benchmark in 2001 but did in 1998. The average concentrations in the impacted reaches were not reported by MW (1999b). However, comparisons of the 2001 impacted area data to background area data indicated that the average concentrations were not significantly different.

The maximum detected concentration of cadmium in impacted sediments was 14.0 mg/kg with an average impacted area concentration of 5.47 mg/kg. These values were compared to the average background area concentration of 1.06 mg/kg. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 13.

The selected freshwater sediment criterion for cadmium was the threshold effects concentration (TEC) reported in MacDonald and others (2000). The reported TEC was 0.99 mg/kg. The maximum detected and average concentrations in impacted sediments exceeded this concentration by a significant factor.

7.9.2.2 Chromium

The maximum detected concentration of chromium in impacted surface water was 4.60 µ/L with an average impacted area concentration of 1.20 µ/L. These values were compared to the average background area concentration of 0.62 µ/L. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 7.

The selected ecological screening criterion was based on the freshwater CCC for chromium. The reported CCC was 74.0 µ/L. Based on this comparison, the maximum detected and average concentrations in the impacted areas did not exceed the benchmark.

The maximum detected concentration of chromium in impacted sediments was 191 mg/kg with an average impacted area concentration of 73.7 mg/kg. These values were compared to the average background area concentration of 35.4 mg/kg. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 5.

The selected freshwater sediment criterion for chromium was the TEC reported in MacDonald and others (2000). The reported TEC was 43.4 mg/kg. The maximum detected and average concentrations in impacted sediments exceeded this concentration.

7.9.2.3 Copper

The maximum detected concentration of copper in impacted surface water was 15.0 µ/L with an average impacted area concentration of 0.57 µ/L. These values were compared to the average background area concentration of 1.30 µ/L for background areas. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 12. However, the average impacted area concentration was less than the average background concentration.

The selected ecological screening criterion was based on the freshwater CCC for copper. The reported CCC was 9.00 µ/L. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark, but not the average.

The maximum detected concentration of copper in impacted sediments was 102 mg/kg with an average impacted area concentration of 17.8 mg/kg. These values were compared to the average background area concentration of 10.5 mg/kg. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 10.

The selected freshwater sediment criterion for copper was the TEC reported in MacDonald and others (2000). The reported TEC was 31.6 mg/kg. The maximum detected concentration in impacted sediments exceeded this concentration. However, the average impacted area concentration did not exceed the TEC.

7.9.2.4 Nickel

The maximum detected concentration of nickel in impacted surface water was 43 µ/L with an average impacted area concentration of 3.13 µ/L. These values were compared to the average background area

concentration of 0.978 µ/L. The maximum detected concentration in the impacted area exceeded the average background area concentration by a factor of 44.

The selected ecological screening criterion was based on the freshwater CCC for nickel. The reported CCC was 52.0 µ/L. Based on this comparison, the maximum detected and average concentrations in the impacted areas did not exceed the CCC.

The maximum detected concentration of nickel in impacted sediments was 164 mg/kg with an average of 64 mg/kg. These values were compared to the average background area concentration of 14 mg/kg. The maximum detected value and the average in the impacted area exceeded the average background area concentration by a factor of 12.

The selected freshwater sediment criterion for nickel was the TEC reported in MacDonald and others (2000). The reported TEC was 22.7 mg/kg. The maximum detected and average concentration in impacted sediments exceeded this concentration.

7.9.2.5 Selenium

The maximum detected concentration of selenium in impacted surface water was 1,140 µ/L with an average impacted area concentration of 66.68 µ/L. These values were compared to the average background area concentration of 0.745 µ/L. The maximum detected concentration in the impacted area greatly exceeded the average background area concentration by a factor of 1,530.

The selected ecological screening criterion was based on the freshwater CCC for selenium. The reported CCC was 5.00 µ/L. Based on this comparison, the maximum detected and average concentrations in the impacted areas exceeded the CCC.

The maximum detected concentration of selenium in impacted sediments was 188 mg/kg with an average of 19.7 mg/kg. These values were compared to the average background area concentration of 1.57 mg/kg. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 119.

There is no standard freshwater sediment criterion for selenium; therefore the value used for screening selenium is 4.0 mg/kg dry weight taken from National Irrigation Water Quality Program Guidelines

(Skorupa 1998). The maximum detected and average concentrations for the impacted areas exceed this criterion.

7.9.2.6 Vanadium

The maximum detected concentration of vanadium in impacted surface water was 6.2 µ/L with an average impacted area concentration of 1.43 µ/L. These values were compared to the average background area concentration of 0.92 µ/L. The maximum detected concentration in the impacted area exceeded the average background area concentration by a factor of 6. There were no applicable ecological benchmarks.

The maximum detected concentration of vanadium in impacted sediments was 133 mg/kg with an average impacted area concentration of 62.57 mg/kg. These values were compared to the average background area concentration of 30.3 mg/kg. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 4. There were no applicable ecological benchmarks.

7.9.2.7 Zinc

The maximum detected concentration of zinc in impacted surface water was 110 µ/L with an average impacted area concentration of 24.18 µ/L. These values were compared to the average background area concentration of 15.05 µ/L. The maximum detected concentration in the impacted area exceeded the average background area concentration by a factor of 7.

The selected ecological screening criterion was based on the freshwater CCC for zinc. The reported CCC was 120 µ/L. Based on this comparison, the maximum detected and average concentrations in the impacted areas did not exceed the CCC.

The maximum detected concentration of zinc in impacted sediments was 866 mg/kg with an average impacted area concentration of 251.73 mg/kg. These values were compared to the average background area concentration of 75.50 mg/kg. The maximum detected value in the impacted area exceeded the average background area concentration by a factor of 11.

The freshwater sediment criterion for zinc was the TEL concentration reported in the NOAA SQuiRT tables (EPA 1999). The reported TEL was 123.1 mg/kg. The maximum detected and average concentration in impacted sediments exceeded the TEL.

7.9.3 Comparison of Fish Tissue Concentrations to Literature Reported Effects Values

A limited body of scientific literature exists that presents tissue concentrations in fish to effects. Fish tissue concentrations in both impacted and background areas were evaluated against no observed effect levels for trout. With the exception of vanadium, the average concentrations in fish from impacted reaches exceeded the reference values. However, in some cases the average concentrations in fish collected from background locations also exceeded the reference values. The data is presented in Tables 7-23 through 7-25.

7.10 UNCERTAINTIES

This section discusses uncertainty associated with the exposure parameters in conducting an AWERA. Because the same methodology, models, and model parameters were used to estimate potential risks in the Tier 1 and Tier 2 assessments, this analysis discusses general uncertainties associated with the AWERA performed for the Resource Area. The uncertainties described for Tier 2 also apply for the Tier 3 assessments. Uncertainties arise due to the application of those methodologies, models, parameters, and parameter values.

7.10.1 Tier 1 Assessment Uncertainty

The Tier 1 assessment, designed to address uncertainty by over estimating risk, serves to increase the level of confidence within the AWERA that risk to a specific ecological receptor will not be removed from further assessment when in fact risk to the ecological receptors actually exists. Therefore, a conservative approach was employed to conduct the Tier 1 AWERA using biological and chemical information that leads to risk calculation results that have a high potential to exceed what is actually present in the study area. The parameters that were used in the dose assessments and risk calculations are listed in Table 7-26, which contains their conservative assumption and influences on the risk calculation results.

All of the parameters utilized in the Tier 1 assessment lead to an overestimate of risk, so that no COPEC with any possibility of posing a risk to the ecological receptors of concern were excluded.

7.10.2 Tier 2 Assessment Uncertainty

The following sections discuss uncertainties that remain after conducting the Tier 2 assessment; these are termed "residual uncertainties." The discussion of residual uncertainties associated with dose modeling for this study is organized as follows:

(1) Input parameters to the dose assessment
(2) TRVs

7.10.2.1 Dose Assessment Input Parameters

Residual uncertainties associated with input parameters used in the dose assessment for the receptors of concern are sub-divided into the following categories:

- Body weight and ingestion rate
- Diet composition
- Estimation of EPCs
- Representativeness of site EPCs for media and tissue data
- COPEC Bioavailability
- Prey species variation in COPEC uptake
- SUFs

Body Weight and Ingestion Rate

Dose parameters used in the Tier 2 assessment were mean values derived from existing literature. Although literature data exist for inputs to the dose calculation such as body weight, ingestion rate, and dietary composition for the receptors in this risk assessment, there is a natural level of variability in these parameters within a population of organisms. Uncertainty is inherent in the use of these values because they were generated from literature sources, rather than being empirically measured in the study area. Therefore, using literature-derived exposure parameters from investigations conducted outside of the study area adds an unknown degree of uncertainty that may over- or under-estimate exposure.

Diet Composition

The percent composition and type of prey ingested by the various receptors was based on literature studies that were not site-specific. Additionally the models were simplified to assume a limited diet, consistent with the literature data. Receptors from the Resource Area may consume food items in percentages that differ from the dose model.

Estimation of EPCs

Calculation of EPCs for receptors evaluated in the Tier 1 assessment involved uncertainties that were not eliminated in the Tier 2 assessment. Residual uncertainties associated with estimation of EPCs include:

- Representativeness of the data that were used to calculate EPCs for sediment, soil, and surface water
- Representativeness of the data that were used to calculate EPCs for tissue

Representativeness of Site EPCs for Media and Tissue Data

Uncertainty related to representativeness of the data is associated with the location and number of samples evaluated which may not adequately cover each stream reach, impacted area, or background area. Therefore, the EPCs for media and tissue may under- or over-estimate the concentration of COPECs to which the ecological receptors may be exposed.

An additional area of uncertainty associated with the data for tissue relates to the taxonomic composition of benthic invertebrates, insects, small mammal, and plant species collected for this assessment. The uncertainty is related to the potential for differential uptake of COPECs based on taxonomic differences between different species.

Representativeness of the Chosen Assessment Receptor

This AWERA assumed that the species chosen adequately represents its guild. In actuality, the assessment endpoint was chosen based on the availability of adequate information for calculating the necessary dose parameters required for the exposure assessment.

COPEC Bioavailability

This AWERA conservatively assumed that each COPEC is 100 percent bioavailable when that is not the case. Depending on the COPEC and receptor, bioavailability may be significantly less than 100 percent.

Prey Species Variation in COPEC Uptake

Each species or organism absorbs and processes COPECs in a different manner that will affect the exposure of to a higher-level receptor. As stated above, uncertainty associated with combining tissue from multiple species is related to the potential for differential uptake of COPECs based on taxonomic differences between species.

SUFs

The Resource Area is a large and complex ecosystem that supports a variety of habitats and numerous species of plants and animals that coexist in a complex and widespread food web. Assumptions on home or foraging ranges for all receptors were based on literature-derived information, which may not truly reflect actual distribution. No site-specific studies were available for the receptors assessed. SUFs for both Tier 1 and Tier 2 were assumed to be 1.0, which may overestimate exposure and does not account for variability in home ranges for each receptor.

7.10.2.2 Toxicity Reference Values

Development of TRVs requires acquisition and integration of toxicity data from numerous sources in an attempt to define a daily dose (mg/kg/day) that is protective of a specific receptor. Because toxicity studies vary, a certain level of uncertainty is associated with the TRV chosen to represent a species. Sources of uncertainty with the TRVs included:

- Quantity and quality of the toxicity data used to derive the TRVs
- Exposure conditions of literature-derived TRVs
- Use of data for surrogate species
- Conversion of laboratory TRVs to receptor TRVs

Quantity and Quality of Toxicity Data Used to Derive the TRVs

Potential uncertainties exist in the quantity and quality of literature-derived toxicity data. TRVs were taken from Sample and others (1996) and Navy (1998). Both documents have been extensively reviewed and the data are based on extensive searches of the primary, peer-reviewed literature and on secondary literature, such as government reports and proceedings from technical conferences. Therefore, it was assumed that sufficient data of reasonably high quality were used to derive the TRVs used in this assessment.

Exposure Conditions of Literature-derived TRVs

The majority of the toxicity data evaluated and used to generate the TRVs were derived from laboratory studies and not from the receptors used in this study. Laboratory settings do not mimic true field conditions. Laboratory studies typically control various factors to isolate one parameter. For example, to establish a dose-response relationship, animals of the same genetic strain and body weight may be administered a chemical in the same medium through the same route of exposure for the same exposure duration, with only the concentration of the chemical varied. Although the controlled experiments result in a more valid interpretation of the isolated parameters or relationship, uncertainty is associated with assuming laboratory exposure conditions are equivalent to exposure conditions in the field. Even extrapolation of field conditions associated with a literature study to exposure conditions in the Resource Area is associated with uncertainty. Exposure duration and toxicity characterization are two parameters that exemplify the difficulty in translating literature-derived data to data that represent exposure conditions for receptors in the Resource Area.

In general, uncertainty is associated with extrapolation of literature-derived toxicity endpoints (especially laboratory-based studies) to equivalent endpoints for receptors in the Resource Area as a result of discrepancies in exposure conditions.

Use of Data for Surrogate Species

The primary source of uncertainty associated with avian TRVs stems from the need to develop TRVs based on data from surrogate species that may or may not appropriately reflect the sensitivity of the receptors used in this AWERA. Developing TRVs based on toxicity values for surrogate species is necessary because appropriate data on the effects of COPECs on the specific receptors of concern are not available.

Conversion of Laboratory TRVs to Receptor TRVs

Allometric conversions are used to convert test species TRVs to receptor TRVs based on a mathematical relationship that uses the ratio of body weights for the test species and receptor species. The practice is based on scaling theory and is applied to correct for different food ingestion rates and metabolism rates that depend on the size of the organism. This theory, as applied to absorption, transport, metabolism, and excretion, assumes that all receptors, physiologically and biochemically, treat all chemicals in the same fashion. However, tremendous differences occur in all of these areas that relate to the metabolic activity and physiological processes of the individual organisms and species. Therefore, a degree of unknown uncertainty exists whenever an allometric conversion is applied to adjust a TRV from a test organism to a receptor species. This uncertainty is not quantifiable without conducting toxicity studies on the specific receptors that the AWERA assesses.

7.11 AREA WIDE ECOLOGICAL RISK ASSESSMENT CONCLUSIONS

The Tier 1, or "worst-case", assessment indicated potentially significant risk from all COPECs. Various COPECs affected different receptors. In some cases, those receptors that use only riparian areas were predicted to be most affected while in other cases the receptors that use the overall Resource Area were more impacted (see Table 7-14). However, the Tier 1 results do not present a realistic assessment of probable risk at a single location. The maximum media concentrations used in the Tier 1 assessment were found at different locations. These results present a bounding estimate of maximum potential risk in the Resource Area for the endpoints selected. However, the extremely high HQs (>2,000) for some receptors indicate that there is a high probability of significant risk to terrestrial receptors occurring in some localized areas.

The Tier 2 assessment was designed to evaluate an "average" risk to the selected endpoints in the Resource Area. Instead of maximum detected concentrations for each media, an area-weighted average was developed for each media. These "average" EPCs were designed to predict the average exposure for the entire receptor population in the Resource Area. To place the potential risks in the appropriate context, HQs were developed based on background only samples as well as the area-weighted EPCs for the entire area.

Based on the Tier 2 assessment, the only significant area-wide risks to ecological receptors are presented by selenium and cadmium. While the other COPECs may present a significant risk in some localized areas, the assessment indicates that they do not pose a significant risk to populations in the Resource Area

as a whole. While selenium and cadmium risks are elevated, they are less than three times the background risk for the Resource Area. Therefore, the risk to overall populations of terrestrial receptors in the Resource Area is expected to be low. However, the risks calculated from the Tier 2 assumptions may significantly underestimate exposure to localized subpopulations of various species.

The Tier 3 assessment did not indicate a significant difference in risk when 1998 surface water data was used instead of 2001 data. The significantly higher concentrations detected in 1998 did not create a significant additional risk because the major portion of the dose for all receptors comes from other media not as transitory as surface water. These other media serve as a "sink" for the various COPECs that move with the surface water. The major effect of the surface water concentrations is to add COPECs into the other media, which serve as a more permanent reservoir of chemicals for exposure to the various receptors.

The Tier 1, 2, and 3 assessments evaluated exposure to terrestrial, aquatic, and riparian receptors. Data concerning effects on aquatic receptors is less well developed and has a higher level of uncertainty. Surface water concentrations of cadmium, copper, and selenium exceeded their respective benchmarks. Sediment concentrations of cadmium, chromium, copper, nickel, selenium, and zinc exceeded their respective benchmarks. There was no available benchmark for vanadium for surface water or sediments. For all COPECs, impacted fish tissue concentrations exceeded the conservative benchmarks except for vanadium.

Based on the Tier 3 assessment, all of the contaminants except nickel and vanadium were a risk to the aquatic/riparian omnivorous birds (red-winged blackbird)(see Table G-6, Appendix G). For the aquatic/riparian herbivorous birds (song sparrow), all contaminants except nickel and vanadium also posed a risk in all three watersheds. All COPECs posed a risk to the aquatic/riparian herbivorous mammals (meadow vole) except for chromium and copper. Selenium was the only COPEC that appeared to impact the piscivorous bird guild (great blue heron) in all three watersheds. Selenium also was the only COPEC that posed a risk to aquatic/riparian benthic-feeding birds (mallard) in the Blackfoot/Little Blackfoot and Georgetown watersheds, but not in the Salt watershed. Nickel, selenium, and vanadium posed a risk to the aquatic/riparian carnivorous mammals (mink) in all three watersheds. Cadmium also posed a risk to the mink in the Blackfoot/Little Blackfoot and Georgetown watersheds. The same COPECs also were found to affect aquatic/riparian omnivorous mammals (raccoon). Only cadmium and selenium posed a risk to the terrestrial herbivorous birds (represented by the northern bobwhite) in all three watersheds (see Table G-68, Appendix G). Nickel posed a risk to the terrestrial herbivorous mammals (cottontail rabbit) in all three watersheds, while selenium only posed a risk in the

Blackfoot/Little Blackfoot watershed. For the terrestrial omnivorous birds (American robin), all COPECs posed a risk in all three watersheds except for nickel and vanadium. For the terrestrial omnivorous mammals (deer mouse), all COPECs posed a risk in all watersheds except for chromium and copper. Based on the Tier 3 assessment, there does not appear to be any impact to the terrestrial carnivore guild (coyote) and the raptors (northern harrier). The primary conclusion of the study is that there is some potential risks to aquatic and riparian receptors, but the data is not sufficient to be definitive.

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TABLES

TABLE 2-1

LIST OF AREA WIDE MINES AND OPERATORS

(PAGE 1 OF 1)

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

Notes:

[1] Gay Mine was leased by FMC Corporation and J.R. Simplot Company, individually and jointly.

[2] Rasmussen Ridge Mine is leased by Nu-West Industries, Inc., an affiliated company of Nu-West.

[3] South Maybe Canyon Mine is not included in the scope of the Selenium Project. It currently is being addressed under a consent order with Nu-West and the U.S. Forest Service.

[4] P4 Production LLC is joint venture between Monsanto and Solutia, Inc.

Source: Montgomery Watson (MW). 1999b.

TABLE 2-2

MEDIUM-SPECIFIC SUMMARY OF SAMPLES CONSIDERED QUANTITATIVELY

(Page 1 of 2)

Stream or Stream-specific Riparian Area [1]	Fish Tissue Samples[5]		Plant Tissue Samples				Soil Samples			Insect and Worm Samples				Small Mammal Samples		Surface Water Samples		Sediment Samples	
			Aquatic	Riparian		Upland	Riparian		Upland	Aquatic Insect	Riparian Insect	Riparian Worm	Upland Insect	Riparian	Upland				
	TtEMI[2]	MW	TtEMI[2]	TtEMI[2]	MW[2]	MW[2]	TtEMI[2]	MW[2]	MW[2]	TtEMI[2]	MW[2]	MW[2]	MW[2]	MW[2]	MW[2]	TtEMI[2]	MW[2]	TtEMI[2]	MW[2,4]
Little Blackfoot River (I)	---	---	---	---	3	---	---	5	---	---	1	2	---	5	---	5	31	---	12
State Land Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	---	1	---
Trail Creek (I)	---	---	---	---	5	---	---	3	---	---	2	---	---	3	---	3	6	---	3
Goodheart Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	---	1	---
Wooley Va lley Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	---	---	---
Blackfoot River (I)	---	1	---	3	3	---	3	3	---	---	3	3	---	5	---	11	40	3	11
Angus Creek (I)	---	---	---	---	3	---	---	5	---	---	3	2	---	4	---	2	---	---	1
Middle Angus Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4	---	---	---
No Name Creek (I, B)	---	---	---	3	---	---	3	---	---	---	---	---	---	---	---	6	1	2	1
Rasmussen Creek (I)	---	---	---	2	---	---	2	---	---	---	---	---	---	---	---	3	4	---	2
Spring Creek (I, B)	4	---	4	---	---	---	---	---	---	3	---	---	---	---	---	8	---	3	---
East Mill Creek (I)	1	1	2	2	5	---	2	3	---	1	3	3	---	3	---	8	3	3	1
Caldwell Creek (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4	8	1	3
Slug Creek(B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	6	1	3
Diamond Creek (B)	---	---	---	1	3	---	1	3	---	---	3	1		3		3	4	1	2
Sheep Creek (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	6	1	3
Maybe Creek (I)	---	---	---	---	---	---	---	---	---	1	---	---	---	---	---	1	---	1	---
Kendall Creek (B)	1	---	1	---	---	---	---	---	---	1	---	---	---	---	---	1	---	1	---
Dry Valley Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10	---	1
Lanes Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4	---	2
Meadow Creek (B)	---	---	---	---	3	---	---	3	---	---	2	1	---	4	---	---	---	---	---
Timber Creek (B)	---	---	---	---	5	---	---	5	---	---	3	5	---	3	---	---	---	---	---
Smoky Creek (I, B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6	6	1	3
South Fork Sage Creek (I)	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	4	3	1	2
Sage Creek (I, B)	1	---	3	---	---	---	---	---	---	2	---	---	---	---	---	10	8	3	4
Deer Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	1	1	1
Crow Creek (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	---	1	---
Montpelier Creek (I, B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6	---	2	---
Georgetown Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	5	1	3
Right Hand Fork Georgetown Creek (I)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9	---	3

TABLE 2-2

MEDIUM-SPECIFIC SUMMARY OF SAMPLES CONSIDERED QUANTITATIVELY

(Page 2 of 2)

Stream or Stream-specific Riparian Area [1]	Fish Tissue Samples[5]		Plant Tissue Samples				Soil Samples			Insect and Worm Samples				Small Mammal Samples		Surface Water Samples		Sediment Samples	
			Aquatic	Riparian		Upland	Riparian		Upland	Aquatic Insect	Riparian Insect	Riparian Worm	Upland Insect	Riparian	Upland				
	TtEMI[2]	MW	TtEMI[2]	TtEMI[2]	MW[2]	MW[2]	TtEMI[2]	MW[2]	MW[2]	TtEMI[2]	MW[2]	MW[2]	MW[2]	MW[2]	MW[2]	TtEMI[2]	MW[2]	TtEMI[2]	MW[2,4]
Grizzly Creek (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	---	1
Formation Creek (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	---	---
Portneuf River (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	8	---	2
Ross Fork (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4	---	2
Lincoln Creek (B)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4	---	2
Phosphate Mines	---	---	---	---	---	16	---	---	35	---	---	---	11	---	16	---	56[6]	---	---
Phosphoria Outcrops	---	---	---	---	---	12	---	---	15	---	---	---	1	---	15	---	---	---	---

Notes:

B Background
I Investigative
MW Montgomery Watson
TtEMI Tetra Tech EM Inc.

1 The streams and stream-specific riparian areas are organized according to the watershed that the portion of each stream sampled lies within, except for Phosphate Mines and Phosphoria Outcrops.

2 Tetra Tech EM Inc. (TtEMI). 2001d. "Final Sampling and Analysis Plan." Prepared for Idaho Department of Environmental Quality (IDEQ). May.

3 U.S. Fish and Wildlife Service. "Fish Tissue Results for the Study Area." 2002.

4 Includes unadjusted laboratory results for samples collected as part of MW 1998-1999 stream sampling program.

5 Number of fish tissue samples analyzed. Some samples were a composite of more than one fish so the number of samples may not be representative of the actual number of fish collected.

6 Phosphate mine surface water data used from mine pit features only (i.e. springs, seeps, pit lakes, and stock ponds). Laboratory data provided by MW was reported as dissolved for trace metals and as total for Selenium, anions, alkalinity, and total suspended solids.

TABLE 6-1

HEALTH EXPOSURE PARAMETER VALUES
REASONABLE MAXIMUM EXPOSURE SCENARIO

Parameter	Recreational Hunter/Fisher		Native American		Subsistence Lifestyle		Notes
	Adult	Child	Adult	Child	Adult	Child	
Exposure Point Concentration in Aquatic and Terrestrial Plants (EPC_{ap}/EPC_{tp}) (mg/kg)	NA	NA	Tier-specific	Tier-specific	Tier-specific	Tier-specific	1
Exposure Point Concentration in Aquatic Life (EPC_{al}) (mg/kg)	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	2
Exposure Point Concentration in Surface Water ($EPC_{SW)}$ (mg/L)	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	2
Exposure Point Concentration in Cattle and Wild Game - Skeletal Muscle and Offal ($EPC_{c/wg}$) (mg/kg)	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	3
Exposure Point Concentration in Plant-based Tea (EPC_{pt}) (mg/L)	NA	NA	Tier-specific	Tier-specific	NA	NA	4
Exposure Point Concentration in Soil (EPC_s) (mg/kg)	NA	NA	NA	NA	Tier-specific	Tier-specific	5
Terrestrial Plant Ingestion Rate (IR_{tp}) (kg[DW]/kg/day)	NA	NA	Plant-specific[6]	Plant-specific[6]	Plant-specific[7]	Plant-specific[7]	6,7
Aquatic Plant Ingestion Rate (IR_{ap}) (kg[DW]/kg/day)	NA	NA	Plant-specific[6]	Plant-specific[6]	NA	NA	6
Plant-based Tea Ingestion Rate (IR_{pt}) (L/day)	NA	NA	0.288	0.034	NA	NA	8
Cattle Ingestion Rate - Skeletal Muscle (IR_{sm}) (g/kg/day)	2.02	3.73	2.46	4.54	2.02	3.73	9
Cattle Ingestion Rate - Offal (IR_o) (g/kg/day)	0.089	0.42	0.25	0.45	0.089	0.42	10
Aquatic Life Ingestion Rate (IR_{al}) (g/day)	25	9	37.5	13.5	170	61.2	11
Surface Water Ingestion Rate (IR_{SW}) (L/day)	2.35	1.5	2.35	1.5	2.35	1.5	12
Soil Ingestion Rate (IR_s) (mg/day)	NA	NA	NA	NA	100	200	13
Fraction Plant Ingested (FI_{pt}) (unitless)	NA	NA	0.25	0.25	1	1	14
Fraction Cattle Ingested (FI) (unitless)	0.157	0.157	0.157	0.157	0.157	0.157	15
Fraction Aquatic Life Ingested (FI_{al}) (unitless)	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	16
Fraction Soil Ingested (FI_s) (unitless)	NA	NA	NA	NA	1	1	17
Wild Game Ingestion Rate - Skeletal Muscle (IR_{wg}) (g/kg/day)	0.026	0.0378	0.0024	0.0035	0.32	0.83	18
Wild Game Ingestion Rate - Offal (IR_{wgo}) (g/kg/day)	0.001	0.004	0.00024	0.00035	0.001	0.004	19
Fraction Wild Game Ingestion (FI_{wg}) (unitless)	0.29	0.29	0.29	0.29	0.58	0.58	20
Inhalation Rate (InR) (m^3/hr)	1.6	1.2	1.6	1.2	1.6	1.2	21
Exposure Frequency Plant-based Tea (EF_{pt}) (days/year)	NA	NA	365	365	NA	NA	22

TABLE 6-1

HEALTH EXPOSURE PARAMETER VALUES
REASONABLE MAXIMUM EXPOSURE SCENARIO

Parameter	Recreational Hunter/Fisher		Native American		Subsistence Lifestyle		Notes
	Adult	Child	Adult	Child	Adult	Child	
Exposure Frequency - Particulates ($EF_{P,SW}$) (days/year)	6	6	6	6	17	17	23
Exposure Frequency (EF) (days/year)	365	365	365	365	365 (350)	365 (350)	22
Exposure Duration (ED) (years)	30 (24)	6	30 (24)	6	30 (24)	6	25
Exposure Time (ET) (hours/day)	8	8	8	8	8	8	26
Conversion Factor1 (CF1) (kg/g)	0.001	0.001	0.001	0.001	0.001	0.001	--
Conversion Factor 2 (CF2) (kg/mg)	NA	NA	NA	NA	1E-06	1E-06	--
Body Weight (BW) (kg)	70	15	70	15	70	15	--
Averaging Time for Noncarcinogens (AT_{non}) (days)	10,950	2,190	10,950	2,190	10,950	2,190	27
Averaging Time for Carcinogens (AT_{carc}) (days)	25,550	25,550	25,550	25,550	25,550	25,550	27
Particulate Emission Factor (PEF) (m^3/kg)	1.31E+09	1.31E+09	1.31E+09	1.31E+09	1.31E+09	1.31E+09	28

Notes:

AT	Averaging time
BW	Body weight
CF	Conversion factor
ED	Exposure duration
EF	Exposure frequency
EPC	Exposure point concentration
ET	Exposure time
FI	Fraction ingested
g/day	Gram per day
g/kg/day	Gram per kilogram per day
InR	Inhalation rate
IR	Ingestion rate
kg	Kilogram
kg [DW]/kg/day	Kilogram dry weight per kilogram per day
kg/g	Kilogram per gram
kg/mg	Kilogram per milligram
L/day	Liter per day
m^3/hr	Cubic meter per hour
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
NA	Not applicable
PEF	Particulate emission factor

1 The only aquatic plant evaluated in the Area Wide Human Health Risk Assessment (AWHHRA) is the watercress (*Nasturium officinale*). The exposure point concentration (EPC) of each chemical of potential concern (COPC) in watercress was calculated from the analytical results from watercress samples collected in the Resource Area. Under Tier 1, the maximum detected concentration of each COPC was used as the EPC. Under Tier 2, EPCs were calculated on a watershed-specific basis if sufficient samples were collected (if not, the EPC was calculated based on all available watercress

samples) based on procedures recommended in U.S. Environmental Protection Agency's (EPA) guidance titled "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992). Under Tier 3, the EPC was calculated on a stream-specific basis following the same guidance used under Tier 2.

COPC-specific EPCs in terrestrial plants were calculated following the procedures recommended in EPA's "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities" (EPA 1998b). Terrestrial plants are divided into three categories for consideration in the AWHHRA: (1) exposed aboveground produce, (2) protected aboveground produce, and (3) belowground produce. Equations used to calculated EPCs are presented below:

EXPOSED AND PROTECTED ABOVEGROUND PRODUCE

$$Pr = Cs \times Br_{ag}$$

BELOWGROUND PRODUCE

$$Pr = Cs \times Br_{bg}$$

where

Pr	=	Concentration of COPC in produce due to root uptake (milligram per kilogram [mg/kg])
Cs	=	Average soil concentration over exposure duration (mg COPC/kg soil) (calculated as 95 percent upper confidence level [UCL_{95}] consistent with EPA [1992])
Br_{ag}	=	Plant-soil bioconcentration factor for aboveground produce (unitless) (Baes and others 1984)
Br_{bg}	=	Plant-soil bioconcentration factor for belowground produce (unitless) (Baes and others 1984)

Under Tier 1, the maximum detected concentration of each COPC in soil was used as the Cs value. Under Tier 2, EPCs for homegrown produce were calculated on a stream-specific basis according to the procedures recommended in EPA's guidance titled "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992).

2 Under Tier 1, EPCs in aquatic life were calculated as the maximum detected concentration (wet weight [WW]) of each COPC from analytical results for fish fillet samples collected from streams in the Resource Area. Under Tier 2, EPCs were calculated as a weighted average based on stream-specific productivity for each watershed for which fish fillet samples have been collected. Under Tier 3, EPCs were calculated on a stream-specific basis according to the procedures recommended in EPA's "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992). Also see Section 6.1.

Under Tier 1, EPCs for surface water were calculated as the maximum detected concentration for surface water samples collected from streams in the Resource Area. Under Tier 2, EPCs were calculated on a stream-specific basis according to EPA's guidance titled "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992).

3 EPCs in cattle (beef skeletal muscle and liver) and wild game (elk skeletal muscle and liver) grazing or living in the Resource Area were calculated based on the tissue-specific analytical results presented in the "1999 Interim Investigation Data Report" (Montgomery Watson [MW] 2000). Under Tier 1, the maximum detected concentration of each COPC was used as the EPC. Under Tier 2, COPC-specific EPCs were calculated in accordance with EPA-recommended procedures (EPA 1992). It should be noted that the beef skeletal muscle and liver values used to calculate EPCs are from tissue samples that have undergone depuration and that steers were artificially penned in on a seleniferous pasture. Also see Section 6.1.

4 EPCs for plants used by Native American populations to make tea (sage and red willow) were calculated based on plant-specific tissue sample analytical results or COPC-specific soil concentrations using soil-plant bioconcentration factors as described in footnote 1 for aboveground plants. More specifically, under Tier 1, the greater of the maximum detected concentration of each COPC in plant tissues or the plant tissue concentration estimated based on the maximum detected soil concentration was used as the EPC. Under Tier 2, EPCs were calculated based on all available sage and red willow samples based on procedures recommended in EPA's guidance titled "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992). Under Tier 3, EPCs were calculated on a stream-specific basis following the same guidance used under Tier 2. For streams without sage or red willow samples, plant tissue EPCs were based on the COPC-specific soil concentrations calculated in accordance with EPA's "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992).

The EPCs in plant-based teas were calculated based on plant tissue EPCs calculated in the manner described above, using the following methodology. No direct information is available regarding the metal content of infusions ("teas") produced from native plants of southeastern Idaho. Several general studies of foodstuffs, such as Ministry of Agriculture, Food, and Fisheries (MAFF) (1998) and U.S. Food and Drug Administration (FDA) (2001) give some information on the intake of metals from beverages including teas. However, while providing data on the concentration of metals in infusions, neither study provides data on the concentration of metals in dry tea. Therefore, estimates of the transfer of metals from dry tea into water cannot be estimated.

However, evidence exists that infusions made from tea (*Camellia sinensis*) known to take up aluminum contain elevated levels of aluminum, especially compared with other beverages (MAFF 1998). Therefore, while data is scarce, it is reasonable to assume that a fraction of the metals present in plant material will be transferred into an infusion made from that material. The primary mechanism for the uptake of metals in soil by plants is diffusion (sometimes modified by chelation, precipitation, and other processes). As a first approximation, the plant-soil bioconcentration factor for forage (Br_{forage}) as defined in EPA (1998b) was used to estimate the fraction of metals in plant material that is dissolved in an infusion.

A review of commercial teas indicates that about 2.2 grams (g) of team are required to produce one 6-ounce (177.4 milliliter [ml]) cup of tea. The amount of material necessary to produce one liter (L) of tea can be estimated as:

2.2 g of tea/177.4 ml of tea = x g of tea/1,000 ml; x = 12.4 g of tea

It is assumed that the same amount of native material (12.4 g) is required to produce one L of tea. The concentration of each COPC in teas produced from native materials can be estimated as:

mg COPC/kg native material x 0.0124 kg native material x Br_{forage} = mg COPC/kg infusion = mg COPC/L infusion (assuming the density of the infusion equals 1 kg/1 L)

Also see Section 6.1.

5 Under Tier 1, the maximum detected concentration of each COPC in soil from riparian areas was used as the EPC. Under Tier 2, soil EPCs were calculated on a riparian area-specific basis in accordance with EPA's "Supplemental Guidance to RAGs: Calculating the Concentration Term" guidance (EPA 1992) (also see Section 6.1).

6 Because no information was identified regarding Native American-specific ingestion rates (IR) for watercress (*Nasturium officinale*), wild onion (*Allium canadense*), and wild carrot (*Daucus carota*), IRtp for wild onion and wild carrot, and IRap for watercress were calculated for Native American adult and child receptors based on information contained in EPA's "Exposure Factors Handbook" (EPA 1997d). Specifically, Table 9-13 presents mean per capita intake rates for various raw agricultural commodities. Using green onion to represent wild onion, it can be shown that both green onion and watercress represent less than 0.1 percent of the total daily intake of vegetables (calculated by summing all vegetable-specific intakes from Table 9-13) – green onion represents about 0.07 percent and watercress represents about 0.01 percent. In order to be conservative for use in representing the reasonable maximum exposure (RME) scenario, it was assumed that both wild onion and watercress were consumed at a rate equal to 0.1 percent of the total vegetable intake of Native Americans. The total RME intake of vegetables by Native Americans was estimated as 10.7 grams per kilogram per day (g/kg/day) as consumed, by summing the 95th percentile intakes of exposed, protected, and root vegetables for Native Americans (Tables 9-9, 9-10, and 9-11, respectively).

Therefore, the intake of both wild onion and watercress was estimated as:

0.001 x 10.7 g/kg/day as consumed = 0.0107 g/kg/day as consumed

In order to convert from WW (as consumed) to dry weight (DW), this value was multiplied by (100 – percent water)/100 = 0.10; assuming both wild onion and watercress are about 90 percent water (see Table 9-27). Therefore,

0.0107 g/kg/day as consumed x 0.10 x 1 kg/1000g = 1.07E-06 kg [DW]/kg/day

Adult and child IRs for wild carrot are assumed to equal those for wild onion.

7 The adult- and child-specific IRs for exposed aboveground, protected aboveground, and belowground (root) vegetables were adopted from EPA's "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities" (EPA 1998b) and are presented below. Note: all intake rates are presented in units of kg[DW]/kg/day.

	Adult	Child
Exposed aboveground produce (Cr_{ag})	0.0003	0.00042
Protected aboveground produce (Cr_{pp})	0.00057	0.00077
Belowground produce (Cr_{bg})	0.00014	0.00022

8 EPA's "Exposure Factors Handbook" presents several tables that provide various estimates, including mean values, for daily intake of tea (EPA 1997d). Table 3-14 presents the results of a study of beverage intake in Great Britain (Hopkins and Ellis 1980). Table 3-21 presents results collected as part of the U.S. Department of Agriculture's (USDA) "Food and Nutrient Intakes by Individuals in the U.S." (USDA 1995). Table 3-26 presents the results of a study of total fluid intake derived from various sources by women aged 15 to 49 years old (Ershow and others 1991). Study-specific tea intake estimates are presented below.

- Hopkins and Ellis (1980): mean tea intake (0.584 L/day); UCL_{95} of the mean (0.608 L/day)
- USDA (1995): mean tea intake – all individuals (0.114 L/day); children (age 5 and under) (0.017 L/day); adults (age 20 and over) (0.140 L/day)
- Ershow and others (1991): mean tea intake (control women) (0.148 L/day); 95th percentile (0.630 L/day)

Based on these results, the following conclusions were drawn. First, the results from the study of Great Britain receptors (Hopkins and Ellis 1980) may not be representative of study area receptors because individuals from Great Britain are expected to intake more tea than U.S. receptors. Second, the mean tea intake rates of adults (age 20 and over) and of control women (age 15 to 49) are similar – 0.140 and 0.148 L/day, respectively (USDA 1995 and Ershow and others 1991). Therefore, for the purposes of the AWHHRA, the mean or central tendency exposure (CTE) tea intake value for adults was estimated as the mean of these two values or 0.144 L/day (about 4 ounces [0.118 L] per day). The RME tea intake rate for adults was estimated as twice the CTE rate or 0.288 L/day (about 8 ounces [0.237 L] per day). Similarly, the mean or CTE child tea intake rate was estimated as 0.017 L/day, based on the mean value for children 5 years and under from USDA (1995). As for adults, the RME child tea intake rate was estimated as twice the mean intake rate or 0.034 L/day.

9 Table 11-3 from EPA's "Exposure Factors Handbook" presents per capita intake of beef (EPA 1997d). For the purposes of characterizing the RME scenario, it was assumed that receptors ingested beef at a rate equal to the 95th percentile. Therefore, the RME IRs for recreational hunter and fisher and subsistence lifestyle receptors were estimated to be 2.3 g/kg/day as consumed (total or general population). Similarly, the beef IR for Native American receptors was estimated to be 2.8 g/kg/day as consumed.

Both the total or general population- and Native American-specific IRs are average intake rates across all age groups. In order to distinguish between adult and child intake rates, the overall intake rates (2.3 and 2.8 g/kg/day as consumed, respectively) were adjusted using factors specific to adults and children. These factors were calculated as ratios of time-weighted mean intake rates for adults age 20 through 69 and children less than 6 years old each over the total mean intake rate for beef (0.825 g/kg/day as consumed) for the "total" population as shown below.

Adult time-weighted intake (see age range-specific intake rates in Table 11-3):

(0.789 [20 to 39 years] x 20 years)/ 50 years + (0.667 [40 to 69 years] x 30 years)/50 years = 0.7158

Child time-weighted intake:

(0.941[<1 year] x 1 year)/6 years + (1.46 [1 to 2 years] x 2 years)/6 years + (1.392 [3 to 5 years] x 3 years)/6 years = 1.34

Adult and child factors were calculated as the ratios of the adult and child time-weighted intakes over the mean "total" beef intake as follows:

Adult factor: 0.7158/0.825 = 0.87
Child factor: 1.34/0.825 = 1.62

Finally, adult and child beef intake rates were calculated as the product of the 95th percentile beef IR for the general population (2.3 g/kg/day) and the adult and child factors:

Adult beef IR: 2.3 x 0.87 = 2.00 g/kg/day as consumed
Child beef IR: 2.3 x 1.62 = 3.73 g/kg/day as consumed

The same process was used for the Native American receptors with the exception that instead of basing the calculations on the 95th percentile beef IR for the general population, the calculations were based on the 95th percentile beef IR for Native Americans (2.8 g/kg/day as consumed – see Table 11-3).

Therefore, adult and child IRs for beef skeletal muscle are summarized below. Note: all intakes are in units of g/kg/day as consumed.

	Adult	Child
Recreational hunter/fisher	2.00	3.73
Subsistence lifestyle	2.00	3.73
Native American	2.46	4.54

10 EPA's "Exposure Factors Handbook" clarifies that ingestion of organ meats and sausages (and presumably offal in general) are not included in the meat-specific IRs presented (see Table 11-3) (EPA 1997d). Therefore, intakes of beef should be summed with intakes of organ meats, sausages, and offal in general. For the purposes of the AWHHRA, it was conservatively assumed that recreational hunter and subsistence lifestyle receptors would,

over the course of one year, ingest a mass of beef tissue other than skeletal muscle equivalent to 50 percent of one beef liver (about 5 pounds). Therefore, IRs for adult and child receptors were calculated as follows:

Adult receptor:	5 pounds x (1 kg/2.2 pounds) x 1000 g/kg x 1/70 kg x 1/365 days	=	0.089 g/kg/day
Child receptor:	5 pounds x (1 kg/2.2 pounds) x 1000 g/kg x 1/15 kg x 1/365 days	=	0.42 g/kg/day

The COPC concentrations of these other beef tissues was estimated using liver concentrations.

For the purposes of evaluating subsistence lifestyle and Native American receptors, it was assumed that these receptors ingested beef tissue other than skeletal muscle at a rate equal to about 10 percent of the skeletal muscle IR based on the work of Harris and Harper (1997). These investigators noted that Native Americans ate more parts of fish and animals than just the fillet or steak. They recommended using a place holder value of 10 percent of the total fish IR (assumed to be 540 g/day for members of the Confederated Tribes of the Umatilla Indian Reservation) to represent "other organs" (Harris and Harper 1997). For the purposes of the AWHHRA, this 10 percent value was used to represent each of the meat types evaluated in the risk assessment. Therefore, both adult and child subsistence lifestyle and Native American receptors are assumed to ingest beef tissue other than skeletal muscle at a rate equal to about 10 percent of the skeletal muscle IR. The concentration of selenium in these other beef tissues was estimated using liver concentrations.

11 The IR for aquatic life for recreational hunters/fishers was identified as 25 g/day based on the EPA-recommended 95th percentile IR for recreational anglers (EPA 1997d). EPA's "Exposure Factors Handbook" also discusses several studies of Native American populations indicating that IRs for Native American populations can be estimated as being from similar to about 100 percent higher than for the general population (West and others 1989; Ebert and others 1993; Peterson and others 1994; Fiore and others 1989; and Fitzgerald and others 1995). Based on best professional judgment, it was assumed that the IR of aquatic life for Native American adults was 50 percent higher than for recreational hunters and fishers, or 37.5 g/day. Finally, the IR for subsistence lifestyle adults was assumed to be equal to the EPA-recommended Native American subsistence IR of 170 g/day (EPA 1997d).

In order to determine receptor-specific child aquatic life IRs, the adult rates were multiplied by a factor calculated as the ratio of child (0 to 9 years old) to adult (greater than or equal to 20 years old) total fish consumption rates (see Table 10-1 in EPA 1997d). The ratio was calculated as: (16.5 g/day)/(46.3 g/day) = 0.36.

Therefore, the receptor-specific aquatic life IRs were calculated as:

Recreational hunter/fisher child:	25 g/day x 0.36	=	9 g/day
Native American child:	37.5 g/day x 0.36	=	13.5 g/day
Subsistence lifestyle child:	170 g/day x 0.36	=	61.2 g/day

It should be noted that these adult and child fish IRs are considered to represent caps on the amount of fish ingested by each receptor. The rates presented were used in Tier 1 of the tiered approach. However, for the purpose of evaluating ingestion of fish across a watershed (see Tier 2 of the tiered approach), an evaluation was made regarding the ability of streams from a given watershed to support chronic intake of fish. To the extent that a

watershed was determined to be unable to support chronic fish ingestion, the RME fish IRs were adjusted downwards. Under Tier 3 of the tiered approach, a similar process was conducted on a stream-specific basis.

12 Receptor-specific tapwater IRs were used to represent the amount of surface water ingested. It was assumed that for each recreational day, the receptor would ingest water only from streams in the Resource Area. This assumption may be conservative for receptors engaged in day-trips; however, the assumption is expected to accurately represent receptors engaged in overnight camping in the Resource Area.

13 Based on EPA's "Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure" (EPA 1993a) and "Exposure Factors Handbook" (EPA 1997d).

14 It was assumed that the recreational hunter/fisher did not ingest plants growing in the Resource Area. It was assumed that the subsistence lifestyle receptor ingests only produce (plants) grown in home gardens located on contaminated floodplains (riparian areas) along streams in the Resource Area. The fraction ingested value for the subsistence lifestyle receptor was calculated on two primary factors: (1) length of the growing season and (2) size of the home garden.

The study area can be divided into "warmer" counties such as Bannock, Franklin, and Oneida and "cooler" such as Bear Lake and Caribou. The growing season for the warmer counties is estimated to be about 110 to 120 days and in cooler counties is estimated to be about 90 to 100 days (Tetra Tech EMI [TtEMI] 2002a). In cooler counties, the cooler nighttime temperatures can slow the growth of warmer-season plants. As a result, plants such as corn, tomatoes, and warm season squashes may not grow well in counties such as Bear Lake and Caribou. However, plants such as beans, beets, carrots, peas, potatoes, and spinach can be raised without significant difficulty in these cooler counties (TtEMI 2002a). Many of the stream segments potentially impacted by mining are located at some of the higher elevations in Bear Lake and Caribou counties. It is expected that growing seasons along these streams would be among the shortest in the cooler counties. However, produce might be canned and used outside the growing season. Therefore, a fraction plant ingested value was estimated as 1. Based on review of the locations at which flood plain soil samples have been collected, this fraction plant ingested value may be reduced if it is judged that insufficient growing space is available in a stream-specific flood plain.

With regard to the fraction of wild onion, wild carrot, and watercress ingested by Native American receptors, it is acknowledged that the 14 active and former mine sites in the study area have a cumulative area equal to about 5 percent of the total study area (60 square miles for the mine sites [see Drawing 1-1 from MW 2000])/(1,200 square miles for the study area [MW 1999b]). However, based on the proposed IRs for wild onion and watercress, it is estimated that Native American receptors would only need to gather about five or six plants to meet the total estimated mass of each species ingested over 1 year (Note: wild onion example -- 0.0107 g/kg BW – day x 70 kg BW x 365 days = 27.3 g wild onion as consumed per year). It is reasonable to believe that a Native American receptor could gather five or six plants of each species on a single trip. Samples of wild onion and watercress of sufficient volume to meet annual ingestion requirements were collected from various sampling locations in the study area. Receptors would be expected to return to known locations of these plants. However, there are certainly other sources of wild onion and watercress (and also wild carrot) besides locations in the study area potentially impacted by mine releases. Therefore, it was assumed that Native American receptors gather wild onion, watercress, and wild carrot from locations potentially impacted by mine releases in the study area about every fourth year. This equates to a fraction ingested of 0.25 under RME conditions.

With regard to the fraction of plant material used to brew teas by Native American receptors, it is acknowledged that only about 0.4, 26.5, and 8.5 percent of the riparian areas in the Salt, Blackfoot/Little Blackfoot, and Georgetown watersheds are considered to be impacted by mine releases. It was assumed that sage and red willow are present at equal frequency in potentially impacted and unimpacted riparian areas throughout the study area. Therefore, use of the approximate percentage of impacted riparian area in the most contaminated watershed (the Blackfoot/Little Blackfoot) represents a conservative estimate of the fraction of plant material used to brew teas that might be harvested from mine impacted riparian areas. Therefore, a fraction ingested of 0.25 under RME conditions was also used for plant material used to brew teas.

15 The deterministic $F_{beef,\ site}$ value of 0.157 was adopted from the "Final 1998 Regional Investigation Report" (MW 1999b) as the fraction ingested (FI_c) value for the AWHHRA. This value is an estimate of the 95th percentile of a distribution merging separate beta distributions for the general public (μ assumed to be 0.50 - see MW 1999b) and ranchers who have cattle grazing on leases containing seleniferous pastures (μ assumed 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 beta distribution derived for the general population was given 100 times more weight than the beta distribution for ranchers because the rancher population was assumed to be about 1 percent the size of the general population. For a more detailed explanation of the basis of this value, the reader is directed to the "Final 1998 Regional Investigation Report" (MW 1999b).

16 A FI value of 1 was used unless otherwise documented in the text.

17 Subsistence receptors may be exposed both at their home and throughout the Resource Area. For the purpose of assessing potential exposure at their homes, a fraction ingested value of 1 was assumed in order to allow health-protective consideration of homebound individuals such as the elderly and young children. Potential exposure through soil ingestion to subsistence lifestyle, recreational, and Native American receptors associated with activities that may require receptors to move beyond the mine-affected areas (such as hunting, fishing, and gathering), exposure through soil ingestion is expected to be insignificant and will not be quantified.

18 Table 11-6 in EPA's "Exposure Factors Handbook" presents per capita game intake rates (g/kg/day as consumed) for various ethnicities including Native American (EPA 1997d). It was judged that a 95th percentile IR was appropriate for evaluating the RME case for recreational hunters and Native American receptors. However, Table 11-6 presents only mean and 99th percentile IRs. In order to estimate receptor-specific 95th percentile IRs the following assumptions were made. First, recreational hunter receptors were represented by "total" IRs and Native American receptors were represented by "Native American" IRs. Second, the ratio of mean to 95th percentile game IRs was assumed to be the same as the ratio of mean to 95th percentile total meat IRs (see Table 11-1). Therefore, the following ethnicity-specific 95th percentile game IRs were estimated (all IRs in units of g/kg/day as consumed):

Recreational Hunter:

$$\frac{(0.01\ [\text{mean game intake Table 11 - 6}]) \times (5.06\ [\text{95th percentile total meat intake Table 11 - 1}])}{(2.146\ [\text{mean total meat intake Table 11 - 1}])} = 0.0236$$

Native American:

$$\frac{(0.001\ [\text{mean game intake Table 11 - 6}]) \times (5.09\ [\text{95th percentile total meat intake Table 11 - 1}])}{(2.269\ [\text{mean total meat intake Table 11 - 1}])} = 0.0022$$

In order to distinguish between adult and child intake rates for recreational hunter and Native American receptors, the overall intake rates (0.0236 and 0.0022 g/kg/day as consumed, respectively) were adjusted using factors specific to adults and children. These factors were calculated as ratios of time-weighted mean intake rates for adults age 20 through 69 and children less than 6 years old each over the mean game intake rates (see Table 11-6) as detailed below.

Adult time-weighted intake (see age range-specific intake rates in Table 11-6):

(0.01 [20 to 39 years] x 20 years)/ 50 years + (0.012 [40 to 69 years] x 30 years)/50 years = 0.011

Child time-weighted intake:

(0.014[<1 year] x 1 year)/6 years + (0.026 [1 to 2 years] x 2 years)/6 years + (0.01 [3 to 5 years] x 3 years)/6 years = 0.016

Adult and child factors were calculated as the ratios of the adult and child time-weighted intakes over the mean "total" beef intake as follows:

Adult factor: 0.011/0.01 = 1.1
Child factor: 0.016/0.01 = 1.6

Finally, adult and child game intake rates were calculated as the product of the overall game IRs for the total (representing recreational hunter receptor populations) and Native American populations (0.0236 and 0.0022 g/kg/day as consumed, respectively) and the adult and child factors. Adult- and child-specific game intake rates calculated in this manner are presented below:

	Adult	Child
Recreational hunter/fisher	0.026	0.0378
Native American	0.0024	0.0035

In order to reflect the potentially higher IRs of subsistence lifestyle receptors, as compared with recreational hunters, the wild game IRs for subsistence lifestyle receptors under RME conditions are based on the 99th percentile. The calculation of the RME wild game IR for adult and child subsistence lifestyle receptors is presented below.

Adult (based on 99th percentile values for Table 11-6):

$$\frac{0.098\ (20\text{ to }39\text{ years old})\ \times\ 20\text{ years}}{50\text{ years}} + \frac{0.462\ (40\text{ to }69\text{ years old})\ \times\ 30\text{ years}}{50\text{ years}} = 0.32$$

Child:

$$\frac{1.113\ (<1\text{ years old})\ \times\ 1\text{ year}}{3\text{ years}} + \frac{0.692\ (1\text{ to }2\text{ years old})\ \times\ 2\text{ years}}{3\text{ years}} = 0.83$$

Note: all intakes are in units of g/kg/day as consumed.

19 It was assumed that recreational hunter and subsistence lifestyle receptors ingested offal from wild game as described for ingestion of offal from beef cattle (see footnote 10). Native American receptors were assumed to ingest offal at an IR equal to 10 percent of the estimated skeletal muscle IR based on Harris and Harper (1997).

20 Appendix I of Montgomery Watson's "Interim Investigation Data Report" indicates that about 29 percent of elk in Idaho Game Management Units (GMU) 66A and 76 (representing much of the Resource Area) from which skeletal muscle and liver tissue samples were collected contained elevated tissue selenium concentrations (MW 2000). Therefore, it was assumed that recreational and Native American hunters will hunt throughout Idaho GMUs 66A and 76 and will have an approximately 29 percent chance of encountering and taking an elk with elevated selenium concentrations. Therefore, a FI_{wg} value of 0.29 was assigned to these two receptor groups. Subsistence lifestyle receptors may be attracted to some of the same features of habitat and access that attract recreational hunters from the general population. Therefore, in order to account for the similarities between hunting habits of the three receptor groups, an FI_{wg} of 0.58 was used to represent a higher potential exposure to contaminated elk for the subsistence lifestyle receptor.

21 It was assumed that receptors may be exposed on or near waste rock piles engaged in hunting large game (such as elk and deer). Receptors are assumed to hunt by tracking on foot or using all-terrain vehicles (ATV). The activity level of receptors hunting in this manner is expected to be moderate. Therefore, inhalation rates associated with moderate activity rates (see Table 5-23 from EPA 1997d) were selected to represent RME conditions.

22 Elders of the Shoshone Bannock Tribe indicate that the Native American community drinks teas brewed from plants that grow in riparian areas along streams in the Resource Area. Plants used in the teas include sage and red willow, which are present for several weeks in the spring. It was assumed that sufficient plant material is gathered to produce teas outside of the growing period. Therefore, an exposure frequency of 365 days/year was used.

23 Based on review of Idaho's "2000 Big Game Rules" (www2.state.id.us/fishgame/common/regulations/regulations.htm), hunting seasons for elk and deer in GMUs 66A and 76 generally run from about August 30 through December. Assuming that snow cover is present from about mid-November, this leaves about 11 weeks of hunting. It was assumed recreational hunters and Native American receptors would hunt one day per week for about 50 percent of the available weeks, 6 days/year in these GMUs. The subsistence lifestyle is assumed to hunt closer to home and possibly more often. Therefore, the subsistence lifestyle receptor was assumed to hunt about 2 days per week over about 75 percent of the available weeks, 17 days/year.

24 Fish, game, beef, and plant IRs are all daily rates averaged over an entire year (365 days). The exposure frequency for soil ingestion (350 days/year) is based on EPA's "Risk Assessment Guidance for Superfund." (EPA 1989).

25 Exposure durations were obtained from EPA (1991).

26 Hunters were assumed to spend approximately 8 hours/day hunting large game by tracking on foot or using ATVs on or near waste rock piles.

27 The averaging time for noncarcinogens reflect exposure durations of 6 and 30 years for child and adult receptors, respectively: 6 years x 365 days/year = 2,190 days and 30 years x 365 days/year = 10,950 days (EPA 1989). The averaging time for carcinogens reflects a 70-year lifetime: 70 years x 365 days/year = 25,550 days.

28 Default PEF from EPA Region 9 "Preliminary Remediation Goals" (EPA 2000d).

TABLE 6-2

HUMAN HEALTH EXPOSURE PARAMETER VALUES
CENTRAL TENDENCY EXPOSURE SCENARIO

Parameter	Recreational Hunter/Fisher		Native American		Subsistence Lifestyle		Notes
	Adult	Child	Adult	Child	Adult	Child	
Exposure Point Concentration in Aquatic and Terrestrial Plants (EPC_{ap}/EPC_{tp}) (mg/kg)	NA	NA	Tier-specific	Tier-specific	Tier-specific	Tier-specific	1
Exposure Point Concentration in Aquatic Life (EPC_{al}) (mg/kg)	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	2
Exposure Point Concentration in Surface Water (EPC_{SW}) (mg/L)	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	Tier-specific	2
Exposure Point Concentration in Cattle and Wild Game - Skeletal Muscle and Offal ($EPC_{c/wg}$) (mg/kg)	Mean	Mean	Mean	Mean	Mean	Mean	3
Exposure Point Concentration in Plant-Based Tea (EPC_{pt}) (mg/L)	NA	NA	Tier-specific	Tier-specific	NA	NA	4
Exposure Point Concentration in Soil (EPC_s) (mg/kg)	Mean	Mean	NA	NA	Mean	Mean	5
Terrestrial Plant Ingestion Rate (IR_{tp}) (kg[DW]/kg/day)	NA	NA	Plant-specific[6]	Plant-specific[6]	Plant-specific[7]	Plant-specific[7]	6,7
Aquatic Plant Ingestion Rate (IR_{ap}) (kg[DW]/kg/day)	NA	NA	Plant-specific[6]	Plant-specific[6]	NA	NA	6
Plant-based Tea Ingestion Rate (IR_{pt}) (L/day)	NA	NA	0.144	0.017	NA	NA	8
Cattle Ingestion Rate – Skeletal Muscle (IR_{sm}) (g/kg/day)	0.72	1.34	0.87	1.61	0.72	1.34	9
Cattle Ingestion Rate – Offal (IR_o) (g/kg/day)	0.044	0.21	0.087	0.16	0.044	0.21	10
Aquatic Life Ingestion Rate (IR_{al}) (g/day)	8	2.9	12	4.3	70	25.2	11
Surface Water Ingestion Rate (IR_{SW}) (L/day)	1.41	0.74	1.41	0.74	1.41	0.74	12
Soil Ingestion Rate (IR_s) (mg/day)	NA	NA	NA	NA	50	100	13
Fraction Plant Ingested (FI_{PT}) (unitless)	NA	NA	0.125	0.125	0.75	0.75	14
Fraction Cattle Ingested (FI) (unitless)	0.051	0.051	0.051	0.051	0.051	0.051	15
Fraction Aquatic Life Ingested (FI_{al}) (unitless)	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	Stream- and watershed-specific	16
Fraction Soil Ingested (FI_s) (unitless)	NA	NA	NA	NA	1	1	17
Wild Game Ingestion Rate – Skeletal Muscle (IR_{wg}) (g/kg/day)	0.011	0.016	0.001	0.0016	0.011	0.016	18

TABLE 6-2

HUMAN HEALTH EXPOSURE PARAMETER VALUES
CENTRAL TENDENCY EXPOSURE SCENARIO

Parameter	Recreational Hunter/Fisher		Native American		Subsistence Lifestyle		Notes
	Adult	Child	Adult	Child	Adult	Child	
Wild Game Ingestion Rate – Offal (IR_{wgo}) (g/kg/day)	4.85E-03	1.80E-03	1.0E-04	1.6E-04	4.85E-03	1.80E-03	19
Fraction Wild Game Ingestion (FI_{wg}) (unitless)	0.29	0.29	0.29	0.29	0.29	0.29	20
Inhalation Rate (InR) (m^3/hr)	1.6	1.2	1.6	1.2	1.6	1.2	21
Exposure Frequency Plant-Based Tea (EF_{pt}) (days/year)	NA	NA	45	45	NA	NA	22
Exposure Frequency-Particulates (EF_p) (days/year)	3	3	3	3	8	8	23
Exposure Frequency (EF) (days/year)	365	365	365	365	365 (350)	365 (350)	24
Exposure Duration (ED) (years)	9	6	9	6	9	6	25
Exposure Time (ET) (hours/day)	4	4	4	4	4	4	26
Conversion Factor1 (CF1) (kg/g)	0.001	0.001	0.001	0.001	0.001	0.001	
Conversion Factor 2 (CF2) (kg/mg)	NA	NA	NA	NA	1E-06	1E-06	--
Body Weight (BW) (kg)	70	15	70	15	70	15	--
Averaging Time for Noncarcinogens (AT_{non}) (days)	3,285	2,190	3,285	2,190	3,285	2,190	27
Averaging Time for Carcinogens (AT_{carc}) (days)	25,550	25,550	25,550	25,550	25,550	25,550	27
Particulate Emission Factor (PEF) (m^3/kg)	1.31E+09	1.31E+09	1.31E+09	1.31E+09	1.31E+09	1.31E+09	28

Notes:

AT	Averaging time
BW	Body weight
CF	Conversion factor
ED	Exposure duration
EF	Exposure frequency
EPC	Exposure point concentration
ET	Exposure time
FI	Fraction ingested
g/day	Gram per day
g/kg/day	Gram per kilogram per day
InR	Inhalation rate
IR	Ingestion rate
kg	Kilogram
kg[DW]/kg/day	Kilogram dry weight per kilogram per day
kg/g	Kilogram per gram
kg/mg	Kilogram per milligram
L/day	Liter per day
m^3/hr	Cubic meter per hour
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
NA	Not applicable
PEF	Particulate emission factor

1 The only aquatic plant evaluated in the Area Wide Human Health Risk Assessment (AWHHRA) is the watercress (*Nasturium officinale*). The exposure point concentration (EPC) of each chemical of potential concern (COPC) in watercress was calculated from the analytical results from watercress samples collected in the Resource Area. Under Tier 2, EPCs were calculated on a watershed-specific basis if sufficient samples were collected (if not, the EPC was calculated based on all available watercress samples) based on procedures recommended in U.S. Environmental Protection Agency's (EPA) guidance titled "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992). The mean value was used as the EPC. Under Tier 3, EPCs were calculated as the mean on a stream-specific basis following the same guidance used under Tier 2.

COPC-specific EPCs in terrestrial plants were calculated following the procedures recommended in EPA's "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities" (EPA 1998b). Terrestrial plants are divided into three categories for consideration in the AWHHRA: exposed aboveground produce, protected aboveground produce, and belowground produce. Equations used to calculated EPCs are presented below:

EXPOSED AND PROTECTED ABOVEGROUND PRODUCE

$$Pr = Cs \times Br_{ag}$$

BELOWGROUND PRODUCE

$$Pr = Cs \times Br_{bg}$$

where

Pr	=	Concentration of COPC in produce due to root uptake (milligram per kilogram [mg/kg])
Cs	=	Average soil concentration over exposure duration (mg COPC/kg soil) (calculated as 95 percent upper confidence limit (UCL_{95}) consistent with EPA (1992))
Br_{ag}	=	Plant-soil bioconcentration factor for aboveground produce (unitless) (Baes and others 1984)
Br_{bg}	=	Plant-soil bioconcentration factor for belowground produce (unitless) (Baes and others 1984)

Under Tier 2, EPCs for homegrown produce were calculated as the mean on a stream-specific basis according to the procedures recommended in EPA's guidance titled "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992).

2 Under Tier 2, EPCs (wet weight) were calculated as a weighted average based on stream-specific productivity for each watershed for which fish fillet samples have been collected. Under Tier 3, EPCs were calculated as mean values on a on a stream-specific basis according to the procedures recommended in EPA's "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992). Also see Section 6.1.

Under Tier 2, EPCs for surface water were calculated as mean values on a stream-specific basis according to EPA's guidance titled "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992).

3 EPCs in cattle (beef skeletal muscle and liver) and wild game (elk skeletal muscle and liver) grazing or living in the Resource Area were calculated based on the tissue-specific analytical results presented in the "1999 Interim Investigation Data Report" (MW 2000). Under Tier 2, COPC-specific EPCs were calculated as mean values in accordance with EPA-recommended procedures (EPA 1992). It should be noted that the beef skeletal muscle and liver values used to calculate EPCs are from tissue samples that have undergone depuration and that steers were artificially penned in on a seleniferous pasture. Also see Section 6.1.

4 EPCs for plants used by Native American populations to make tea (sage and red willow) were calculated based on plant-specific tissue sample analytical results or COPC-specific soil concentrations using soil-plant bioconcentration factors as described in footnote 1 for aboveground plants. Under Tier 2, EPCs were calculated based on all available sage and red willow samples based on procedures recommended in EPA's "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992). Under Tier 3, EPC's were calculated as mean values on a stream-specific basis following the same guidance used under Tier 2. For streams without sage or red willow samples, plant tissue EPCs were based on the COPC-specific soil concentrations calculated in accordance with EPA's "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992).

The EPCs in plant-based teas were calculated based on plant tissue EPCs calculated in the manner described above, using the following methodology. No direct information is available regarding the metal content of infusions ("teas") produced from native plants of southeastern Idaho. Several general studies of foodstuffs, such as Ministry of Agriculture, Food, and Fisheries (MAFF) (1998) and U.S. Food and Drug Administration (FDA) (2001) give some information on the intake of metals from beverages including teas. However, while providing data on the concentration of metals in infusions, neither study provides data on the concentration of metals in dry tea. Therefore, estimates of the transfer of metals from dry tea into water cannot be estimated.

However, evidence exists that infusions made from tea (*Camellia sinensis*) known to take up aluminum contain elevated levels of aluminum, especially compared with other beverages (MAFF 1998). Therefore, while data is scarce, it is reasonable to assume that a fraction of the metals present in plant material will be transferred into an infusion made from that material. The primary mechanism for uptake of metals in soil by plants is diffusion (sometimes modified by chelation, precipitation, and other processes). As a first approximation, the plant-soil bioconcentration factor for forage (Br_{forage}) as defined in EPA (1998b) was used to estimate the fraction of metals in plant material that is dissolved in an infusion.

A review of commercial teas indicates that about 2.2 grams (g) of team are required to produce one 6-ounce (177.4 milliliter [ml]) cup of tea. The amount of material necessary to produce one liter (L) of tea can be estimated as:

2.2 g of tea/177.4 ml tea = x g of tea/1,000 ml; x = 12.4 g tea

It is assumed that the same amount of native material (12.4 g) is required to produce one liter of tea. The concentration of each COPC in teas produced from native materials can be estimated as:

mg COPC/kg native material x 0.0124 kg native material x Br_{forage} = mg COPC/kg infusion = mg COPC/L infusion (assuming the density of the infusion equals 1 kg/1 L)

Also see Section 6.1.

5 Under Tier 2, soil EPCs were calculated as mean values on a riparian area-specific basis in accordance with EPA's "Supplemental Guidance to RAGs: Calculating the Concentration Term" (EPA 1992) (also see Section 6.1).

6 Because no information was identified regarding Native American-specific ingestion rates (IR) for watercress (*Nasturium officinale*), wild onion (*Allium canadense*), and wild carrot (*Daucus carota*), IR_{tp} for wild onion and wild carrot, and IR_{ap} for watercress were calculated for Native American adult and child receptors based on information contained in EPA's "Exposure Factors Handbook" (EPA 1997d). Specifically, Table 9-13 presents mean per capita intake rates for various raw agricultural commodities. Using green onion to represent wild onion, it can be shown that both green onion and watercress represent less than 0.1 percent of the total daily intake of vegetables (calculated by summing all vegetable-specific intakes from Table 9-13) – green onion represents about 0.07 percent and watercress represents about 0.01 percent. To represent the central tendency exposure (CTE) scenario, it was assumed that both wild onion and watercress were consumed at a rate equal to 0.1 percent of the total vegetable intake of Native Americans. The total CTE intake of vegetables by Native Americans was estimated as 3.1 grams/kilogram/day (g/kg/day) as consumed, by summing the mean intakes of exposed, protected, and root vegetables for Native Americans (Tables 9-9, 9-10, and 9-11, respectively).

Therefore, the intake of both wild onion and watercress was estimated as follows:

0.001 x 3.1 g/kg/day as consumed = 3.1E-03 g/kg/day as consumed

In order to convert from WW (as consumed) to dry weight (DW), this value was multiplied by (100 – percent water)/100 = 0.10; assuming both wild onion and watercress are about 90 percent water (see Table 9-27). Therefore,

3.1E-03 g/kg/day as consumed x 0.10 x 1 kg/1000g = 3.1E-07 kg [DW]/kg/day

Adult and child IRs for wild carrot are assumed to equal those for wild onion.

7 The adult- and child-specific IRs for exposed aboveground, protected aboveground, and belowground (root) vegetables were adopted from EPA's "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities" (EPA 1998b) and are presented below. Note: all intake rates are presented in units of kg[DW]/kg/day.

	Adult	Child
Exposed aboveground produce (Cr_{ag})	0.0003	0.00042
Protected aboveground produce (Cr_{pp})	0.00057	0.00077
Belowground produce (Cr_{bg})	0.00014	0.00022

8 EPA's "Exposure Factors Handbook" presents several tables that provide various estimates, including mean values, for daily intake of tea (EPA 1997d). Table 3-14 presents the results of a study of beverage intake in Great Britain (Hopkins and Ellis 1980). Table 3-21 presents results collected as part of the U.S. Department of Agriculture's (USDA) "Food and Nutrient Intakes by Individuals in the U.S" (USDA 1995). Table 3-26 presents the results of a study of total fluid intake derived from various sources by women aged 15 to 49 years old (Ershow and others 1991). Study-specific tea intake estimates are presented below.

- Hopkins and Ellis (1980): mean tea intake (0.584 L/day); UCL_{95} of the mean (0.608 L/day)
- USDA (1995): mean tea intake – all individuals (0.114 L/day); children (age 5 and under) (0.017 L/day); adults (age 20 and over) (0.140 L/day)
- Ershow and others (1991): mean tea intake (control women) (0.148 L/day); 95th percentile (0.630 L/day)

Based on these results, the following conclusions were drawn. First, the results from the study of Great Britain receptors (Hopkins and Ellis 1980) may not be representative of study area receptors because individuals from Great Britain are expected to intake more tea than U.S. receptors. Second, the mean tea intake rates of adults (age 20 and over) and of control women (age 15 to 49) are similar – 0.140 and 0.148 L/day, respectively (USDA 1995 and Ershow and others 1991). Therefore, for the purposes of the AWHHRA, the mean or central tendency exposure (CTE) tea intake value for adults was estimated as the mean of these two values or 0.144 L/day (about 4 ounces [0.118 L] per day). Similarly, the mean or CTE child tea intake rate was estimated to be 0.017 L/day, based on the mean value for children 5 years and under from USDA (1995).

9 Table 11-3 from EPA's "Exposure Factors Handbook" presents per capita intake of beef (EPA 1997d). For the purposes of characterizing the CTE scenario, it was assumed that receptors ingested beef at a rate equal to the mean for the "total" population. Therefore, the CTE IRs for recreational hunter and fisher and subsistence lifestyle receptors were estimated to be 0.825 g/kg/day as consumed (total or general population). Similarly, the beef IR for Native American receptors was estimated to be 0.995 g/kg/day as consumed.

Both the total or general population -and Native American-specific IRs are average intake rates across all age groups. In order to distinguish between adult and child intake rates, the overall intake rates (2.3 and 2.8 g/kg/day as consumed, respectively) were adjusted using factors specific to adults and children. These factors were calculated as ratios of time-weighted mean intake rates for adults age 20 through 69 and children less than 6 years old each over the total mean intake rate for beef (0.825 g/kg/day as consumed) for the "total" population as shown below.

Adult time-weighted intake (see age range-specific intake rates in Table 11-3):

(0.789 [20 to 39 years] x 20 years)/ 50 years + (0.667 [40 to 69 years] x 30 years)/50 years = 0.7158

Child time-weighted intake:

(0.941[<1 year] x 1 year)/6 years + (1.46 [1 to 2 years] x 2 years)/6 years + (1.392 [3 to 5 years] x 3 years)/6 years = 1.34

While time-weighted averages can be computed directly for the recreational and subsistence lifestyle receptors, information for Native Americans is presented in EPA's "Exposure Factors Handbook" for only the overall population. It is not broken out for adults and children; therefore, adult and child Native American beef ingestion values must be calculated using adult and child factors.

Adult and child factors were calculated as the ratios of the adult and child time-weighted intakes over the mean "total" beef intake as follows:

Adult factor: 0.7158/0.825	=	0.87
Child factor: 1.34/0.825	=	1.62

Finally, adult and child beef intake rates were calculated as the product of the mean beef IR for the Native Americans (0.995 g/kg/day) and the adult and child factors:

Adult beef IR: 0.995 x 0.87	=	0.87 g/kg/day as consumed
Child beef IR: 0.995 x 1.62	=	1.61 g/kg/day as consumed

Therefore, adult and child IRs for beef skeletal muscle are summarized below. Note: all intakes are in units of g/kg/day as consumed.

	Adult	Child
Recreational hunter/fisher	0.72	1.34
Subsistence lifestyle	0.72	1.34
Native American	0.87	1.61

10 EPA's "Exposure Factors Handbook" clarifies that ingestion of organ meats and sausages (and presumably offal in general) are not included in the meat-specific IRs presented (see Table 11-3)(EPA 1997d). Therefore, intakes of beef should be summed with intakes of organ meats, sausages, and offal in general. For the purposes of the AWHHRA, it was conservatively assumed that recreational hunter and subsistence lifestyle receptors would, over the course of one year, ingest a mass of beef tissue other than skeletal muscle equivalent to 25 percent of one beef liver (about 2.5 pounds). Therefore, IRs for adult and child receptors were calculated as follows:

Adult receptor:	2.5 pounds x (1 kg/2.2 pounds) x 1000 g/kg x 1/70 kg x 1/365 days	=	0.044 g/kg/day
Child receptor	2.5 pounds x (1 kg/2.2 pounds) x 1000 g/kg x 1/15 kg x 1/365 days	=	0.21 g/kg/day

The COPC concentrations in these other beef tissues was estimated using liver concentrations.

For the purposes of evaluating subsistence lifestyle and Native American receptors, it was assumed that these receptors ingested beef tissue other than skeletal muscle at a rate equal to about 10 percent of the skeletal muscle IR based on the work of Harris and Harper (1997). These investigators noted that Native Americans ate more parts of fish and animals than just the fillet or steak. They recommended using a place holder value of 10 percent of the

total fish IR (assumed to be 540 g/day for members of the Confederated Tribes of the Umatilla Indian Reservation) to represent "other organs" (Harris and Harper 1997). For the purposes of the AWHHRA, this 10 percent value was used to represent each of the meat types evaluated in the risk assessment. Therefore, both adult and child subsistence lifestyle and Native American receptors are assumed to ingest beef tissue other than skeletal muscle at a rate equal to about 10 percent of the skeletal muscle IR. The concentration of selenium in these other beef tissues was estimated using liver concentrations.

11 The IR for aquatic life for recreational hunters/fishers was identified as 8 g/day based on the EPA-recommended mean IR for recreational anglers (EPA 1997d). EPA's "Exposure Factors Handbook" also discusses several studies of Native American populations indicating that IRs for Native American populations can be estimated as being from similar to about 100 percent higher than for the general population (West and others 1989; Ebert and others 1993; Peterson and others 1994; Fiore and others 1989; and Fitzgerald and others 1995). Based on best professional judgment, it was assumed that the IR of aquatic life for Native American adults was 50 percent higher than for recreational hunters and fishers, or 12 g/day. Finally, the IR for subsistence lifestyle adults was assumed to be equal to the EPA-recommended Native American subsistence IR of 70 g/day (EPA 1997d).

In order to determine receptor-specific child aquatic life IRs, the adult rates were multiplied by a factor calculated as the ratio of child (0 to 9 years old) to adult (greater than or equal to 20 years old) total fish consumption rates (see Table 10-1 in EPA 1997d). The ratio was calculated as: (16.5 g/day)/(46.3 g/day) = 0.36.

Therefore, the receptor-specific aquatic life IRs were calculated as:

Recreational hunter/fisher child:	8 g/day x 0.36	=	2.9 g/day
Native American child:	12 g/day x 0.36	=	4.3 g/day
Subsistence lifestyle child:	70 g/day x 0.36	=	25.2 g/day

It should be noted that these adult and child fish IRs are considered to represent caps on the amount of fish ingested by each receptor. The rates presented were used in Tier 1 of the tiered approach. However, for the purpose of evaluating ingestion of fish across a watershed (see Tier 2 of the tiered approach), an evaluation was made regarding the ability of streams from a given watershed to support chronic intake of fish. To the extent that a watershed was determined to be unable to support chronic fish ingestion, the CTE fish IRs were adjusted downwards. Under Step 3 of the tiered approach, a similar process was conducted on a stream-specific basis.

12 Receptor-specific tapwater IRs were used to represent the amount of surface water ingested. It was assumed that for each recreational day, the receptor would ingest water only from streams in the Resource Area. This assumption may be conservative for receptors engaged in day-trips; however, the assumption is expected to accurately represent receptors engaged in overnight camping in the Resource Area.

13 Based on EPA's "Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure" (EPA 1993a) and "Exposure Factors Handbook" (EPA 1997d).

14 It was assumed that the recreational hunter/fisher did not ingest plants growing in the Resource Area. It was assumed that the subsistence lifestyle receptor ingests only produce (plants) grown in home gardens located on contaminated floodplains (riparian areas) along streams in the Resource Area. The fraction ingested (FI) value for the subsistence lifestyle receptor was calculated on two primary factors: (1) length of the growing season and (2) size of the home garden.

The study area can be divided into "warmer" counties such as Bannock, Franklin, and Oneida and "cooler" such as Bear Lake and Caribou. The growing season for the warmer counties is estimated to be about 110 to 120 days and in cooler counties is estimated to be about 90 to 100 days (TtEMI 2002a). In cooler counties, the cooler nighttime temperatures can slow the growth of warmer-season plants. As a result, plants such as corn, tomatoes, and warm season squashes may not grow well in counties such as Bear Lake and Caribou. However, plants such as beans, beets, carrots, peas, potatoes, and spinach can be raised without significant difficulty in these cooler counties (TtEMI 2002a). Many of the stream segments potentially impacted by mining are located at some of the higher elevations in Bear Lake and Caribou counties. It is expected that growing seasons along these streams would be among the shortest in the cooler counties. Therefore, a fraction plant ingested value was estimated as 0.75 based on the ratio of the shortest estimate of growing season in cooler counties (90 days) to the longest estimate of growing season in warmer counties (120 days). Based on review of the locations at which flood plain soil samples have been collected, this fraction plant ingested value may be further reduced if it is judged that insufficient growing space is available in a stream-specific flood plain.

With regard to the fraction of wild onion, wild carrot, and watercress ingested by Native American receptors, it is acknowledged that the 14 active and former mine sites in the study area have a cumulative area equal to about 5 percent of the total study area (60 square miles for the mine sites [see Drawing 1-1 from MW 2000])/(1,200 square miles for the study area [MW 1999b]). However, based on the proposed ingestion rates (IR) for wild onion and watercress, it is estimated that Native American receptors would only need to gather about five or six plants to meet the total estimated mass of each species ingested over 1 year (Note: wild onion example -- 0.0107 g/kg BW – day x 70 kg BW x 365 days = 27.3 g wild onion as consumed per year). It is reasonable to believe that a Native American receptor could gather five or six plants of each species on a single trip. Samples of wild onion and watercress of sufficient volume to meet annual ingestion requirements were collected from various sampling locations in the study area. Receptors would be expected to return to known locations of these plants. However, there are certainly other sources of wild onion and watercress (and also wild carrot) besides locations in the study area potentially impacted by mine releases. Therefore, it was assumed that Native American receptors gather wild onion, watercress, and wild carrot from locations potentially impacted by mine releases in the study area about every fourth year. This equates to a fraction ingested of 0.25 under RME conditions. The FI under CTE conditions was assumed to be one-half of the RME value.

15 The mean estimate of the variable $F_{beef, site}$, 0.051, was adopted from the "Final 1998 Regional Investigation Report" (MW 1999, 2001).

16 A FI value of 1 was used unless otherwise documented in the text.

17 Subsistence receptors may be exposed both at their home and throughout the Resource Area. To assess potential exposure at their homes, a fraction ingested value of 1 was assumed in order to allow health-protective consideration of homebound individuals such as the elderly and young children. Potential exposure through soil ingestion to subsistence lifestyle, recreational, and Native American receptors associated with activities that may require receptors to move beyond the mine-affected areas (such as hunting, fishing, and gathering), exposure through soil ingestion is expected to be insignificant and was not quantified.

18 Table 11-6 in EPA's "Exposure Factors Handbook" presents per capita game intake rates (g/kg/day as consumed) for various ethnicities including Native American. It was judged that a mean IR was appropriate for evaluating the CTE case. Recreational hunter and subsistence lifestyle receptors were represented by the "total" or general population mean IR of 0.01 g/kg/day as consumed and Native American receptors were represented by the "Native American" mean IR of 0.001.

In order to distinguish between adult and child intake rates, the overall intake rates (0.01 and 0.001 g/kg/day as consumed, respectively) were adjusted using factors specific to adults and children. These factors were calculated as ratios of time-weighted mean intake rates for adults age 20 through 69 and children less than 6 years old each over the mean game intake rates (see Table 11-6) as detailed below.

Adult time-weighted intake (see age range-specific intake rates in Table 11-6):

(0.01 [20 to 39 years] x 20 years)/ 50 years + (0.012 [40 to 69 years] x 30 years)/50 years = 0.011

Child time-weighted intake:

(0.014[<1 year] x 1 year)/6 years + (0.026 [1 to 2 years] x 2 years)/6 years + (0.01 [3 to 5 years] x 3 years)/6 years = 0.016

Adult and child factors were calculated as the ratios of the adult and child time-weighted intakes over the mean "total" beef intake as follows:

Adult factor: 0.011/0.01 = 1.1
Child factor: 0.016/0.01 = 1.6

Finally, adult and child game intake rates were calculated as the product of the overall game IRs for the total (representing recreational and subsistence lifestyle receptor populations) and Native American populations (0.01 and 0.001 g/kg/day as consumed, respectively) and the adult and child factors:

Adult- and child-specific game intake rates calculated in this manner are presented below:

	Adult	Child
Recreational hunter/fisher	0.011	0.016
Subsistence lifestyle	0.011	0.016
Native American	0.0011	0.0016

Note: all intakes are in units of g/kg/day as consumed.

19 It was assumed that recreational hunter and subsistence lifestyle receptors ingested offal from wild game at the same ratio to wild game skeletal muscle in the same offal to skeletal muscle proportion identified for beef cattle. Native American receptors were assumed to ingest offal at an IR equal to 10 percent of the estimated skeletal muscle IR based on Harris and Harper (1997).

TABLE 6-2

HUMAN HEALTH EXPOSURE PARAMETER VALUES
CENTRAL TENDENCY EXPOSURE SCENARIO

20 Appendix I of Montgomery Watson's "Interim Investigation Data Report" indicates that about 29 percent of elk in Idaho Game Management Units (GMU) 66A and 76 (representing much of the Resource Area) from which skeletal muscle and liver tissue samples were collected contained elevated tissue selenium concentrations. Therefore, it was assumed that recreational and Native American hunters will hunt throughout Idaho GMU 76 and will have an approximately 29 percent chance of encountering and taking an elk with elevated selenium concentrations. Therefore, a FI_{wg} value of 0.29 was assigned to these two receptor groups. Subsistence lifestyle receptors may be attracted to some of the same features of habitat and access that attract recreational hunters from the general population. Therefore, in order to account for the potential similarities between hunting habits of the three receptor groups, an FI_{wg} of 0.29 was also used to represent the subsistence lifestyle receptor.

21 It was assumed that receptors potentially exposed while hunting large game by tracking on foot or using all-terrain vehicles (ATV) would have moderate activity levels. Therefore, inhalation rates associated with a moderate activity level were selected to represent CTE conditions (see Table 5-23 from EPA 1997d).

22 Elders of the Shoshone Bannock Tribe indicate that the Native American community drinks teas brewed from plants that grow in riparian areas along streams in the Resource Area. The plants used in the teas include sage and red willow which are present for several weeks in the spring. It was assumed that sufficient plant material is gathered to produce teas over a 3-month period (about mid-April through mid-July) or 91 days/year under RME conditions. The EF_{pt} value was assumed to be one-half the RME value or 45 days/year under CTE conditions.

23 It was assumed that hunters would be exposed about one-half as often under CTE conditions as was assumed under RME conditions.

24 Fish, game, beef, and plant IRs are all daily rates averaged over an entire year (365 days). The exposure frequency for soil ingestion (350 days/year)is based on EPA's "Risk Assessment Guidance for Superfund" (EPA 1989).

25 Exposure durations were obtained from EPA (1991).

26 Hunters were assumed to spend approximately 4 hours/day hunting large game from blinds located near waste rock piles.

27 The averaging time for noncarcinogens reflect exposure durations of 6 and 30 years for child and adult receptors, respectively: 6 years x 365 days/year = 2,190 days and 30 years x 365 days/year = 10,950 days (EPA 1989). The averaging time for carcinogens reflects a 70-year lifetime: 70 years x 365 days/year = 25,550 days.

28 Default particulate emission factor (PEF) from EPA Region 9 "Preliminary Remediation Goals" (EPA 2000d).

TABLE 6-3

MEDIUM-SPECIFIC SUMMARY OF SAMPLES CONSIDERED QUANTITATIVELY

(Page 1 of 3)

Stream or Stream-specific Riparian Area [1]	Fish Tissue Samples[4]		Plant Tissue Samples				Soil Samples[2]	Insect Samples	Surface Water Samples		Sediment Samples	
			Aquatic		Terrestrial							
	TtEMI[2]	MW[3]	TtEMI[2]	MW[2]	TtEMI[2]	MW[2]			TtEMI[2]	MW[2]	TtEMI[2]	MW[2]
Little Blackfoot River (I)	---	---	---	---	---	---	---	---	5	31	---	12
State Land Creek (I)	---	---	---	---	---	---	---	---	3	---	1	---
Trail Creek (I)	---	---	---	---	---	---	---	---	3	6	---	3
Goodheart Creek (I)	---	---	---	---	---	---	---	---	2	---	1	---
Wooley Valley Creek (I)	---	---	---	---	---	---	---	---	3	---	---	---
Blackfoot River (I)	---	3	---	---	3	---	3	---	11	40	3	11
Angus Creek (I)	---	---	---	---	---	---	---	---	2	---	---	1
Middle Angus Creek (I)	---	---	---	---	---	---	---	---	4	---	---	---
No Name Creek (I, B)	---	---	---	---	3	---	3	---	6	1	2	1
Rasmussen Creek (I)	---	---	---	---	2	---	2	---	3	4	---	2
Spring Creek (I, B)	4	---	4	---	---	---	---	2	8	---	3	---
East Mill Creek (I)	1	3	2	---	2	---	2	1	8	3	3	1
Smoky Creek (I, B)	---	---	---	---	---	---	---	---	6	6	1	3

TABLE 6-3

MEDIUM-SPECIFIC SUMMARY OF SAMPLES CONSIDERED QUANTITATIVELY

(Page 2 of 3)

Stream or Stream-specific Riparian Area [1]	Fish Tissue Samples[4]		Plant Tissue Samples				Soil Samples[2]	Insect Samples	Surface Water Samples		Sediment Samples	
			Aquatic		Terrestrial							
	TtEMI[2]	MW[3]	TtEMI[2]	MW[2]	TtEMI[2]	MW[2]			TtEMI[2]	MW[2]	TtEMI[2]	MW[2]
South Fork Sage Creek (I)	---	3	---	---	---	---	---	---	4	3	1	2
Sage Creek (I, B)	1	---	3	---	---	---	---	1	10	8	3	4
Deer Creek (I)	---	---	---	---	---	---	---	---	3	1	1	1
Montpelier Creek (I, B)	---	---	---	---	---	---	---	---	6	---	2	---
Georgetown Creek (I)	---	---	---	---	---	---	---	---	3	5	1	3
Caldwell Creek (B)	---	---	---	---	---	---	---	---	4	8	1	3
Slug Creek (B)	---	---	---	---	---	---	---	---	3	6	1	3
Diamond Creek (B)	---	---	---	---	1	---	1	---	3	4	1	2
Sheep Creek (B)	---	---	---	---	---	---	---	---	3	6	1	3
Crow Creek (B)	---	---	---	---	---	---	---	---	3	---	1	---
Maybe Creek (I)	---	---	---	---	---	---	---	1	1	---	1	---
Kendall Creek (B)	1	---	1	---	---	---	---	1	1	---	1	---
Grizzly Creek (I)	---	---	---	---	---	---	---	---	---	2	---	1
Dry Valley Creek (I)	---	---	---	---	---	---	---	---	---	10	---	1

TABLE 6-3

MEDIUM-SPECIFIC SUMMARY OF SAMPLES CONSIDERED QUANTITATIVELY

(Page 3 of 3)

Stream or Stream-specific Riparian Area [1]	Fish Tissue Samples[4]		Plant Tissue Samples				Soil Samples[2]	Insect Samples	Surface Water Samples		Sediment Samples	
			Aquatic		Terrestrial							
	TtEMI[2]	MW[3]	TtEMI[2]	MW[2]	TtEMI[2]	MW[2]			TtEMI[2]	MW[2]	TtEMI[2]	MW[2]
Lanes Creek (I)	---	---	---	---	---	---	---	---	---	4	---	2
Formation Creek (I)	---	---	---	---	---	---	---	---	---	2	---	---
Right Hand Fork Creek	---	---	---	---	---	---	---	---	---	9	---	3
Portneuf River	---	---	---	---	---	---	---	---	---	8	---	2
Ross Fork	---	---	---	---	---	---	---	---	---	4	---	2
Lincoln Creek	---	---	---	---	---	---	---	---	---	4	---	2

Notes:

B Background
I Investigative
MW Montgomery Watson
TtEMI Tetra Tech EM Inc.

1 The streams and stream-specific riparian areas are organized according to the watershed that the portion of each stream sampled lies within.

2 Tetra Tech EM Inc. (TtEMI). 2001d. "Final Sampling and Analysis Plan." Prepared for Idaho Department of Environmental Quality (IDEQ). May.

3 Montgomery Watson (MW). 1999b. "Final 1998 Regional Investigation Report." December.

4 Number of fish tissue samples analyzed. Some samples consisted of a composite of more than one fish so the number of samples may not be representative of the actual number of fish collected.

TABLE 6-4

METALS ANALYZED AND DETECTION LIMITS FOR SURFACE WATER, SEDIMENT, SOIL, AND TISSUE SAMPLES[1]

(Page 1 of 1)

Analyte	Surface Water (mg/L)	Sediment (mg/g)	Soil (mg/g)	Insect Tissue (mg/g)	Plant Tissue (mg/g)	Fish Tissue (mg/g)
Aluminum	0.050 - 50.0	2 - 20	NA	0.26 - 24.8	0.43 - 3.2	0.94 - 1.3
Antimony	0.20 - 2.50	0.04 - 1.6	1.6	0.04 - 3.6	0.01 - 1.4	0.14 - 0.19
Arsenic	0.50 - 1.00	0.075 - 0.5	0.5	0.05 - 5	0.03 - 1.1	0.19 - 0.27
Barium	3 - 10	0.019 - 0.3	0.18	0.08 - 7.4	0.11 - 0.82	0.41 - 0.58
Beryllium	0.10 - 5	0.019 - 0.08	0.08	0.01 - 0.6	0.004 - 1	0.02 - 0.03
Boron	10 - 25	1 - 2	2	0.07 - 6.2	0.12 - 1.3	0.23 - 0.33
Cadmium	0.10 - 0.20	0.02 - 0.2	0.2	0.01 - 0.6	0.005 - 0.12	0.02 - 0.03
Calcium	20 - 200	NA	NA	3.7 - 351	4.6 - 34.7	13.4 - 18.7
Chromium	0.10 - 0.50	0.075 - 1	0.18	0.04 - 1.2	0.005 - 0.24	0.16 - 0.22
Cobalt	NA	NA	NA	0.03 - 3	0.04 - 0.44	0.11 - 0.16
Copper	0.13 - 50	0.28 - 1	0.28	0.04 - 3.8	0.06 - 10	0.71 - 1.0
Iron	10	NA	NA	0.46 - 43.4	1.1 - 11.2	1.6 - 2.3
Lead	0.10 - 0.25	0.02 - 1.5	1.5	0.03 - 3	0.005 - 3	0.11 - 0.16
Magnesium	5 - 200	NA	NA	2.8 - 259	4.1 - 42	9.8 - 13.8
Manganese	2 - 5	0.1 - 2.2	0.1	0.03 - 2.4	0.04 - 3	0.09 - 0.013
Mercury	0.0002 - 0.50	0.0042 - 0.075	0.0042	0.01 - 0.02	0.01 - 8	0.28 - 0.44
Molybdenum	0.10 - 2.50	1 - 3.8	3.8	0.03 - 2.6	0.005 - 0.48	0.1 - 0.14
Nickel	0.13 - 0.40	0.04 - 0.5	0.5	0.03 - 2.8	0.12 - 5	0.11 - 0.15
Potassium	300 - 500	NA	NA	3.7 - 345	NA	NA
Selenium	1 - 50	0.04 - 5	0.04	0.05 - 4.6	0.04 - 0.95	0.17 - 0.25
Silver	0.05 - 0.25	0.01 - 0.2	0.2	0.03 - 3.2	0.06 - 0.63	0.12 - 0.64
Sodium	300 - 2000	100	100	7.6 - 711	11.7 - 120	26.9 - 37.9
Thallium	0.05 - 2.50	0.01 - 2	2	0.05 - 4.6	0.003 - 1.1	0.17 - 0.25
Uranium	0.05 - 0.10	0.01 - 2	2	NA	0.003 - 0.8	NA
Vanadium	0.05 - 1.00	0.16 - 3.1	0.16	0.04 - 3.6	0.04 - 1	0.42 - 0.6
Zinc	10 - 50	0.14 - 1	0.14	0.03 - 2.8	0.11 - 10	0.15 - 0.21

Notes:

µg/g Microgram per gram
µg/L Microgram per liter
NA Not analyzed

Analytical results from 2001 are presented in Appendix H. Analytical data for fish tissue and surface water samples are presented in MW (1999b).

TABLE 6-5

SUMMARY OF 1998 AND 2001 FISH TISSUE SAMPLES CONSIDERED QUANTITATIVELY

(Page 1 of 1)

Stream	B or I[1]	Watershed	Collected By[2]	Fish Samples Collected[3]
Upper Sage Creek	B	Salt	TtEMI	Cutthroat trout (1) – 5 inches
Lower Sage Creek	I	Salt	TtEMI	Cutthroat trout (3) – 4.5-5.5 inches
South Fork Sage Creek	I	Salt	MW	Brown trout (3) – at least 6 inches long
Kendall Creek	B	Blackfoot	TtEMI	Cutthroat trout (1) – 5.5 inches
Spring Creek above East Mill Creek	B	Blackfoot	TtEMI	Brook trout (3) – 6.0-6.5 inches; sculpin (5) – 1.5-2.5 inches
Spring Creek below East Mill Creek	I	Blackfoot	TtEMI	Cutthroat trout (2) – 4.5-5.5 inches; dace (5) – 2.0-3.0 inches; sculpin (12) – 1.5-3.0 inches
East Mill Creek	I	Blackfoot	TtEMI	Brook trout (1) – 11 inches; cutthroat trout (1) – 6 inches
East Mill Creek	I	Blackfoot	MW	Cutthroat trout (2); brook trout (1) – at least 6 inches long
Blackfoot River	I	Blackfoot	MW	Cutthroat trout (3) – at least 6 inches long

Notes:

[1] Background = B; Impacted = I

[2] Montgomery Watson (MW) samples collected in 1998; Tetra Tech EMI (TtEMI) samples collected in 2001. MW results are presented in "Final 1999 Regional Investigation Report" (MW 1999), and TtEMI results are presented in Appendix H.

[3] Number of fish collected. Some analytical samples consisted of a composite of more than one fish so the number of samples may not be representative of the actual number of fish collected.

TABLE 6-6

SUMMARY OF TIER 1 EXPOSURE POINT CONCENTRATIONS[1]

(Page 1 of 3)

Chemical of Potential Concern	Inhalation of Particulates (mg/kg)	Ingestion of Surface Water (mg/kg)	Ingestion of Elk and Other Wild Game – Skeletal (mg/kg)	Ingestion of Elk and Other Wild Game – Offal (mg/kg)	Ingestion of Beef Cattle – Skeletal (mg/kg)	Ingestion of Beef Cattle – Offal (mg/kg)
Aluminum	--	--	--	--	--	--
Antimony	2.30E+01	--	--	--	--	--
Arsenic	7.70E+01	--	--	--	--	--
Barium	--	--	--	--	--	--
Beryllium	2.10E+00	--	--	--	--	--
Boron	7.60E+01	--	--	--	--	--
Cadmium	1.20E+02	3.10E-04	2.78E-01	1.70E+00	--	5.60E-01
Chromium	1.50E+03	4.60E-03	--	--	--	--
Cobalt	--	--	--	--	--	--
Copper	2.10E+02	--	--	--	--	--
Cyanide	--	--	--	--	--	--
Iron	--	--	--	--	--	--
Lead	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--
Manganese	--	--	--	--	--	--
Mercury	--	--	--	--	--	--
Molybdenum	6.50E+01	--	--	--	--	--
Nickel	4.60E+02	--	--	--	--	--
Selenium	1.50E+03	1.14E+00	9.20E-01	1.30E+01	1.30E+00	9.10E-01
Silver	1.30E+01	--	--	--	--	--
Thallium	--	--	--	--	--	--
Uranium	6.30E+01	--	--	--	--	--
Vanadium	1.20E+03	--	--	--	--	--
Zinc	2.00E+03	--	--	--	--	--

TABLE 6-6

SUMMARY OF TIER 1 EXPOSURE POINT CONCENTRATIONS[1]

(Page 2 of 3)

Chemical of Potential Concern	Ingestion of Aquatic Life (mg/kg WW)	Ingestion of Aquatic Plants (mg/kg)	Ingestion of Surface and Subsurface Soil (mg/kg)	Ingestion of Aboveground Produce (mg/kg)	Ingestion of Belowground Produce (mg/kg)	Ingestion of Terrestrial Vegetation (mg/kg)	Ingestion of Tea (mg/L)
Aluminum	--	4.50E+03	--	**1.48E+00**	**6.44E-01**	**2.28E+00**	**9.82E-02**
Antimony	--	1.00E+00	--	--	--	--	--
Arsenic	--	2.20E+00	2.90E+01	**2.98E-03**	**3.76E-03**	**3.38E-03**	**4.20E-04**
Barium	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--
Boron	--	--	--	--	--	--	--
Cadmium	3.53E-01[2]	1.15E+01	6.30E+01	**5.75E+00**	**2.94E+00**	**4.37E+00**	**4.15E-01**
Chromium	8.46[2]	4.52E+01	9.70E+02	**2.64E-02**	**2.43E-02**	**3.24E-02**	**1.00E-03**
Cobalt	--	2.40E+00	--	**3.11E-03**	**2.52E-03**	**5.04E-03**	**1.79E-04**
Copper	--	1.14E+01	--	--	--	--	--
Cyanide	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--
Lead	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--
Molybdenum	--	--	--	--	--	--	--
Nickel	--	2.39E+01	--	**8.01E-02**	**6.88E-02**	**7.48E-02**	**6.82E-03**
Selenium	7.76[2]	3.94E+01	1.50E+02	**3.51E-01**	**3.96E-01**	**4.32E-01**	**7.14E-03**
Silver	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--
Uranium	--	--	--	**1.47E-02**	**1.28E-02**	**2.02E-02**	--
Vanadium	--	2.44E+01	--	**9.96E-03**	**9.00E-03**	**1.29E-02**	**4.09E-04**
Zinc	--	1.62E+02	--	**5.69E+01**	**3.48E+01**	**9.48E+02**	**4.90E+00**

TABLE 6-6

SUMMARY OF TIER 1 EXPOSURE POINT CONCENTRATIONS[1]

(Page 3 of 3)

Notes:

--	Not detected
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
WW	Wet weight

Bolded results signify that uptake factors (listed in Table 6-21) were applied to the concentration.

1 Concentrations in units of milligram per kilogram (mg/kg) are presented in dry weight with several exceptions. The exceptions include fish tissue, wild game, and beef cattle. Concentrations for these media are presented in wet weight (WW) – see footnote 2.

2 Analytical results reported in units of mg/kg dry weight (DW) were converted to a WW basis using the formula below. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples collected in 2001 by Tetra Tech EMI.

$$\text{Concentration WW} = \text{Concentration DW} \times ([100 - W] / 100)$$

TABLE 6-6

SUMMARY OF TIER 1 EXPOSURE POINT CONCENTRATIONS[1]

(Page 1 of 3)

Chemical of Potential Concern	Inhalation of Particulates (mg/kg)	Ingestion of Surface Water (mg/kg)	Ingestion of Elk and Other Wild Game – Skeletal (mg/kg)	Ingestion of Elk and Other Wild Game – Offal (mg/kg)	Ingestion of Beef Cattle – Skeletal (mg/kg)	Ingestion of Beef Cattle – Offal (mg/kg)
Aluminum	--	--	--	--	--	--
Antimony	2.30E+01	--	--	--	--	--
Arsenic	7.70E+01	--	--	--	--	--
Barium	--	--	--	--	--	--
Beryllium	2.10E+00	--	--	--	--	--
Boron	7.60E+01	--	--	--	--	--
Cadmium	1.20E+02	3.10E-04	2.78E-01	1.70E+00	--	5.60E-01
Chromium	1.50E+03	4.60E-03	--	--	--	--
Cobalt	--	--	--	--	--	--
Copper	2.10E+02	--	--	--	--	--
Cyanide	--	--	--	--	--	--
Iron	--	--	--	--	--	--
Lead	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--
Manganese	--	--	--	--	--	--
Mercury	--	--	--	--	--	--
Molybdenum	6.50E+01	--	--	--	--	--
Nickel	4.60E+02	--	--	--	--	--
Selenium	1.50E+03	1.14E+00	9.20E-01	1.30E+01	1.30E+00	9.10E-01
Silver	1.30E+01	--	--	--	--	--
Thallium	--	--	--	--	--	--
Uranium	6.30E+01	--	--	--	--	--
Vanadium	1.20E+03	--	--	--	--	--
Zinc	2.00E+03	--	--	--	--	--

TABLE 6-6

SUMMARY OF TIER 1 EXPOSURE POINT CONCENTRATIONS[1]

(Page 2 of 3)

Chemical of Potential Concern	Ingestion of Aquatic Life (mg/kg WW)	Ingestion of Aquatic Plants (mg/kg)	Ingestion of Surface and Subsurface Soil (mg/kg)	Ingestion of Aboveground Produce (mg/kg)	Ingestion of Belowground Produce (mg/kg)	Ingestion of Terrestrial Vegetation (mg/kg)	Ingestion of Tea (mg/L)
Aluminum	--	4.50E+03	--	**1.48E+00**	**6.44E-01**	**2.28E+00**	**9.82E-02**
Antimony	--	1.00E+00	--	--	--	--	--
Arsenic	--	2.20E+00	2.90E+01	**2.98E-03**	**3.76E-03**	**3.38E-03**	**4.20E-04**
Barium	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--
Boron	--	--	--	--	--	--	--
Cadmium	3.53E-01[2]	1.15E+01	6.30E+01	**5.75E+00**	**2.94E+00**	**4.37E+00**	**4.15E-01**
Chromium	8.46[2]	4.52E+01	9.70E+02	**2.64E-02**	**2.43E-02**	**3.24E-02**	**1.00E-03**
Cobalt	--	2.40E+00	--	**3.11E-03**	**2.52E-03**	**5.04E-03**	**1.79E-04**
Copper	--	1.14E+01	--	--	--	--	--
Cyanide	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--
Lead	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--
Molybdenum	--	--	--	--	--	--	--
Nickel	--	2.39E+01	--	**8.01E-02**	**6.88E-02**	**7.48E-02**	**6.82E-03**
Selenium	7.76[2]	3.94E+01	1.50E+02	**3.51E-01**	**3.96E-01**	**4.32E-01**	**7.14E-03**
Silver	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--
Uranium	--	--	--	**1.47E-02**	**1.28E-02**	**2.02E-02**	--
Vanadium	--	2.44E+01	--	**9.96E-03**	**9.00E-03**	**1.29E-02**	**4.09E-04**
Zinc	--	1.62E+02	--	**5.69E+01**	**3.48E+01**	**9.48E+02**	**4.90E+00**

TABLE 6-6

SUMMARY OF TIER 1 EXPOSURE POINT CONCENTRATIONS[1]

(Page 3 of 3)

Notes:

--	Not detected
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
WW	Wet weight

Bolded results signify that uptake factors (listed in Table 6-21) were applied to the concentration.

1 Concentrations in units of milligram per kilogram (mg/kg) are presented in dry weight with several exceptions. The exceptions include fish tissue, wild game, and beef cattle. Concentrations for these media are presented in wet weight (WW) – see footnote 2.

2 Analytical results reported in units of mg/kg dry weight (DW) were converted to a WW basis using the formula below. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples collected in 2001 by Tetra Tech EMI.

$$\text{Concentration WW} = \text{Concentration DW} \times ([100 - W] / 100)$$

TABLE 6-7

SUMMARY OF TIER 2 EXPOSURE POINT CONCENTRATIONS[1]
REASONABLE MAXIMUM EXPOSURE CONDITIONS

Chemical of Potential Concern	Ingestion of Surface Water - Blk/LBlk Watershed (mg/L)	Ingestion of Surface Water - Salt Watershed (mg/L)	Ingestion of Surface Water - Georgetown Watershed (mg/L)	Ingestion of Elk and Other Wild Game - Skeletal (mg/kg)	Ingestion of Elk and Other Wild Game - Offal (mg/kg)	Ingestion of Beef Cattle - Skeletal (mg/kg)	Ingestion of Beef Cattle - Offal (mg/kg)	Ingestion of Aquatic Life - Blk/LBlk Watershed (mg/kg WW)	Ingestion of Aquatic Life - Salt Watershed (mg/kg WW)	Ingestion of Aquatic Life - Georgetown Watershed (mg/kg WW)
Antimony	--	--	--	--	--	--	--	--	--	--
Arsenic	--	--	--	--	--	--	--	--	--	--
Barium	--	--	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--	--	--
Boron	--	--	--	--	--	--	--	--	--	--
Cadmium	2.70E-04	1.20E-04	6.00E-05	1.30E-01	5.10E-01	--	--	7.29E-02[2]	3.06E-02[2]	1.20E-01[2]
Chromium	1.07E-03	3.90E-04	3.50E-04	--	--	--	--	6.90E-01[2]	5.20E-01[2]	6.50E-01[2]
Cobalt	--	--	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--	--	--
Cyanide	--	--	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--	--	--
Lead	--	--	--	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--	--	--
Molybdenum	--	--	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--	--	--	--
Selenium	1.20E-02	3.93E+00	1.80E-03	4.50E-01	4.86E+00	8.70E-01	7.70E-01	4.12E+00[2]	2.77E+00[2]	5.35E+00[2]
Silver	--	--	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--	--
Uranium	--	--	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--	--	--

TABLE 6-7

SUMMARY OF TIER 2 EXPOSURE POINT CONCENTRATIONS[1]
REASONABLE MAXIMUM EXPOSURE CONDITIONS

(Page 2 of 3)

Chemical of Potential Concern	Residential Areas							
	Ingestion of Surface Soil – RA 1 (SL-002) (mg/kg)	Ingestion of Surface Soil - RA 2 (SL-001) (mg/kg)	Ingestion of Surface Soil - RA 3 (SL-005) (mg/kg)	Ingestion of Surface Soil - RA 4 (SL-006) (mg/kg)	Ingestion of Surface Soil – RA 5 (ST-026) (mg/kg)	Ingestion of Surface Soil - RA 6 (ST-076) (mg/kg)	Ingestion of Surface Soil - RA 7 (ST-130) (mg/kg)	Ingestion of Surface Soil - RA 8 (ST-227) (mg/kg)
Antimony	8.40E+00	1.17E+00	1.98E+00	1.93E+00	1.08E+00	9.00E-01	1.16E+00	1.29E+00
Arsenic	1.60E+01	6.97E+00	6.70E+00	6.44E+00	4.35E+00	7.07E+00	6.56E+00	7.19E+00
Barium	1.33E+02	1.77E+02	1.82E+02	1.82E+02	1.36E+02	2.71E+02	1.82E+02	1.76E+02
Beryllium	1.33E+00	1.24E+00	1.20E+00	1.20E+00	8.00E-01	1.30E+00	1.35E+00	1.05E+00
Boron	2.24E+01	1.30E+01	8.53E+00	1.30E+01	3.62E+00	1.14E+01	7.97E+00	3.62E+00
Cadmium	2.87E+01	2.48E+00	2.44E+00	8.70E-01	9.30E-01	1.44E+00	1.86E+00	2.65E+00
Chromium	4.34E+02	6.16E+01	7.10E+01	5.09E+01	3.75E+01	4.95E+01	5.80E+01	6.92E+01
Cobalt	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Copper	6.17E+01	1.53E+01	1.88E+01	1.57E+01	1.15E+01	1.60E+01	2.00E+01	2.09E+01
Cyanide	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Iron	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Lead	5.29E+00	1.03E+01	1.21E+01	7.10E+00	7.18E+00	1.60E+01	1.26E+01	1.14E+01
Magnesium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Manganese	7.29E+02	1.23E+03	9.16E+02	1.28E+03	7.09E+02	8.45E+02	1.39E+03	1.11E+03
Mercury	2.92E+02	2.94E+01	4.73E+01	2.90E+01	1.56E+01	3.24E+01	3.45E+01	5.00E+01
Molybdenum	1.47E+01	1.69E+00	1.69E+00	1.69E+00	--	--	--	--
Nickel	1.36E+02	2.66E+01	3.19E+01	2.25E+01	1.75E+01	2.55E+01	4.44E+01	3.16E+01
Selenium	6.74E+01	1.48E+00	3.36E+00	8.50E-01	1.32E+00	1.08E+00	1.21E+00	6.08E+00
Silver	2.36E+00	9.00E-02	9.00E-02	9.00E-02	7.00E-02	8.00E-02	5.00E-02	3.10E-01
Thallium	7.60E-01	7.60E-01	7.60E-01	7.60E-01	4.00E-01	5.80E-01	4.20E-01	4.50E-01
Uranium	4.17E+00	7.47E+00	5.06E+00	5.06E+00	--	--	--	--
Vanadium	2.50E+02	5.88E+01	5.30E+01	5.30E+01	3.46E+01	4.98E+01	5.62E+01	6.76E+01
Zinc	6.78E+02	1.15E+02	1.02E+02	9.76E+01	7.11E+01	1.02E+02	1.18E+02	1.51E+02

TABLE 6-7

SUMMARY OF TIER 2 EXPOSURE POINT CONCENTRATIONS[1]
REASONABLE MAXIMUM EXPOSURE CONDITIONS

Notes:

--	Not a chemical of potential concern or not analyzed for
Blk/Lblk	Blackfoot/Little Blackfoot watershed
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
RA	Residential area
WW	Wet weight

1 All concentrations in units of milligram per kilogram (mg/kg) are presented in dry weight (DW) with several exceptions. The exceptions include fish tissue, wild game, and beef cattle concentrations which are presented in wet weight (WW). See footnote 2.

2 Analytical results reported in units of mg/kg DW were converted to a WW basis using the following formula. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples collected in 2001 by Tetra Tech EMI.

$$\text{Concentration WW} = \text{Concentration DW} \times ([100 - W] / 100)$$

TABLE 6-8

SUMMARY OF TIER 2 EXPOSURE POINT CONCENTRATIONS[1]
CENTRAL TENDENCY EXPOSURE CONDITIONS

Chemical of Potential Concern	Ingestion of Surface Water - Blk/LBlk Watershed (mg/L)	Ingestion of Surface Water - Salt Watershed (mg/L)	Ingestion of Surface Water - Georgetown Watershed (mg/L)	Ingestion of Elk and Other Wild Game - Skeletal (mg/kg)	Ingestion of Elk and Other Wild Game - Offal (mg/kg)	Ingestion of Beef Cattle - Skeletal (mg/kg)	Ingestion of Beef Cattle - Offal (mg/kg)	Ingestion of Aquatic Life - Blk/LBlk Watershed (mg/kg WW)	Ingestion of Aquatic Life - Salt Watershed (mg/kg WW)	Ingestion of Aquatic Life - Georgetown Watershed (mg/kg WW)
Antimony	--	--	--	--	--	--	--	--	--	--
Arsenic	--	--	--	--	--	--	--	--	--	--
Barium	--	--	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--	--	--
Boron	--	--	--	--	--	--	--	--	--	--
Cadmium	1.20E-04	1.20E-04	6.00E-05	1.10E-01	4.40E-01	--	--	5.41E-02[2]	3.06E-02[2]	3.76E-02[2]
Chromium	5.00E-04	3.90E-04	3.00E-04	--	--	--	--	4.50E-01[2]	3.80E-01[2]	4.00E-01[2]
Cobalt	--	--	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--	--	--
Cyanide	--	--	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--	--	--
Lead	--	--	--	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--	--	--
Molybdenum	--	--	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--	--	--	--
Selenium	5.77E-03	7.30E-04	1.16E-03	3.80E-01	3.80E+00	7.40E-01	6.90E-01	2.88E+00[2]	1.95E+00[2]	2.24E+00[2]
Silver	--	--	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--	--
Uranium	--	--	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--	--	--

TABLE 6-8

SUMMARY OF TIER 2 EXPOSURE POINT CONCENTRATIONS[1]
CENTRAL TENDENCY EXPOSURE CONDITIONS

Chemical of Potential Concern	Residential Areas							
	Ingestion of Surface Soil – RA 1 (SL-002) (mg/kg)	Ingestion of Surface Soil - RA 2 (SL-001) (mg/kg)	Ingestion of Surface Soil - RA 3 (SL-005) (mg/kg)	Ingestion of Surface Soil - RA 4 (SL-006) (mg/kg)	Ingestion of Surface Soil – RA 5 (ST-026) (mg/kg)	Ingestion of Surface Soil - RA 6 (ST-076) (mg/kg)	Ingestion of Surface Soil - RA 7 (ST-130) (mg/kg)	Ingestion of Surface Soil - RA 8 (ST-227) (mg/kg)
Antimony	8.40E+00	1.17E+00	1.98E+00	1.93E+00	1.08E+00	9.00E-01	1.16E+00	1.29E+00
Arsenic	1.60E+01	6.97E+00	6.70E+00	6.44E+00	4.35E+00	7.07E+00	6.56E+00	7.19E+00
Barium	1.33E+02	1.77E+02	1.82E+02	1.82E+02	1.36E+02	2.71E+02	1.82E+02	1.76E+02
Beryllium	1.33E+00	1.24E+00	1.20E+00	1.20E+00	8.00E-01	1.30E+00	1.35E+00	1.05E+00
Boron	2.24E+01	1.30E+01	8.53E+00	1.30E+01	3.62E+00	1.14E+01	7.97E+00	3.62E+00
Cadmium	2.87E+01	2.48E+00	2.44E+00	8.70E-01	9.30E-01	1.44E+00	1.86E+00	2.65E+00
Chromium	4.34E+02	6.16E+01	7.10E+01	5.09E+01	3.75E+01	4.95E+01	5.80E+01	6.92E+01
Cobalt	--	--	--	--	--	--	--	--
Copper	6.17E+01	1.53E+01	1.88E+01	1.57E+01	1.15E+01	1.60E+01	2.00E+01	2.09E+01
Cyanide	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--
Lead	5.29E+00	1.03E+01	1.21E+01	7.10E+00	7.18E+00	1.60E+01	1.26E+01	1.14E+01
Magnesium	--	--	--	--	--	--	--	--
Manganese	7.29E+02	1.23E+03	9.16E+02	1.28E+03	7.09E+02	8.45E+02	1.39E+03	1.11E+03
Mercury	2.92E+02	2.94E+01	4.73E+01	2.90E+01	1.56E+01	3.24E+01	3.45E+01	5.00E+01
Molybdenum	1.47E+01	1.69E+00	1.69E+00	1.69E+00	--	--	--	--
Nickel	1.36E+02	2.66E+01	3.19E+01	2.25E+01	1.75E+01	2.55E+01	4.44E+01	3.16E+01
Selenium	6.74E+01	1.48E+00	3.36E+00	8.50E-01	1.32E+00	1.08E+00	1.21E+00	6.08E+00
Silver	2.36E+00	9.00E-02	9.00E-02	9.00E-02	7.00E-02	8.00E-02	5.00E-02	3.10E-01
Thallium	7.60E-01	7.60E-01	7.60E-01	7.60E-01	4.00E-01	5.80E-01	4.20E-01	4.50E-01
Uranium	4.17E+00	7.47E+00	5.06E+00	5.06E+00	--	--	--	--
Vanadium	2.50E+02	5.88E+01	5.30E+01	5.30E+01	3.46E+01	4.98E+01	5.62E+01	6.76E+01
Zinc	6.78E+02	1.15E+02	1.02E+02	9.76E+01	7.11E+01	1.02E+02	1.18E+02	1.51E+02

TABLE 6-8

SUMMARY OF TIER 2 EXPOSURE POINT CONCENTRATIONS[1]
CENTRAL TENDENCY EXPOSURE CONDITIONS

Notes:

--	Not a chemical of potential concern or not analyzed for
Blk/Lblk	Blackfoot/Little Blackfoot watershed
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
RA	Residential area
WW	Wet weight

1 All concentrations in units of milligram per kilogram (mg/kg) are presented in dry weight (DW) with several exceptions. The exceptions include fish tissue, wild game, and beef cattle concentrations which are presented in wet weight (WW). See footnote 2.

2 Analytical results reported in units of mg/kg DW were converted to a WW basis using the following formula. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples collected in 2001 by Tetra Tech EMI.

$$\text{Concentration WW} = \text{Concentration DW} \times ([100 - W] / 100)$$

TABLE 6-9

TIER 2 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 1 of 3)

COPC[2]	Blackfoot River Impacted Reach[3]		Dry Valley Creek Impacted Reach[3]		East Mill Creek Impacted Reach[3]		Maybe Creek Impacted Reach[3]		Spring Creek Impacted Reach[3]	
	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)
Cadmium	0.2518	0.4975	0.0073	0.4975	0.0015	1.5	0.0041	0.4975	0.0014	0.21
Chromium	0.2518	2.775	0.0073	2.775	0.0015	2.2	0.0041	2.775	0.0014	3.35
Selenium	0.2518	22.775	0.0073	22.775	0.0015	33	0.0041	22.775	0.0014	23.15

COPC[2]	State Land Creek Impacted Reach[3]		Watershed-wide Unimpacted Reach[3]		AWAC[6] (mg/kg DW)	Standard Error (mg/kg)	UCL_{95}[7] (mg/kg DW)	AWAC[8] (mg/kg WW)	UCL_{95}[8] (mg/kg WW)
	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)					
Cadmium	0.0048	0.4975	0.7292	0.1275	0.23	5.21E-02	0.31	5.41E-02	7.29E-02
Chromium	0.0048	2.775	0.7292	1.6	1.92	7.58	2.93	0.45	0.69
Selenium	0.0048	22.775	0.7292	8.3	12.24	206.44	17.52	2.88	4.12

Notes:

AWAC Area-weighted average concentration
COPC Chemical of potential concern
DW Dry weight
mg/kg Milligram per kilogram (net weight)
UCL_{95} 95 percent upper confidence limit of the mean
WW Wet weight

1 Fish tissue exposure point concentrations (EPC) are based on fish tissue analytical data from fish tissue samples collected by Tetra Tech EM Inc. (TtEMI) in 2001. Complete fish tissue analytical results are presented in Appendix H.

2 Arsenic was not detected in any fish tissue sample; therefore, EPCs were not calculated for arsenic in fish tissue.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (TtEMI 2002b). Unimpacted reaches are defined as reaches which do not qualify as impacted. Because of the low number of fish tissue samples, the average concentration of each chemical of potential concern (COPC) in unimpacted reaches (and impacted reaches with no fish tissue samples) was based on fish tissue samples collected from unimpacted reaches (and impacted reaches) throughout the Resource Area.

TABLE 6-9

TIER 2 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

4 Fraction of area was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Available analytical data from other watersheds were used to estimate fish tissue concentrations for tributaries with no available analytical results. Reach-specific analytical results were based on the following sample numbers: Blackfoot River – impacted (EMCTT043, LSCTT040, SCBETT046); Dry Valley Creek – impacted (EMCTT043, LSCTT040, SCBETT046); East Mill Creek – impacted (EMCTT043); Maybe Creek – impacted (EMCTT043, LSCTT040, SCBETT046); Spring Creek – impacted (SCBETT046); State Land Creek – impacted (EMCTT043, LSCTT040, SCBETT046); Watershed-wide – unimpacted (KCTT042, SCAETT047, USCTT041). See Appendix H for complete 2001 fish tissue results.

6 COPC-specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC} i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = \text{AWAC} + t_{(1-\propto,\, n-1)} \left[\left(SE / n\,(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(\text{AWAC}_i - \text{AWAC}_n\right)^2$$

where

UCL_{95}	=	95 Percent upper confidence level
AWAC	=	Area-weighted average concentration
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

TABLE 6-9

TIER 2 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 3 of 3)

8 AWAC and UCL_{95} values calculated on a dry weight (DW) basis were converted to a wet weight (WW) basis using the following formula. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples (see footnote 5):

$$\text{Concentration WW} = \text{Concentration DW} \times ([100 - W]/100)$$

TABLE 6-10

TIER 2 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 1 of 2)

COPC[2]	Maybe Creek Impacted Reach[3]		Spring Creek Impacted Reach[3]		East Mill Creek Impacted Reach[3]		Watershed-wide Unimpacted Reach[3]		AWAC[6] (µg/L)	Standard Error (risks)	UCL_{95}[7] (µg/L)
	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)			
Cadmium	0.004	1.80	0.001	6.25E-02	0.002	0.44	0.993	0.12	0.12	4.67E-02	0.27
Chromium	0.004	0.90	0.001	0.492	0.002	0.92	0.993	0.49	0.50	7.22E-01	1.07
Selenium	0.004	1140.00	0.001	5.4	0.002	64.13	0.993	0.98	5.77	85.98	11.97

Notes:

µg/L Microgram per liter
AWAC Area-weighted average concentration
COPC Chemical of potential concern
UCL_{95} 95 percent upper confidence limit of the mean

1 Surface water exposure point concentrations (EPC) are based on surface water analytical data from surface water samples collected by Tetra Tech EM Inc. (TtEMI) in 2001. Complete surface water analytical results are presented in Appendix H.

2 Arsenic was not detected in any surface water sample; therefore, EPCs were not calculated for arsenic in surface water.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (TtEMI 2002b). Unimpacted reaches are defined as reaches which do not qualify as impacted.

4 Fraction of area was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Reach-specific analytical results were based on the following sample numbers: Maybe Creek – impacted (MCTT044); Spring Creek – impacted (SCBETT046, SPRTT016); East Mill Creek – impacted (EMCTT017, EMCTT043, EMCNTT045); and Watershed-specific – unimpacted (ANGTT010, BFDTT008, BFNTT009, BFUTT015, CALTT004, DIATT018, GHCTT006, KCTT042, LBFTT001, MACTT011, NNATT013, NNBTT012, RASTT014, SCAETT047, SHETT019, SLCTT002, SLUTT005, TRATT003, WVCTT007). See Appendix H for complete 2001 surface water results.

TABLE 6-10

TIER 2 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 2 of 2)

6 Chemical of potential concern- (COPC) specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC}i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = AWAC + t_{(1-\propto,\, n-1)} \left[\left(SE / n\,(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(AWAC_i - AWAC_n\right)^2$$

where

UCL_{95}	=	95 Percent upper confidence level
AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

TABLE 6-11

TIER 2 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
SALT WATERSHED

(Page 1 of 2)

COPC[2]	Sage Creek Impacted Reach[3]		Resource Area Unimpacted Reach[3]		AWAC[6] (mg/kg)	Standard Error (mg/kg)	UCL_{95}[7] (mg/kg DW)	AWAC[8] (mg/kg WW)	UCL_{95}[8] (mg/kg WW)
	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)					
Cadmium	0.0041	0.07	0.9959	0.1275	0.13	1.61E-02	0.69 (0.13)	3.06E-02	0.16 (3.06E-02)
Chromium	0.0041	2.2	0.9959	1.6	1.60	2.54	8.71 (2.2)	0.38	2.05 (0.52)
Selenium	0.0041	11.8	0.9959	8.3	8.31	68.33	45.22 (11.8)	1.95	10.63 (2.77)

Notes:

µg/L Microgram per liter
AWAC Area-weighted average concentration
COPC Chemical of potential concern
DW Dry weight
mg/kg Milligram per kilogram (net weight)
UCL_{95} 95 percent upper confidence limit of the mean
WW Wet weight

1 Reported concentrations in fish tissue were collected by Tetra Tech EM Inc. (TtEMI) in 2001. Complete fish tissue concentrations are presented in Appendix H.

2 Arsenic was not detected in any fish tissue sample; therefore, exposure point concentrations (EPC) were not calculated for arsenic in fish tissue.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (TtEMI 2002b). Unimpacted reaches are defined as reaches that do not qualify as impacted.

4 Fraction of area was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Reach-specific analytical results were based on the following sample numbers: Sage Creek (LSCTT040) and Resource Area-wide unimpacted reaches (KCTT042, SCAETT047, USCTT041). See Appendix H for complete 2001 fish tissue results.

TABLE 6-11

TIER 2 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
SALT WATERSHED

6 Chemical of potential concern- (COPC) specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC}i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = AWAC + t_{(1-\propto,\, n-1)} \left[\left(SE / n\,(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(AWAC_i - AWAC_n\right)^2$$

where

UCL_{95}	=	95 Percent upper confidence level
AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

If calculated UCL_{95} value exceeds the maximum detected concentration, the maximum concentration (reported in parentheses) was selected as the EPC under reasonable maximum exposure conditions.

8 AWAC and UCL_{95} values calculated on a dry weight (DW) basis were converted to a wet weight (WW) basis using the following formula. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples (see footnote 5):

Concentration WW = Concentration DW x ([100 – W]/100)

TABLE 6-12

TIER 2 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
SALT WATERSHED

(Page 1 of 2)

COPC[2]	Sage Creek Impacted Reach[3]		Watershed-wide Unimpacted Reach[3]		AWAC[6] (µg/L)	Standard Error (µg/L)	UCL_{95}[7] (µg/L)
	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)			
Cadmium	0.002	6.2E-02	0.998	0.12	0.12	1.43E-02	0.65 (0.12)
Chromium	0.002	0.32	0.998	0.39	0.39	1.51E-01	2.13 (0.39)
Selenium	0.002	4.00	0.998	0.72	0.73	5.16E-01	3.93

Notes:

µg/L Microgram per liter
AWAC Area-weighted average concentration
COPC Chemical of potential concern
UCL_{95} 95 percent upper confidence limit of the mean

1 Surface water exposure point concentrations (EPC) are based on surface water analytical data from surface water samples collected by Tetra Tech EM Inc. (TtEMI) in 2001. Complete surface water analytical results are presented in Appendix H.

2 Arsenic was not detected in any surface water sample; therefore, EPCs were not calculated for arsenic in surface water.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (TtEMI 2002b). Unimpacted reaches are defined as reaches that do not qualify as impacted.

4 Fraction of area was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Reach-specific analytical results were based on the following sample numbers: Sage Creek – impacted (LSCTT040, SCMTT026); and watershed-specific – unimpacted (CCATT029, DCMTT028, SCATT024, SCBTT025, SCPTT027, SMATT021, SMBTT020, SSBTT022, USCTT041). See Appendix H for complete 2001 surface water results.

TABLE 6-12

TIER 2 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
SALT WATERSHED

6 Chemical of potential concern- (COPC) specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC} i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = AWAC + t_{(1-\propto,\, n-1)} \left[\left(SE / n\,(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(AWAC_i - AWAC_n\right)^2$$

where

UCL_{95}	=	95 Percent upper confidence level
AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

If the calculated UCL_{95} value exceeds the maximum detected concentration, the maximum concentration (reported in parentheses) was used as the EPC under reasonable maximum exposure conditions.

TABLE 6-13

TIER 2 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
GEORGETOWN WATERSHED

(Page 1 of 2)

COPC[2]	Georgetown Creek Impacted Reach[3]		Resource Area Unimpacted Reach[3]		AWAC[6] (mg/kg DW)	Standard Error (mg/kg)	UCL_{95}[7] (mg/kg DW)	AWAC[8] (mg/kg WW)	UCL_{95}[8] (mg/kg WW)
	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)					
Cadmium	0.0848	0.4975	0.9152	0.1275	0.16	1.54E-02	0.71 (0.49)	3.76E-02	0.17 (0.12)
Chromium	0.0848	2.775	0.9152	1.6	1.70	2.20	8.32 (2.775)	0.40	1.96 (0.65)
Selenium	0.0848	22.775	0.9152	8.3	9.53	61.43	45.52 (22.775)	2.24	10.70 (5.35)

Notes:

AWAC Area-weighted average concentration
COPC Chemical of potential concern
DW Dry weight
mg/kg Milligram per kilogram (net weight)
UCL_{95} 95 percent upper confidence limit of the mean
WW Wet weight

1 Reported concentrations in fish tissue were collected by Tetra Tech EM Inc. (TtEMI) in 2001. Complete fish tissue concentrations are presented in Appendix H.

2 Arsenic was not detected in any surface water sample; therefore, exposure point concentrations (EPC) were not calculated for arsenic in fish tissue.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (TtEMI 2002b). Unimpacted reaches are defined as reaches that do not qualify as impacted.

4 Fraction was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Analytical data outside of the Georgetown watershed were used as surrogate data to represent the Georgetown watershed. The surrogate data was weighted using Georgetown watershed-specific impacted and unimpacted reaches. Watershed-specific analytical results were based on the following sample numbers: Georgetown Creek (EMCTT043, LSCTT040, SCBETT046) and Resource Area-wide unimpacted reaches (KCTT042, SCAETT047, USCTT041). See Appendix H for complete 2001 fish tissue analytical results.

TABLE 6-13

TIER 2 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
GEORGETOWN WATERSHED

6 Chemical of potential concern- (COPC) specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC}i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = AWAC + t_{(1-\propto,\, n-1)} \left[\left(SE / n\,(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(AWAC_i - AWAC_n\right)^2$$

where

AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

If the calculated UCL_{95} value exceeds the maximum detected concentration, the maximu m concentration (reported in parentheses) was used as the EPC under reasonable maximum exposure conditions.

8 AWAC and UCL_{95} values calculated on a dry weight (DW) basis were converted to a wet weight (WW) basis using the following formula. The percent mois ture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples (see footnote 5):

Concentration WW = Concentration DW x ([100 – W]/100)

TABLE 6-14

TIER 2 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
GEORGETOWN WATERSHED

(Page 1 of 2)

COPC[2]	Georgetown Creek Impacted Reach[3]		Watershed-wide Unimpacted Reach[3]		AWAC[6] (µg/L)	Standard Error (µg/L)	UCL_{95}[7] (µg/L)
	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)			
Cadmium	0.0848	0.06	0.9152	0.06	0.06	3.04E-01	0.31 (0.06)
Chromium	0.0848	0.35	0.9152	0.30	0.30	7.63E-02	1.54 (0.35)
Selenium	0.0848	1.80	0.9152	1.10	1.16	1.04	5.71 (1.8)

Notes:

µg/L Microgram per liter
AWAC Area-weighted average concentration
COPC Chemical of potential concern
UCL_{95} 95 percent upper confidence limit of the mean

1 Reported concentrations in surface water were obtained from "Final 1998 Regional Investigation Report" (Montgomery Watson [MW] 1999b).

2 Arsenic was not detected in any surface water sample; therefore, exposure point concentrations (EPC) were not calculated for arsenic in surface water.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (Tetra Tech EMI [TtEMI] 2002b). Unimpacted reaches are defined as reaches that do not qualify as impacted.

4 Fraction was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

Reach-specific analytical results were based on the following sample numbers: Georgetown Creek – impacted (GTCTT032), and Watershed-specific – unimpacted (MCATT030, MCBTT031). See Appendix H for complete 2001 surface water results.

5 COPC-specific AWACs were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC}i\right)$$

where

AWAC = Area-weighted average concentration
Fraction j = Fraction of area for reach j
Concentration COPC i = Concentration of COPC i in reach j

TABLE 6-14

TIER 2 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
GEORGETOWN WATERSHED

(Page 2 of 2)

6 COPC-specific 95 percent upper confidence level UCL_{95} values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = AWAC + t_{(1-\propto, n-1)} \left[(SE / n(n-1))\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(AWAC_i - AWAC_n\right)^2$$

where

UCL_{95}	=	95 Percent upper confidence level
AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

If calculated UCL_{95} value exceeds the maximum detected concentration, the maximum concentration (reported in parentheses) was used as the EPC under reasonable maximum exposure conditions

TABLE 6-15

TIER 2 ELK AND BEEF CATTLE EXPOSURE POINT CONCENTRATIONS[1,2]

(Page 1 of 1)

Chemical of Potential Concern	Elk		Beef Cattle	
	Skeletal Muscle (mg/kg WW)	Offal (Liver) (mg/kg WW)	Skeletal Muscle (mg/kg WW)	Offal (Liver) (mg/kg WW)
Cadmium	1.30E–01 (1.10E–01)	5.13E–01 (4.38E–01)	Not analyzed for	Not analyzed for
Selenium	4.50E–01 (3.76E–01)	4.86 (3.80)	8.72E–01 (7.41E–01)	7.66E–01 (6.91E–01)

Notes:

mg/kg Milligram per kilogram
WW Wet weight

Exposure point concentrations (EPC) under reasonable maximum exposure (RME) conditions were calculated as the 95 percent upper confidence limit (UCL_{95}) of the mean; EPCs under central tendency exposure (CTE) conditions were calculated as the mean. CTE results are presented in parentheses.

1 Elk and beef skeletal muscle and offal (liver) EPCs are based on tissue data presented in Montgomery Watson (MW) (2000). Elk tissue results were based on results for 26 animals as "after-the-fact treatment." Beef cattle results were based on 15 treated animals.

2 EPCs (UCL_{95} and mean under RME and CTE conditions, respectively) were calculated according to U.S. Environmental Protection Agency (EPA) (1992). The distribution of each data set was tested and EPCs were calculated using the Washington Department of Ecology (WDE) MTCA *Stat* 3.0 statistical program (WDE 2002).

TABLE 6-16

TIER 2 RESIDENTIAL AREA-SPECIFIC SOIL EXPOSURE POINT CONCENTRATIONS[1]

(Page 1 of 2)

Chemical of Potential Concern	RA1 (SL-002)	RA2 (SL-001)	RA3 (SL-005)	RA4 (SL-006)	RA5 (ST026)	RA6 (ST076)	RA7 (ST130)	RA8 (ST227)	Mean Unimpacted Soil[2]
Soil Sample Specific Concentrations (mg/kg)									
Arsenic	29	8.9	8.3	7.70	3.03	9.13	7.98	9.40	6.74
Cadmium	63	4.4	4.3	0.79	0.93	2.07	3.00	4.77	1.16
Chromium	910	75	96	51.00	21.00	48.00	67.00	92.00	63.17
Selenium	150	2.4	6.6	0.99	2.03	1.50	1.78	12.70	0.93
Exposure Point Concentrations[3] (mg/kg)									
Arsenic	15.95	6.97	6.70	6.44	4.35	7.07	6.56	7.19	
Cadmium	28.65	2.48	2.44	0.87	0.93	1.44	1.86	2.65	
Chromium	434.37	61.57	70.95	50.85	37.46	49.51	58.00	69.16	
Selenium	67.38	1.48	3.36	0.85	1.32	1.08	1.21	6.08	

Notes:

mg/kg Milligram per kilogram
RA Residential area

1 Soil samples were collected from impacted and unimpacted riparian areas by Tetra Tech EM Inc. (TtEMI) and Montgomery Watson (MW) in 2001. Complete riparian area soil samples are presented in Appendix H.

2 The mean unimpacted soil concentration of each chemical of potential concern (COPC) was calculated as the arithmetic mean of the analytical results for 11 unimpacted soil samples (SL003, SL004, SL007, SL008, SL009, SL010, SL011, ST049, ST153, ST235, and ST237). See Appendix C for complete results

3 Residential area- (RA) specific exposure point concentrations (EPC) were calculated as area-weighted average concentrations (AWAC) as described in Appendix C using the following equation:

$$AWAC = \left([MIC_j] \times [AI_j] / ARP \right) + \left([MUC] \times [AURP] / ARP \right)$$

where:

AWAC = Aera-weighted average concentration (milligram per kilogram [mg/kg])
MIC = Mean impacted concentration (mg/kg)

TABLE 6-16

TIER 2 RESIDENTIAL AREA-SPECIFIC SOIL EXPOSURE POINT CONCENTRATIONS[1]

(Page 2 of 2)

AI	=	Area impacted (12,095 square feet [ft^2]; calculated as 147.5 ft x 82 ft – assuming (1) the restricted property occupies 0.5 acre measuring 147.5 ft on each side and is located adjacent to the stream; and (2) the impacted riparian areas extends 25 meters (82 ft) from the stream)
ARP	=	Area of residential property (21,780 ft^2; defined as that portion of a subsistence lifestyle receptor's property immediately surrounding the home; assumed to be 0.5 acre in area)
MUC	=	Mean unimpacted concentration (mg/kg)
AURP	=	Area of unimpacted residential property (9,666 ft^2); calculated as 147.5 ft x (147.5 – 82 ft).

TABLE 6-17

TIER 3 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

COPC[2]	Blackfoot River Impacted Reach[3]		Dry Valley Creek Impacted Reach[3]		East Mill Creek Impacted Reach[3]		Maybe Creek Impacted Reach[3]		Spring Creek Impacted Reach[3]	
	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)
Cadmium	0.2518	0.0315	0.0073	0.0315	0.0015	0.0315	0.0041	0.0315	0.0014	0.0315
Selenium	0.2518	3.6	0.0073	3.6	0.0015	3.6	0.0041	3.6	0.0014	3.6

COPC[2]	State Land Creek Impacted Reach[3]		Resource-wide Unimpacted Reach[3]		AWAC[6] (mg/kg DW)	Standard Error (mg/kg)	UCL_{95}[7] (mg/kg DW)	AWAC[8] (mg/kg WW)	UCL_{95}[8] (mg/kg WW)
	Fraction of Area[4]	Concentration[5] (mg/kg DW)	Fraction of Area[4]	Concentration[5] (mg/kg DW)					
Cadmium	0.0048	0.0315	0.7292	0.0315	3.15E-02	5.55E-03	5.38E-02	7.40E-03	1.26E-02
Selenium	0.0048	3.6	0.7292	1.3	1.92E+00	20.22	3.27	0.45	0.77

Notes:

mg/kg Milligram per kilogram (net weight)
AWAC Area-weighted average concentration
COPC Chemical of potential concern
DW Dry weight
UCL_{95} 95 percent upper confidence limit of the mean

1 Fish tissue exposure point concentrations are based on fish tissue analytical data from fish tissue samples collected by Montgomery Watson (MW) in 1998 (MW 1999b).

2 Arsenic was not detected in any fish tissue sample; therefore, exposure point concentrations (EPC) were not calculated for arsenic in fish tissue.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (Tetra Tech EMI [TtEMI] 2002b). Unimpacted reaches are defined as reaches which do not qualify as impacted. Because of the low number of fish tissue samples, the average concentration of each chemical of potential concern (COPC) in unimpacted reaches (and impacted reaches with no fish tissue samples) was based on fish tissue samples collected from unimpacted reaches (and impacted reaches) throughout the Resource Area.

4 Fraction was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Reach-specific analytical results were based on the following sample numbers: Blackfoot River – impacted (ST024, ST227); Dry Valley Creek – impacted (ST024, ST227); East Mill Creek – impacted (ST024, ST227); Maybe Creek – impacted (ST024, ST227); Spring Creek – impacted (ST024,

TABLE 6-17

TIER 3 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 2 of 3)

ST227); State Land Creek – impacted (ST024, ST227); Resource Area-wide – unimpacted reaches (ST228). See Appendix H for complete 2001 fish tissue results.

6 COPC-specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC} i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = \text{AWAC} + t_{(1-\propto, n-1)} \left[\left(SE / n(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(AWAC_i - AWAC_n\right)^2$$

where

AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

TABLE 6-17

TIER 3 FISH TISSUE EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 3 of 3)

8 AWAC and UCL_{95} values calculated on a dry weight (DW) basis were converted to a wet weight (WW) basis using the following formula. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples considered under Tier 2 (see footnote 5 of Table 6-9); the use of this value was based on the belief that moisture content values should remain constant and for consistency:

$$\text{Concentration WW} = \text{Concentration DW} \times ([100 - W]/100)$$

TABLE 6-18

TIER 3 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 1 of 2)

COPC[2]	Blackfoot River Impacted Reach[3]		Dry Valley Creek Impacted Reach[3]		East Mill Creek Impacted Reach[3]		State Land Creek Impacted Reach[3]	
	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)
Cadmium	0.2518	1.36	0.0073	1.28	0.0015	0.983	0.0048	1.9
Chromium	0.2518	0.004	0.0073	0.003	0.0015	0.003	0.0048	0.0078
Selenium	0.2518	5.17	0.0073	22.09	0.0015	121.67	0.0048	16.18

COPC[2]	Watershed-wide Unimpacted Reach[3]		AWAC[6] (µg/L)	Standard Error (µg/L)	UCL_{95}[7] (µg/L)
	Fraction of Area[4]	Concentration[5] (µg/L)			
Cadmium	0.7347	1.403	1.39	7.00	2.65
Chromium	0.7347	0.003	3.28E-03	3.81E-05	6.21E-03
Selenium	0.7347	0.824	2.33	18.39	4.37

Notes:

µg/L Microgram per liter
AWAC Area-weighted average concentration
COPC Chemical of potential concern
UCL_{95} 95 percent upper confidence limit of the mean

1 Reported concentrations in surface water were obtained from "Final 1998 Regional Investigation Report" (Montgomery Watson [MW] 1999b).

2 Arsenic was not detected in any surface water sample; therefore, exposure point concentrations (EPC) were not calculated for arsenic in surface water.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (Tetra Tech [TtEMI] 2002b). Unimpacted reaches are defined as reaches that do not qualify as impacted.

4 Fraction was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Reach-specific analytical results were based on the following sample numbers: Blackfoot River – impacted (ST019, ST020, ST022, ST023, ST024, ST026, ST029, ST229, ST232); Dry Valley Creek – impacted (ST113); East Mill Creek – impacted (ST145, ST150, ST227); State Land Creek –

TABLE 6-18

TIER 3 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
BLACKFOOT/LITTLE BLACKFOOT WATERSHED

(Page 2 of 2)

impacted (ST071); Watershed-specific – unimpacted (ST043, ST044, ST046, ST047, ST048, ST049, ST076, ST078, ST097, ST098, ST100, ST101, ST129, ST131, ST132, ST137, ST152, ST153, ST155, ST156, ST161, ST162, ST163). Complete 1998 surface water results were obtained from (MW 1999b).

6 Chemical of potential concern- (COPC) specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC} i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = \text{AWAC} + t_{(1-\propto, n-1)} \left[(SE / n(n-1))\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(\text{AWAC}_i - \text{AWAC}_n\right)^2$$

where

UCL_{95}	=	95 Percent upper confidence level
AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Aera-weighted average concentration for the ith reach

TABLE 6-19

TIER 3 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
SALT WATERSHED

(Page 1 of 2)

COPC[2]	Sage Creek Impacted Reach[3]		Watershed-wide Unimpacted Reach[3]		AWAC[6] (µg/L)	Standard Error (µg/L)	UCL_{95}[7] (µg/L)
	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)			
Cadmium	0.0041	2.0	0.9959	1.19	1.20	1.40	6.48 (2.0)
Chromium	0.0041	7.0 E-03	0.9959	3.5E-03	3.51E-03	1.22E-05	1.9E-02 (7.0E-03)
Selenium	0.0041	2.3E+01	0.9959	4.66E-01	5.59E-01	1.07E-01	2.02

Notes:

µg/L Microgram per liter
AWAC Area-weighted average concentration
COPC Chemical of potential concern
UCL_{95} 95 percent upper confidence limit of the mean

1 Reported concentrations in surface water were obtained from "Final 1998 Regional Investigation Report" (Montgomery Watson [MW] 1999b

2 Arsenic was not detected in any surface water sample; therefore, exposure point concentrations (EPC) were not calculated for arsenic in surface water.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (Tetra Tech EMI [TtEMI] 2002b). Unimpacted reaches are defined as reaches that do not qualify as impacted.

4 Fraction was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Reach-specific analytical results were based on the following sample numbers: Sage Creek – impacted (ST187); and Watershed-wide unimpacted reaches (ST173, ST174, ST176, ST183, ST184, ST185, ST188, ST193, ST228).

TABLE 6-19

TIER 3 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
SALT WATERSHED

(Page 2 of 2)

6 Chemical of potential concern- (COPC) specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC} i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence level (UCL_{95}) values were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = \text{AWAC} + t_{(1-\propto, n-1)} \left[\left(SE / n(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(\text{AWAC}_i - \text{AWAC}_n\right)^2$$

where

AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

Because the calculated UCL_{95} value exceeds the maximum detected concentration for each COPC, the maximum detected concentration (reported in parentheses) was used as the EPC under reasonable maximum exposure conditions.

TABLE 6-20

TIER 3 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
GEORGETOWN WATERSHED

(Page 1 of 2)

COPC[2]	Georgetown Creek Impacted Reach[3]		Watershed-wide Unimpacted Reach[3]		AWAC[6] (µg/L)	Standard Error (µg/L)	UCL_{95}[7] (µg/L)
	Fraction of Area[4]	Concentration[5] (µg/L)	Fraction of Area[4]	Concentration[5] (µg/L)			
Cadmium	0.0848	1.00E+00	0.9152	1.00E+00	1.00E+00	8.45E-01	5.10 (1.0)
Chromium	0.0848	3.00E+00	0.9152	5.00E-03	2.59E-01	6.23E-02	1.37
Selenium	0.848	3.43E+00	0.9152	3.50E-01	6.11E-01	1.87E-01	2.54

Notes:

µg/L Microgram per liter
AWAC Area-weighted average concentration
COPC Chemical of potential concern
UCL_{95} 95 percent upper confidence limit of the mean

1 Reported concentrations in surface water were obtained from "Final 1998 Regional Investigation Report" (Montgomery Watson [MW] 1999b).

2 Arsenic was not detected in any surface water sample; therefore, exposure point concentrations (EPC) were not calculated for arsenic in surface water.

3 An impacted stream reach was defined as a reach where selenium exceeded the chronic surface water criterion (5 micrograms per liter [µg/L]) in at least one sample. The linear extent of each impacted reach was estimated as reported in "Final 2001 Total Maximum Daily Load Baseline Monitoring Report" (Tetra Tech EMI [TtEMI] 2002b). Unimpacted reaches are defined as reaches that do not qualify as impacted.

4 Fraction was calculated based on the area of each reach relative to the total surface water area for the Blackfoot/Little Blackfoot watershed as described in Appendix C.

5 Reach-specific analytical results were based on the following sample numbers: Georgetown Creek – impacted (ST196); and Watershed-wide unimpacted reaches (ST200, ST202).

TABLE 6-20

TIER 3 SURFACE WATER EXPOSURE POINT CONCENTRATIONS[1]
GEORGETOWN WATERSHED

6 Chemical of potential concern- (COPC) specific area-weighted average concentrations (AWAC) were calculated using the following equation:

$$\text{AWAC} = \sum_{j=1}^{n} \left(\text{Fraction } j \times \text{Concentration COPC}i\right)$$

where

AWAC	=	Area-weighted average concentration
Fraction j	=	Fraction of area for reach j
Concentration COPC i	=	Concentration of COPC i in reach j

7 COPC-specific 95 percent upper confidence levels (UCL_{95}) were calculated using the following equation. Note that the concentration of all COPCs were assumed to be normally distributed.

$$UCL_{95} = \text{AWAC} + t_{(1-\propto,\, n-1)} \left[\left(SE / n(n-1)\right)\right]^{1/2}$$

$$SE = \sum_{i=1}^{n} \left(\text{AWAC}_i - \text{AWAC}_n\right)^2$$

where

AWAC	=	Area-weighted average concentration based on n reaches
$\propto$	=	Acceptable Type 1 error (p = 0.05)
SE	=	Standard error of the weighted regional mean
t	=	Student's t statistic
n	=	Number of reaches
$AWAC_n$	=	Area-weighted average concentration based on n reaches (equals regional mean)
$AWAC_i$	=	Area-weighted average concentration for the ith reach

Because the calculated UCL_{95} value exceeds the maximum detected concentration for each COPC, the maximum detected concentration (reported in parentheses) was used as the EPC under reasonable maximum exposure conditions.

TABLE 6-21

SUMMARY OF UPTAKE FACTORS

(Page 1 of 1)

COPC	$Br_{Aboveground}$	$Br_{Belowground}$	$Br_{Terrestrial\ Vegetation}$	Br_{Forage}
	unitless	unitless	unitless	unitless
Aluminum	4.00E-03	6.50E-04	2.30E-03	4.00E-03
Antimony	3.19E-02	3.00E-02	3.00E-02	--
Arsenic	6.33E-03	8.00E-03	7.20E-03	3.60E-02
Barium	3.22E-02	1.50E-02	1.50E-02	1.50E-01
Beryllium	2.58E-03	1.50E-03	2.00E-03	1.00E-02
Boron	--	--	--	--
Cadmium	1.25E-01	6.40E-02	9.50E-02	3.64E-01
Chromium	7.50E-03	4.50E-03	6.00E-03	7.50E-03
Cobalt	2.00E-02	7.00E-03	1.40E-02	2.00E-02
Copper	2.69E-01	2.50E-01	2.50E-01	4.00E-01
Cyanide	1.00E+00	--	--	--
Iron	--	--	--	4.00E-03
Lead	--	--	--	4.50E-02
Magnesium	--	--	--	1.00E+00
Manganese	7.55E-02	5.00E-02	5.00E-02	2.50E-01
Mercury	9.00E-01	3.60E-02	4.70E-01	9.00E-01
Molybdenum	8.42E-02	6.00E-02	6.00E-02	--
Nickel	9.31E-03	8.00E-03	8.70E-03	3.20E-02
Selenium	2.50E-02	2.20E-02	2.40E-02	1.60E-02
Silver	1.38E-01	1.00E-01	1.00E-01	4.00E-01
Thallium	8.58E-04	4.00E-04	4.00E-04	4.00E-03
Uranium	--	--	--	--
Vanadium	5.50E-03	3.00E-03	4.30E-03	5.50E-03
Zinc	1.50E+00	9.00E-01	1.20E+00	2.50E-01

Notes:

-- = Not detected

Br = Plant-soil bioconcentration factor

$Br_{Aboveground}$ and $Br_{Belowground}$ = Adopted from U.S. Environmental Protection Agency (EPA) 1998b or calculated following the methodology presented in EPA 1998b using plant-soil concentration factor for vegetation (Bv) and plant-soil concentration factor for representative tissues (Br) values from Baes and others 1984.

$Br_{Terrestrial\ Vegetation}$ = Calculated as mean of chemical of potential concern- (COPC) specific Bv and Br values from Baes and others 1984.

Br_{Forage} = COPC-specific Bv values from Baes and others 1984.

COPC = Chemical of potential concern

TABLE 6-22

REFERENCES DOSES FOR CHEMICALS OF POTENTIAL CONCERN

(Page 1 of 2)

Chemical of Potential Concern	Oral RfD						Inhalation RfDi	
	RfD (mg/kg/day)	RfD Source (date accessed)	Confidence Level	Critical Effect or Site of Critical Effect	UF	MF	RfDi (mg/kg/day)	RfDi Source
Aluminum	1.00E+00	EPA Region 9	Medium	--	3	--	1.40E-03	EPA Region 9
Antimony	4.00E-04	IRIS (04/10/02)	--	Longevity, blood glucose, cholesterol	1000	1	NA	--
Arsenic	3.00E-04	IRIS (04/10/02)	Medium	Hyper pigmentation, kertosis, and possible vascular complications	3	1	NA	--
Barium	7.00E-02	IRIS (04/10/02)	High	Significant proteinuria	3	--	1.43E-04	HEAST
Beryllium	2.00E-03	IRIS (04/10/02)	--	Small intestinal lesions	300	1	5.71E-06	IRIS
Boron	9E-02	IRIS (04/10/02)	Medium	Testicular atrophy	100	1	5.71E-03	HEAST
Cadmium	5.00E-04	IRIS (04/10/02)	Low	No effects observed	10	--	NA	--
Chromium	1.50E+00	IRIS (04/10/02)	Low	No effects observed	100	10	2.86E-05	IRIS
Cobalt	6.00E-02	EPA Region 9	--	--	--	--	NA	--
Copper	3.70E-02	EPA Region 9	Medium	Central nervous system (CNS) effects	1	1	NA	--
Cyanide	2.00E-02	IRIS	Medium	No adverse effects	100	5	NA	--
Iron	3.00E-01	EPA Region 9	High	Clinincal Selenosis	3	1	NA	--
Lead	NA	IRIS (04/10/02)	--	--	--	--	NA	--
Magnesium	NA	IRIS (04/10/02)	--	--	--	--	NA	--
Manganese	1.40E-01	IRIS (04/10/02)	Medium	CNS effects	1	1	1.43E-05	IRIS
Mercury	3.00E-04	IRIS (04/10/02)	Low	CNS and peripheral nervous system (PNS) effects	30	1	8.57E-05	IRIS
Molybdenum	5.00E-03	HEAST	--	--	--	--	NA	--
Nickel	2.00E-02	IRIS (04/10/02)	Medium	Decreased organ and body weight	300	1	NA	--
Selenium	5.00E-03	HEAST	High	No observed effects	3000	1	NA	--
Silver	5.00E-03	IRIS (04/10/02)	Low	Reduced birth weights	3	1	NA	--
Thallium	6.60E-05	EPA Region 9	--	--	--	--	NA	--
Uranium	2.00E-04	--	--	--	--	--	NA	--

TABLE 6-22

REFERENCES DOSES FOR CHEMICALS OF POTENTIAL CONCERN

(Page 2 of 2)

Chemical of Potential Concern	Oral RfD						Inhalation RfDi	
	RfD (mg/kg/day)	RfD Source (date accessed)	Confidence Level	Critical Effect or Site of Critical Effect	UF	MF	RfDi (mg/kg/day)	RfDi Source
Vanadium	7.00E-03	HEAST	Medium	Occular exudate, inflamed and prominent meibamian glands	300	1	NA	--
Zinc	3.00E-01	IRIS (04/10/02)	--	Decrease in erythrocyte super oxide dismutase concentration	3	1	NA	--

Notes:

--	No information available
CNS	Central nervous system
EPA	U.S. Environmental Protection Agency (EPA)
HEAST	EPA's "Health Effects Assessment Summary Tables, FY1997 Update." Office of Solid Waste and Emergency Response. EPA-540-R-97-036. July.
IRIS	EPA's Integrated Risk Information System. On-Line Address: http://www.epa.gov/ngispgm3/iris/index.html
MF	Modifying factor
mg/kg/day	Milligram per kilogram per day
NA	Not applicable
PNS	Peripheral nervous system
RfD	Reference dose
RfD_i	Inhalation reference dose
UF	Uncertainty factor

TABLE 6-23

SLOPE FACTORS FOR CHEMICALS OF POTENTIAL CONCERN

(Page 1 of 2)

Chemical of Potential Concern	SF $(mg/kg/day)^{-1}$	SF Source (date accessed)	Weight of Evidence	Sfi $(mg/kg/day)^{-1}$	Sfi Source (date accessed)
Aluminum	NA	NA	--	NA	NA
Antimony	NA	NA	NA	NA	NA
Arsenic	1.5E+00	IRIS (10/18/00)	A	15	IRIS
Barium	NA	NA	--	NA	NA
Beryllium	NA	NA	--	8.4	IRIS
Boron	NA	NA	NA	NA	NA
Cadmium	NA	NA	--	6.3	IRIS
Chromium	NA	NA	--	294	IRIS
Cobalt	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA
Cyanide	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA
Molybdenum	NA	NA	NA	NA	NA
Nickel	NA	NA	--	1.70E+00	IRIS
Selenium	NA	NA	B2	NA	NA
Silver	NA	NA	B2	NA	NA
Thallium	NA	NA	B2	NA	NA
Uranium	NA	NA	NA	NA	NA
Vanadium	NA	NA	B2	NA	NA
Zinc	NA	NA	B2	NA	NA

TABLE 6-23

SLOPE FACTORS FOR CHEMICALS OF POTENTIAL CONCERN

(Page 2 of 2)

Notes:

--	Information was not available
A	Proven carcinogen in humans
B2	Documented carcinogenicity in animal studies, but evidence of carcinogenicity in humans is inconclusive
IRIS	U.S. Environmental Protection Agency's Integrated Risk Information System. On-Line Address: http://www.epa.gov/ngispgm3/iris/index.html
mg/kg/day	Milligram per kilogram per day
NA	Not applicable
SF	Slope factor
SF_i	Inhalation slope factor

TABLE 6-24

TIER 1 HAZARD SUMMARY

(Page 1 of 1)

Receptor	Inhalation of Particulates	Ingestion of Surface Water	Ingestion of Elk		Ingestion of Beef		Ingestion of Aquatic Life (fish)	Ingestion of Terr/Aq Plants	Ingestion of Tea	Ingestion of Surface Soil	Ingestion of Homegrown Produce	Total
			Skeletal	Offal	Skeletal	Offal						
Rec Adult	1.2E-04	1.3E-01	5.6E-03	1.7E-03	8.2E-02	1.8E-02	8.1E-01	NA	NA	NA	NA	**1.0E+00**
Rec Child	4.2E-04	3.8E-01	8.1E-03	7.0E-03	1.5E-01	8.6E-02	**1.4E+00**	NA	NA	NA	NA	**2.0E+00**
NA Adult	1.2E-04	1.3E-01	5.2E-04	4.2E-04	1.0E-01	5.1E-02	**1.2E+00**	2.0E-02	8.7E-01	NA	NA	**2.4E+00**
NA Child	4.2E-04	3.8E-01	7.5E-04	6.1E-04	1.9E-01	9.2E-02	**2.0E+00**	2.0E-02	4.8E-01	NA	NA	**3.2E+00**
SL Adult	3.4E-04	3.6E-01	6.9E-02	1.7E-03	8.2E-02	1.8E-02	**5.5E+00**	NA	NA	3.5E-01	1.1E-02	**6.4E+00**
SL Child	1.2E-03	**1.1E+00**	1.8E-01	7.0E-03	1.5E-01	8.6E-02	**9.2E+00**	NA	NA	**3.2E+00**	1.4E-02	**1.4E+01**

Notes:

NA	Not applicable
NA Adult	Native American adult
NA Child	Native American child
Rec Adult	Adult recreationalist
Rec Child	Child recreationalist
SL Adult	Subsistence lifestyle adult
SL Child	Subsistence lifestyle child
Terr/Aq	Terrestrial/aquatic

Bolded results denote significant hazard.

Significant exposure pathways:

Recreationalist:	Ingestion of aquatic life (fish): hazards driven by cadmium and selenium
Native American:	Ingestion of aquatic life (fish): hazards driven by cadmium and selenium
Subsistence Lifestyle:	Ingestion of aquatic life (fish): hazards driven by cadmium and selenium
	Ingestion of surface soil (child only): hazards driven by arsenic and cadmium
	Ingestion of surface water (child only): hazards driven by selenium

TABLE 6-25

TIER 1 RISK SUMMARY

(Page 1 of 1)

Receptor	Inhalation of Particulates	Ingestion of Surface Water	Ingestion of Elk		Ingestion of Beef		Ingestion of Aquatic Life (fish)	Ingestion of Terr/Aq Plants	Ingestion of Tea	Ingestion of Surface Soil	Ingestion of Homegrown Produce	Total
			Skeletal	Offal	Skeletal	Offal						
Rec Adult	4.3E-07	--	--	--	--	--	--	NA	NA	NA	NA	4.3E-07
Rec Child	3.0E-07	--	--	--	--	--	--	NA	NA	NA	NA	3.0E-07
Rec Total	7.3E-07	--	--	--	--	--	--	NA	NA	NA	NA	7.3E-07
NA Adult	4.3E-07	--	--	--	--	--	--	3.8E-07	2.8E-07	NA	NA	**1.1E-06**
NA Child	3.0E-07	--	--	--	--	--	--	7.6E-08	3.1E-08	NA	NA	4.1E-07
NA Total	7.3E-07	--	--	--	--	--	--	4.6E-07	3.1E-07	NA	NA	**1.5E-06**
SL Adult	1.2E-06[1]	--	--	--	--	--	--	NA	NA	**2.6E-05**	2.0E-09	**2.7E-05**
SL Child	1.2E-06[1]	--	--	--	--	--	--	NA	NA	**4.8E-05**	5.3E-10	**4.9E-05**
SL Total	2.4E-06[1]	--	--	--	--	--	--	NA	NA	**7.3E-05**	2.5E-09	**7.6E-05**

Notes:

NA Not applicable
NA Adult Native American adult
NA Child Native American child
Rec Adult Adult recreationalist
Rec Child Child recreationalist
SL Adult Subsistence lifestyle adult
SL Child Subsistence lifestyle child
Terr/Aq Terrestrial/aquatic

[1] These results are based on the assumption that chromium detected in waste pile soil is present entirely as hexavalent chromium. As discussed in Section 6.7.2.2, these results are expected to be less than 1E-06 when more realistic estimates of the percentage of hexavalent chromium in waste pile soil are applied.

Bolded results denote significant risk.

Significant exposure pathways:

Recreationalist: None
Native American: None
Subsistence Lifestyle: Ingestion of surface soil; risks driven by arsenic only

TABLE 6-26

TIER 2 HAZARD INDEX SUMMARY – REASONABLE MAXIMUM EXPOSURE CONDITIONS[1]

(Page 1 of 2)

Receptor[2]	Ingestion of Surface Water	Ingestion of Elk		Ingestion of Beef		Ingestion of Aquatic Life (Fish)	Ingestion of Surface Soil	Total HI		
		Skeletal[3]	Offal[3]	Skeletal[3]	Offal[3]			Blackfoot/ Little Blackfoot Watershed	Salt Watershed	Georgetown Watershed
Recreational Adult	BW – 1.6E-03 SW – 5.7E-04 GW – 2.7E-04	2.6E-03	5.8E-04	5.5E-02	2.2E-03	BW – 3.5E-01 SW – 2.2E-01 GW – 4.7E-01	NA	4.1E-01	2.8E-01	5.3E-01
Recreational Child	BW – 4.8E-03 SW – 1.7E-03 GW – 7.9E-04	3.8E-03	2.3E-03	1.0E-01	1.0E-02	BW – 5.8E-01 SW – 3.7E-01 GW – 7.9E-01	NA	7.1E-01	4.9E-01	9.1E-01
Native American Adult	BW – 1.6E-03 SW – 5.7E-04 GW – 2.7E-04	2.4E-04	1.4E-04	6.7E-02	6.0E-03	BW – 5.2E-01 SW – 3.3E-01 GW – 7.0E-01	NA	6.0E-01	4.0E-01	7.8E-01
Native American Child	BW – 4.8E-03 SW – 1.7E-03 GW – 7.9E-04	3.6E-04	2.0E-04	1.2E-01	1.1E-02	BW – 8.7E-01 SW – 5.5E-01 GW – 1.2E+00	NA	1.0E+00	6.9E-01	1.3E+00
Subsistence Lifestyle Adult	BW – 4.6E-03 SW – 1.6E-03 GW – 7.5E-04	3.2E-02	5.8E-04	5.5E-02	2.3E-03	BW – 2.4E+00 SW – 1.5E+00 GW – 3.2E+00	1.7E-01 (RA1)	2.6E+00	1.8E+00	3.4E+00
Subsistence Lifestyle Child	BW – 1.4E-02 SW – 4.8E-03 GW – 2.2E-03	8.4E-02	2.3E-03	1.0E-01	1.0E-02	BW – 4.0E+00 SW – 2.5E+00 GW – 5.3E+00	1.6E+00 (RA1; all others <1)	5.8E+00	4.3E+00	7.1E+00

Notes:

BW Blackfoot/Little Blackfoot River watershed
GW Georgetown Creek watershed
HI Hazard index
NA Not applicable
RA1 Residential area 1 (soil sample location SL002)
RME Reasonable maximum exposure
SW Salt River watershed
Terr/Aq Terrestrial/Aquatic

1 Exposure pathways associated with total risks and total hazard indexes (HI) less than 1E-06 and 1, respectively, under Tier 1, were not retained for analysis under Tier 2. On this basis, four exposure pathways were not evaluated under Tier 2: inhalation of particulates, ingestion of aquatic and terrestrial plants, ingestion of tea made from terrestrial plants, and ingestion of homegrown produce. Similarly, individual chemicals of potential concern (COPC) associated

TABLE 6-26

TIER 2 HAZARD INDEX SUMMARY – REASONABLE MAXIMUM EXPOSURE CONDITIONS[1]

(Page 2 of 2)

with risks and HIs less than 1E-07 and 0.1, respectively, were also eliminated. On this basis, only four COPCs were evaluated under Tier 2: arsenic, cadmium, chromium, and selenium. See also footnote 3.

2 Receptor-specific hazard results are presented in Appendix E.

3 Ingestion of elk and beef cattle skeletal muscle and offal were associated with HIs less than 1 for all receptors under Tier 1. However, these exposure pathways were retained for consideration under Tier 2 primarily because hunting and ranching in the Resource Area are popular activities and, therefore, these exposure pathways may be of particular concern to the public.

TABLE 6-27

TIER 2 HAZARD INDEX SUMMARY – CENTRAL TENDENCY CONDITIONS[1]

(Page 1 of 2)

Receptor[2]	Ingestion of Surface Water	Ingestion of Elk		Ingestion of Beef		Ingestion of Aquatic Life (Fish)	Ingestion of Surface Soil	Total HI		
		Skeletal[3]	Offal[3]	Skeletal[3]	Offal[3]			Blackfoot/ Little Blackfoot Watershed	Salt Watershed	Georgetown Watershed
Recreational Adult	BW – 2.3E-04 SW – 6.4E-05 GW – 5.8E-05	9.4E-04	2.3E-03	5.4E-03	3.1E-04	BW – 7.8E-02 SW – 5.2E-02 GW – 6.0E-02	NA	8.7E-02	6.1E-02	6.9E-02
Recreational Child	BW – 5.7E-04 SW – 1.6E-04 GW – 1.4E-04	1.4E-03	8.6E-04	1.0E-02	1.5E-03	BW – 1.3E-01 SW – 8.7E-02 GW – 1.0E-01	NA	1.5E-01	1.0E-01	1.2E-01
Native American Adult	BW – 2.3E-04 SW - 6.4E-05 GW – 5.8E-05	8.6E-05	4.8E-05	6.6E-03	6.1E-04	BW – 1.2E-01 SW – 7.7E-02 GW – 9.0E-02	NA	1.2E-01	8.5E-02	9.7E-02
Native American Child	BW – 5.7E-04 SW – 1.6E-04 GW – 1.4E-04	1.4E-04	7.6E-05	1.2E-02	1.1E-03	BW – 2.0E-01 SW – 1.3E-01 GW – 1.5E-01	NA	2.1E-01	1.4E-01	1.6E-01
Subsistence Lifestyle Adult	BW – 6.2E-04 SW – 1.7E-04 GW – 1.6E-04	9.4E-04	2.3E-03	5.4E-03	3.1E-04	BW – 6.8E-01 SW – 4.5E-01 GW – 5.2E-01	All <0.1	7.8E-01	5.5E-01	6.2E-01
Subsistence Lifestyle Child	BW – 1.5E-03 SW – 4.2E-04 GW – 3.8E-04	1.4E-03	8.6E-04	1.0E-02	1.5E-03	BW – 1.1E+00 SW – 7.6E-01 GW – 8.8E-01	All <0.8	2.0E+00	1.6E+00	1.7E+00

Notes:

BW Blackfoot/Little Blackfoot River watershed
CTE Central tendency exposure
GW Georgetown Creek watershed
HI Hazard index
NA Not applicable
SW Salt River watershed

1 Exposure pathways associated with total risks and total hazard indexes (HI) less than 1E-06 and 1, respectively, under Tier 1, were not retained for analysis under Tier 2. On this basis, four exposure pathways were not evaluated under Tier 2: inhalation of particulates, ingestion of aquatic and terrestrial plants, ingestion of tea made from terrestrial plants, and ingestion of homegrown produce. Similarly, individual chemicals of potential concern (COPC) associated with risks and HIs less than 1E-07 and 0.1, respectively, were also eliminated. On this basis, only four COPCs were evaluated under Tier 2: arsenic, cadmium, chromium, and selenium. See also footnote 3.

TABLE 6-27

TIER 2 HAZARD INDEX SUMMARY – CENTRAL TENDENCY CONDITIONS[1]

(Page 2 of 2)

2 Receptor-specific hazard results are presented in Appendix E.

3 Ingestion of elk and beef cattle skeletal muscle and offal were associated with HIs less than 1 for all receptors under Tier 1. However, these exposure pathways were retained for consideration under Tier 2 primarily because hunting and ranching in the resource area are popular activities and, therefore, these exposure pathways may be of particular concern to the public.

TABLE 6-28

TIER 2 RISK SUMMARY[1]

(Page 1 of 1)

Exposure Pathway	Subsistence Lifestyle Receptors[2]		
	Adult	Child	Total[3]
Inhalation of Particulates:	<3.9E-07 (T1)	<3.9E-07 (T1)	<7.7E-07
Ingestion of Surface Soil:			
RA1 (SL002) – As (15.95)[4]	1.4E-05 (2.1E-06)	2.6E-05 (1.3E-05)	4E-05 (2E-05)
RA2 (SL001) – As (6.97)	6.1E-06 (9.2E-07)	1.1E-05 (5.7E-06)	2E-0-5 (7E-06)
RA3 (SL005) – As (6.7)	5.9E-06 (8.9E-07)	1.1E-05 (5.5E-06)	2E-05 (6E-06)
RA4 (SL006) – As (6.44)	5.7E-06 (8.5E-07)	1.1E-05 (5.3E-06)	2E-05 (6E-06)
RA5 (ST026) – As (4.35)	3.8E-06 (5.7E-07)	7.2E-06 (3.6E-06)	1E-05 (4E-06)
RA6 (ST076) – As (7.07)	5.7E-06 (9.3E-07)	1.2E-05 (5.8E-06)	2E-05 (7E-06)
RA7 (ST130) – As (6.56)	5.7E-06 (8.7E-07)	1.1E-05 (5.4E-06)	2E-05 (6E-06)
RA8 (ST227) – As (7.19)	5.7E-06 (9.5E-07)	1.1E-05 (5.9E-06)	2E-05 (7E-06)
Unimpacted[5] – As (6.74)	5.3E-06 (8.9E-07)	1.0E-05 (5.5E-06)	2E-05 (6E-06)
Mean W. US[6] – As (5.5)	4.4E-06 (7.3E-07)	8.4E-06 (4.5E-06)	1E-05 (5E-06)

Notes:

As Arsenic
CTE Central tendency exposure
NS Not significant (less than 1E-06)
RA Residential area
RME Reasonable maximum exposure
T1 Tier 1
W. US Western United States

Risks associated with ingestion of surface soil are presented for adults, child, and total, in the form a (b), where a represents risks under reasonable maximum exposure (RME) conditions and b represents risks under (CTE) conditions.

1 Exposure pathways associated with total risks and total hazard indexes (HI) less than 1E-06 and 1, respectively, under Tier 1 were not retained for analysis under Tier 2. On this basis, four exposure pathways were not evaluated under Tier 2: inhalation of particulates, ingestion of aquatic and terrestrial plants, ingestion of tea made from terrestrial plants, and ingestion of homegrown produce. Similarly, individual chemicals of potential concern (COPC) associated with risks and HIs less than 1E-07 and 0.1, respectively, were also eliminated. On this basis, only four COPCs were evaluated under Tier 2: arsenic, cadmium, chromium, and selenium. See also footnote 3.

2 Receptor-specific hazard results are presented in Tables 6-26 and 6-27 (subsistence lifestyle adult and child, respectively)

3 Because the risks associated with ingestion of soil greatly exceed the risks associated with inhalation of particulates, total risks for subsistence lifestyle receptors (after rounding) equal the risks associated with ingestion of soil.

4 Arsenic (As) concentrations presented in parenthesis are units of milligrams per kilogram (mg/kg)

5 The concentration of arsenic in unimpacted soil in the Resource Area was calculated as the arithmetic average of all unimpacted soil samples. See Table 6-16.

6 As presented in Shacklette and Boerngen (1984).

TABLE 6-29

BACKGROUND AND SUPPLEMENTAL EXPOSURE SUMMARY

(Page 1 of 1)

COPC	RfD (mg/kg/day)	Background Exposure (mg/kg/day)		Supplemental Exposure (mg/kg/day)	Background HI	Supplemental HI
Arsenic	3.00E-04	Child:	1.35E-02	--	4.50E+01	--
		Adult:	4.00E-04	--	1.33E+00	--
Cadmium	5.00E-04		4.30E-04	--	8.60E-01	--
Chromium	1.50E+00		1.10E-03	1.40E-03	7.33E-04	9.33E-04
Selenium	5.00E-03		1.60E-03	2.70E-04	3.20E-01	5.40E-02

Notes:

--	Information not available
COPC	Chemical of potential concern
HI	Hazard Index
mg/kg/day	Milligram per kilogram per day
RfD	Reference dose

TABLE 6-30

TIER 2 COMPARISON OF VARIOUS MEASURES OF FISH TISSUE CONCENTRATIONS[1]

(Page 1 of 1)

Watershed	COPC	Unimpacted Mean	Unimpacted UCL_{95}[4]	Area-weighted Average Concentration[2] (AWAC)	UCL_{95}[3]
Blackfoot/Little Blackfoot	Cadmium	3.00E-02	5.29E-02	5.41E-02	7.29E-02
	Chromium	3.76E-01	5.11E-01	0.45	0.69
	Selenium	1.95	3.72	2.88	4.12
Salt	Cadmium	3.00E-02	5.29E-02	3.06E-02	3.06E-02
	Chromium	3.76E-01	5.11E-01	0.38	0.52
	Selenium	1.95	3.72	1.95	2.77
Georgetown	Cadmium	3.00E-02	5.29E-02	3.76E-02	0.12
	Chromium	3.76E-01	5.11E-01	0.40	0.65
	Selenium	1.95	3.72	2.24	5.35

Notes:

COPC Chemical of potential concern
UCL_{95} 95 Percent upper confidence limit on the arithmetic mean

1 All fish tissue concentrations are presented in units of milligrams of contaminant per kilogram (mg/kg) of fish tissue – wet weight (WW) – see Tables 6-9, 6-11, and 6-13. Fish tissue concentrations were originally reported on a dry weight (DW) basis. These concentrations were converted to a WW basis using the following formula. The percent moisture (W) used in the calculations (76.5) represents the average moisture content based on all fish tissue samples collected by Tetra Tech EMI in 2001.

$$\text{Concentration WW} = \text{Concentration DW} \times ([100 - W] / 100)$$

2 The area-weighted average concentration (AWAC) is used as the exposure point concentration (EPC) under central tendency exposure (CTE) conditions. Calculation of watershed-specific AWACs is presented in Appendix C.

3 The 95 percent upper confidence level (UCL_{95}) is used as the EPC under reasonable maximum exposure (RME) conditions. Calculation of watershed-specific UCL_{95} values is presented in Appendix C.

4 The UCL_{95} values for unimpacted reaches were calculated assuming a normal distribution in order to be consistent with the arithmetic mean values for unimpacted reaches used in the weighted average calculations.

TABLE 7-1

CRITERIA FOR SURFACE WATER, SEDIMENT, AND SOIL

(Page 1 of 3)

Metal	Surface Water[1] (µg/L)		Sediment[2] (mg/kg)		Soil (mg/kg)			
					EPA Region 4[3]		EPA EcoSSLs[4]	
	Acute	Chronic	TEC	PEC	Value	Source[5]	Plant	Soil Invertebrate
Aluminum	750[6]	87[6]	25,500[7]		50	2		
Antimony	88	30	3[8]		3.5	5	Pending	NA
Arsenic	340	150	9.79	33	10	2	37	Pending
Barium					165	5		
Beryllium	130[9]	5.3[9]			1.1	5		
Boron					0.5	2		
Cadmium	4.3[18]	2.2[18]	0.99	4.98	1.6	9	29	110
Chromium	570[18]	74[18]	43.4	111	0.4	2,3	5	Pending
Cobalt					20	1,2,6	31.8[10]	
Copper	13[18]	9[18]	31.6	147	40	9	Pending[10]	61
Lead	65[11,18]	2.5[11,18]	35.8	128	50	1,2		
Manganese			630[7]		100	2		
Mercury	1.4[12]	0.77[12]	0.18	1.06	0.1	2		
Molybdenum					2	2		
Nickel	470[18]	52[18]	22.7	48.6	30	2	30.5[10]	
Selenium	13 to 186[13]	5[13]	4[14]		0.81	5	0.8[10]	
Silver	1.7[15,18]	0.12	4.5[8]		2	2		
Thallium	1,400[16]	40[16]			1	2		
Uranium					5	2		
Vanadium					2	2		
Zinc	120[18]	120[18]	123[17]		50	2	190	120

Notes:

µg/L	Micrograms per liter	mg/L	Milligrams per liter
EcoSSL	Ecological soil screening level	PEC	Probable effect concentration
EPA	U.S. Environmental Protection Agency	TEC	Threshold effect concentration
mg/kg	Milligrams per kilogram		

TABLE 7-1

CRITERIA FOR SURFACE WATER, SEDIMENT, AND SOIL

(Page 2 of 3)

1 Taken from 1998 Federal Register 63: 68353 to 68364 and Buchman, M.F. 1999. "NOAA Screening Quick Reference Tables." National Oceanic and Atmospheric Administration (NOAA) HAZMAT Report 99-1. Coastal Protection and Restoration Division. Seattle, Washington; and 1997 Federal Register 62: 42159 to 42208).

2 Taken from MacDonald, D.D., C.G. Ingersoll, and T. Berger. 2000. "Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems." *Archives of Environmental Contamination and Toxicology*. Volume 39. Pages 20 through 31.

3 Taken from EPA, Region 4. 2001. "Recommended Ecological Screening Values (mg/kg) for Soil." Based on Friday, G.P. 1998. "Ecological Screening Values for Surface Water, Sediment, and Soil." Westinghouse Savannah River Company, Savannah River Technology Center. WSRC-TR-98-00110. Aiken, South Carolina. Found at the following Internet site: http://www.epa.gov/region4/waste/ots/ecolbul.htm.

4 Taken from EPA. 2000. "Ecological Soil Screening Level Guidance, Draft." Office of Emergency and Remedial Response. Washington, DC. July.

5 Sources for soil data from EPA Region 4: (1) Beyer, W.N. 1990. "Evaluating Soil Contamination." U.S. Fish and Wildlife Service. *Biological Report*. Volume 90. Number 2. Pages 1 through 25; (2) Efroymson, R.A., M.E. Will, and G.W. Suter, III. 1997a. "Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes." Oak Ridge National Laboratory. ES/ER/TM-126/R2 and Efroymson, R.A., M.E. Will, G.W. Suter, III, and A.C. Wooten. 1997b. "Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision." Oak Ridge National Laboratory. ES/ER/TM-85/R3; (3) Canadian Council of Ministries of the Environment. 1997. "Recommended Canadian Soil Quality Guidelines." Winnipeg, Manitoba, Canada; (4) Ministry of Housing, Spatial Planning and Environment. 1994. "Intervention Values and Target Values – Soil Quality Standards." Directorate General for Environmental Protection, Department of Soil Protection. The Hague, The Netherlands; (5) Crommentuijn, T., M.D. Polder, and E.J. van de Plassche. 1997. "Maximum Permissible Concentration and Negligible Concentrations for Metals, Taking Background Concentrations into Account." RIVM Report No. 60151001. The Netherlands.

6 For pH 6.5 to 9.0 and expressed as total recoverable.

7 Value represents the lowest threshold effects level for *Hyalella azteca* as taken from Buchman (1999).

8 Value represents the upper effects threshold based on Microtox® studies as taken from Buchman (1999).

9 Lowest observable effect level from 45 Federal Register 79326.

10 Taken from Kapustka, L.A., D.L Eskew, and R.S. Wentsel. 2000. "Phytotoxicity Testing for Ecological Soil Screening Levels (EcoSSLs): Cobalt, Selenium, Nickel, and Pentachlorophenol." Poster Presentation, 21st Annual Meeting, Society of Environmental Toxicology and Chemistry, 12 to 16 November. Nashville, Tennessee.

11 Values represent change to filtered basis.

12 Derived from inorganic mercury but applied to total mercury. Does not account for food web uptake.

13 Freshwater acute value depends on ratio of selenite to selenate.

TABLE 7-1

CRITERIA FOR SURFACE WATER, SEDIMENT, AND SOIL

(Page 3 of 3)

[14] Value represents the toxicity threshold as recommended by Van Derveer and Canton (1997), San Joaquin Valley Drainage Program (1990) and Lemly and Smith (1987) as cited in Skorupa, J. 1998. "Selenium." In P.L. Martin and D.E. Larsen (editors). Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. National Irrigation Water Quality Program Information Report No. 3. Department of the Interior. Pages 139 through 184. November.

[15] Acute value was adjusted by two to be comparable to 1985 derivations.

[16] Lowest observable effect level from 45 Federal Register 79340.

[17] Value represents the threshold effects level as taken from Buchman (1999).

[18] Hardness-dependent value with 25 milligram per liter (mg/L) as minimum and 400 mg/L as maximum calcium carbonate; value entered is for 100 mg/L calcium carbonate. Value must be corrected for hardness.

TABLE 7-2

ASSESSMENT ENDPOINTS AND ASSOCIATED RECEPTORS

Guild	Receptor(s)	Assessment Endpoint
Terrestrial Ecosystem		
1° Producers – Terrestrial Plants	NA	Assessed through other communities and guilds
1° Consumers – Terrestrial Invertebrates	NA	Assessed through other communities and guilds
1° Consumers – Terrestrial, Herbivorous Birds	Chipping sparrow – *Spizella passerina* Surrogate – Northern Bobwhite (*Colinus virginianus*)	Protection of terrestrial, herbivorous birds that may ingest contaminated plants and surface water and incidental ingestion of associated soil from potentially lethal, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities
1° Consumers – Terrestrial, Herbivorous Mammals	Black-tailed jackrabbit – *Lepus californicus* Surrogate – Eastern Cottontail (*Sylvilagus floridanus*)	Protection of terrestrial, herbivorous mammals that may ingest contaminated plants and surface water and incidental ingestion of associated soil from potentially systemic or general toxic effects of metals resulting from phosphate mining activities
2° Consumers – Terrestrial, Omnivorous Birds	American Robin – *Turdus migratorius*	Protection of terrestrial, omnivorous birds that may ingest contaminated food and surface water and associated soil or sediment from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities

TABLE 7-2

ASSESSMENT ENDPOINTS AND ASSOCIATED RECEPTORS

Community or Guild	Receptor(s)	Assessment Endpoint
Terrestrial Ecosystem (continued)		
2° Consumers – Terrestrial, Omnivorous Mammals	Deer Mouse – *Peromyscus maniculatus*	Protection of terrestrial, omnivorous mammals that may ingest contaminated plants, prey, and surface water and incidental ingestion of associated soil and sediment from potentially systemic or general toxic effects of metals resulting from phosphate mining activities
2° Consumers – Reptiles	NA	Assessed through other communities and guilds
Aquatic and Riparian Ecosystem		
1° Producers – Phytoplankton and Aquatic Macrophytes	NA	Assessed through other communities and guilds
1° Consumers – Zooplankton and Benthic Invertebrates	NA	Assessed through other communities and guilds
1° Consumers – Aquatic and Riparian, Herbivorous Birds	Song Sparrow – *Melospiza melodia*	Protection of aquatic and riparian, herbivorous birds that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or surface water from potentially lethal, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities

TABLE 7-2

ASSESSMENT ENDPOINTS AND ASSOCIATED RECEPTORS

Community or Guild	Receptor(s)	Assessment Endpoint
Aquatic and Riparian Ecosystem (continued)		
1° Consumers – Aquatic and Riparian, Herbivorous Mammals	Long-tailed Vole – *Microtus longicaudus* Surrogate – Meadow vole (*Microtus pennsylvanicus*)	Protection of aquatic and riparian, herbivorous mammals that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or surface water from potentially systemic, or general toxic effects of metals resulting from phosphate mining activities
1° Consumers – Benthic Fish	Common carp – *Cyprinus carpio*	Protection of benthic fish from contaminated food and associated sediments form potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities
2° Consumers – Aquatic and Riparian, Omnivorous Birds	Yellow-headed blackbird – *Xanthocephalus xanthocephalus* Surrogate will be the Red-winged blackbird – *Agelaius phoeniceus*	Protection of aquatic and riparian, omnivorous birds that may ingest contaminated food and associated soil, sediment, or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities

TABLE 7-2

ASSESSMENT ENDPOINTS AND ASSOCIATED RECEPTORS

Community or Guild	Receptor(s)	Assessment Endpoint
Aquatic and Riparian Ecosys tem (continued)		
2° Consumers – Aquatic and Riparian, Piscivorous Birds	Great blue heron – *Ardea herodias*	Protection of aquatic and riparian, piscivorous birds that may ingest contaminated food and associated sediment or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities
2° Consumers – Aquatic and Riparian, Benthic-feeding Birds	Mallard – *Anas platyrhynchas*	Protection of aquatic and riparian, benthic-feeding birds that may ingest contaminated food and associated sediment or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities
2° Consumers – Aquatic and Riparian, Omnivorous Mammals	Raccoon – *Procyon lotor*	Protection of aquatic and riparian, omnivorous mammals that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining activities

TABLE 7-2

ASSESSMENT ENDPOINTS AND ASSOCIATED RECEPTORS

Community or Guild	Receptor(s)	Assessment Endpoint
Aquatic and Riparian Ecosystem (continued)		
2° Consumers – Aquatic and Riparian, Carnivorous Mammals	Mink – *Mustela vison*	Protection of aquatic and riparian, carnivorous mammals that may ingest contaminated prey and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining activities
2° Consumers – Fish	Large-spotted Snake River cutthroat trout (Yellowstone cutthroat trout)– *Oncorhynchus clarki bouvieri* Surrogate is the Rainbow trout – *Oncorhynchus mykiss*	Protection of fish from contaminated food and associated sediments and water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities
2° Consumers – Amphibians	NA	Assessed through other communities and guilds
Tertiary Consumers		
3° Consumers – Carnivorous Mammals	Coyote – *Canis latrans*	Protection of carnivorous mammals that may ingest contaminated prey and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining activities

TABLE 7-2

ASSESSMENT ENDPOINTS AND ASSOCIATED RECEPTORS

Community or Guild	Receptor(s)	Assessment Endpoint
Tertiary Consumers (continued)		
3° Consumers – Raptors	Northern Harrier (*Circus cyaneus*)	Protection of raptors that may ingest contaminated food and associated soil, sediment, or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities

Notes:

NA Not applicable

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Terrestrial Ecosystem			
Terrestrial, Herbivorous Birds	Chipping sparrow Surrogate - Northern bobwhite	Protection of terrestrial, herbivorous birds that may ingest contaminated plants and surface water and incidental ingestion of associated soil from potentially lethal, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values
Terrestrial, Herbivorous Mammals	Black-tailed jackrabbit Surrogate – Eastern Cottontail	Protection of terrestrial, herbivorous mammals that may ingest contaminated plants and surface water and incidental ingestion of associated soil from potentially systemic or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Terrestrial Ecosystem (continued)			
Terrestrial, Omnivorous Birds	American robin	Protection of terrestrial, omnivorous birds that may ingest contaminated food and surface water and associated soil or sediment from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values
Terrestrial, Omnivorous Mammals	Deer mouse	Protection of terrestrial, omnivorous mammals that may ingest contaminated plants, prey, and surface water and incidental ingestion of associated soil and sediment from potentially systemic or general toxic effects of metals resulting from phosphate mining activities.	1. Collect, analyze, and evaluate tissue residue data 2. Measurement of COPEC concentrations in selected food items 3. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 4. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Aquatic And Riparian Ecosystem			
Aquatic and Riparian, Herbivorous Birds	Song sparrow	Protection of aquatic and riparian, herbivorous birds that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or surface water from potentially lethal, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values
Aquatic and Riparian, Herbivorous Mammals	Long-tailed vole Surrogate – Meadow vole	Protection of aquatic and riparian, herbivorous mammals that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or surface water from potentially systemic or general toxic effects of metals resulting from phosphate mining activities.	1. Collect, analyze, and evaluate tissue residue data 2. Measurement of COPEC concentrations in selected food items 3. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 4. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Aquatic and Riparian Ecosystem (continued)			
Benthic Fish	Common carp	Protection of benthic fish from contaminated food and associated sediments form potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Collect, analyze, and evaluate tissue residue data 2. Measurement of COPEC concentrations in selected food items 3. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 4. Evaluate differences in aquatic community structure between impacted and background areas
Aquatic and Riparian, Omnivorous Birds	Yellow-headed blackbird Surrogate - Red-winged blackbird	Protection of aquatic and riparian, omnivorous birds that may ingest contaminated food and associated soil, sediment, or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Aquatic and Riparian Ecosystem (continued)			
Aquatic and Riparian, Piscivorous Birds	Great blue heron	Protection of aquatic and riparian, piscivorous birds that may ingest contaminated food and associated sediment or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values
Aquatic and riparian benthic-feeding birds	Mallard	Protection of aquatic and riparian, benthic-feeding birds that may ingest contaminated food and associated sediment or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Aquatic and Riparian Ecosystem(continued)			
Aquatic and Riparian, Omnivorous Mammals	Raccoon	Protection of aquatic and riparian, omnivorous mammals that may ingest contaminated plant food and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values
Aquatic and Riparian, Carnivorous Mammals	Mink	Protection of aquatic and riparian, carnivorous mammals that may ingest contaminated prey and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Aquatic and Riparian Ecosystem(continued)			
Fish	Yellowstone cutthroat trout Surrogate- Rainbow trout	Protection of fish from contaminated food and associated sediments and water from potentially lethal, mutagenic, reproductive, systemic or general toxic effects of metals resulting from phosphate mining activities.	1. Collect, analyze, and evaluate tissue residue data 2. Measurement of COPEC concentrations in selected food items 3. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 4. Evaluate differences in aquatic community structure between impacted and background areas
Carnivorous Mammals	Coyote	Protection of carnivorous mammals that may ingest contaminated prey and incidental ingestion of associated soil, sediment, or water from potentially systemic or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

TABLE 7-3

MEASUREMENT ENDPOINTS USED TO ASSESS THE ASSESSMENT ENDPOINT RECEPTORS

Guild	Assessment Endpoint Receptor	Assessment Endpoint	Measurement Endpoints
Aquatic and Riparian Ecosystem(continued)			
Raptors	Northern harrier	Protection of raptors that may ingest contaminated food and associated soil, sediment, or water from potentially lethal, mutagenic, reproductive, systemic, or general toxic effects of metals resulting from phosphate mining activities.	1. Measurement of COPEC concentrations in selected food items 2. Compare concentrations in food items to levels from areas not impacted by phosphate mining activities 3. Model chemical levels in food items to calculate a potential dose and compare this dose to appropriate toxicity threshold values

Notes:

COPEC Chemical of potential ecological concern

TABLE 7-4

SUMMARY OF CONSERVATIVE EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Assumptions	Reference and Basis of Value
Body Weight (kilograms)		
Northern bobwhite	0.1939	Robel (1969, as cited in EPA 1993b), based on lowest mean body weight of both sexes for three seasons from Kansas
Eastern cottontail	1.800	Lord (1963, as cited in EPA 1993b), based on lowest body weight for both sexes from Illinois
American robin	0.103	Based on the lowest body weight of an adult robin of both sexes from Pennsylvania (Clench and Leberman 1978, as cited in EPA 1993b)
Deer mouse	0.022	Millar (1989, as cited in EPA 1993), based on lowest mean body weight for both males and females from North America
Song sparrow	0.0232	Smith and Arcese (1988)
Meadow vole	0.039	Myers and Krebs (1971, as cited in EPA 1993b), based on lowest mean for both males and females all year from south Indiana
Red-winged blackbird	0.043	Beletsky (1996)
Great blue heron	2.500	Lowest body weight (Butler 1992)
Mallard duck	1.814	Nelson and Martin (1953, as cited in EPA 1993b), based on mean lowest body weight for females throughout the United States
Raccoon	7.100	Sanderson (1984, as cited in EPA 1993b), based on lowest body weights of wild caught males and females from Illinois
Mink	1.040	Mitchell (1961, as cited in EPA 1993b), based on the lowest mean body weight for females for summer and fall from Montana
Coyote	12.000	Based on females from Minnesota (Windberg and others 1997)
Northern harrier	0.654	Bildstein (1988, as cited in MacWhirter and Bildstein 1996)
Dietary Composition		
Northern bobwhite	85.6% Vegetation; 14.4% invertebrates	Handley (1931, as cited in EPA 1993b), based on average percentage from birds in the southeastern United States
Eastern cottontail	100% Vegetation	EPA (1993b)

TABLE 7-4

SUMMARY OF CONSERVATIVE EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Assumptions	Reference and Basis of Value
Dietary Composition (continued)		
American robin	50% Vegetation and 50% invertebrates	EPA (1993b)
Deer mouse	54.5% Vegetation and 45.5% invertebrates	Flake (1973, as cited in EPA 1993b), based on average of four seasons diet for mice from Colorado short grass prairie
Song sparrow	Primarily herbivorous and granivorous; may consume insects and other invertebrates during yoke formation	University of Michigan (2000) (http://animaldiversity.ummz.umich.edu/accounts/melospiza/m._melodia$narrative.html)
Meadow vole	98% Vegetation and 2% invertebrates	Lindroth and Batzli (1984, as cited in EPA 1993b), based on average of two studies during four seasons in Illinois
Red-winged blackbird	90% Plant material, seeds, and grains in fall and winter; 70% insects and 17% grain during the breeding season	Diet during fall and winter taken from Bent (1985), Martin and others (1961), and Crase and DeHaven (1978), all as cited in Zeiner and others (1990) Diet of males and females during breeding season in agricultural and nonagricultural land in Ontario, Canada based on McNicholl (1987)
Great blue heron	72% Fish, 17% invertebrates, and 11% miscellaneous	Prey ingestion percentages (Zeiner and others 1990)
Mallard duck	25.3% Vegetation and 74.7% invertebrates	Swanson and others (1985, as cited in EPA 1993b), based on spring breeding season in south-central North Dakota prairie pothole area

TABLE 7-4

SUMMARY OF CONSERVATIVE EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Assumptions	Reference and Basis of Value
Dietary Composition (continued)		
Raccoon	48.48% Vegetation, 31.78% invertebrates, 9.28% mammals, 6.33% reptiles/amphibians, 1.75% fish, 1.5% birds, and 0.91% other not identified	Tabatabai and Kennedy (1988) and Hamilton (1951), all as cited in EPA (1993b), based on average of percent wet volume of digestive tract or stomach contents of raccoons from Tennessee (four seasons) and New York (summer only)
Mink	54% Trout, 19% other fish, 7.5% invertebrates. 2.5% amphibians, 5.5% birds and mammals, 9% vegetation, and 2.5% unidentified	Alexander (1977, as cited in EPA 1993b), based on stomach contents for four seasons from Michigan streams and rivers.
Coyote	90% Mice, rats, rabbits, squirrels, and carrion. Some deer and ground nesting birds. Various fruits, berries, seeds, and grasses consumed when available	Omnivorous based on http://www.ukans.edu/~mammals/canis-latr.html

TABLE 7-4

SUMMARY OF CONSERVATIVE EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Assumptions	Reference and Basis of Value
Dietary Composition (continued)		
Northern harrier	80% Mammals, 15% birds, 3% reptiles and amphibians, and 2% invertebrates	Bildstein (1987), based on pellet content in the northern part of the harrier range and another study by Brown and Amadon (1968)
Food Ingestion Rate (grams per day)		
Northern bobwhite	27.095	Value shown is calculated using mean body weight (BW = 193.9 grams) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in grams]$^{0.681}$)/14 (Nagy and others 1999)
Eastern cottontail	100.63	Value shown is calculated using mean body weight (BW = 1,800 grams) in an allometric equation for herbivorous mammals, food requirements for herbivores (7.94 x [BW in grams]$^{0.646}$)/10 (Nagy and others 1999)
American robin	17.61	Value shown is calculated using mean body weight (BW = 103 grams) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in grams]$^{0.681}$)/14 (Nagy and others 1999)
Deer mouse	3.54	Value shown is calculated using mean body weight (BW = 22 grams) in an allometric equation for rodents, food requirements for omnivores (5.48 x [BW in grams]$^{0.712}$)/14 (Nagy and others 1999)
Song sparrow	6.37	Value shown is calculated using mean body weight (BW = 23.15 grams) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in grams]$^{0.681}$)/14 (Nagy and others 1999)
Meadow vole	7.44	Value shown is calculated using mean body weight (BW = 39 grams) in an allometric equation for rodents, food requirements for herbivores (5.48 x [BW in grams]$^{0.712}$)/10 (Nagy and others 1999)
Red-winged blackbird	9.7	Value shown is calculated using mean body weight (BW = 43 grams) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in grams]$^{0.681}$)/14 (Nagy and others 1999)
Great blue heron	133.56	Value shown calculated using mean body weight (BW = 2,500 grams) in an allometric equation for all birds, food requirements for piscivores (10.5 x [BW in grams]$^{0.681}$)/16.2 (Nagy and others 1999)

TABLE 7-4

SUMMARY OF CONSERVATIVE EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Assumptions	Reference and Basis of Value
Food Ingestion Rate (grams per day) (continued)		
Mallard duck	124.22	Value shown calculated using mean body weight (BW = 1,814 grams) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in grams]$^{0.681}$)/14 (Nagy and others 1999)
Raccoon	155.17	Value shown is calculated using mean body weight (BW = 7,100 grams) in an allometric equation for omnivorous mammals, food requirements for omnivores (6.03 x [BW in grams]$^{0.678}$)/14 (Nagy and others 1999)
Mink	31.7	Value shown is calculated using mean body weight (BW = 1,040 grams) in an allometric equation for omnivorous mammals, food requirements for omnivores (6.03 x [BW in grams]$^{0.678}$)/14 (Nagy and others 1999)
Coyote	251.115	Value shown is calculated using mean body weight (BW = 12,000 grams) in an allometric equation for omnivorous mammals, food requirements for omnivores (6.03 x [BW in grams]$^{0.678}$)/14 (Nagy and others 1999)
Northern harrier	48.23	Calculated using mean body weight (BW = 654 grams) in an allometric equation for all birds, food requirements for all birds (10.5 x [BW]$^{0.681}$)/18 (Nagy and others 1999)
Water Ingestion Rate (liters per day)		
Northern bobwhite	0.020	Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Eastern cottontail	0168	Value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
American robin	0.013	Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Deer mouse	0.319	Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Song sparrow	0.0047	Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Meadow vole	0.005	Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Red-winged blackbird	0.007	Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Great blue heron	0.109	Actual value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Mallard duck	0.088	Actual value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Raccoon	0.489	Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Mink	0.059	Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Coyote	0.930	Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Northern harrier	0.044	Estimated based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)

TABLE 7-4

SUMMARY OF CONSERVATIVE EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Assumptions	Reference and Basis of Value
Soil/Sediment Ingestion Rate (grams per day)		
Northern bobwhite	0.54	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for omnivores (Beyer 1994)
Eastern cottontail	2.42	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2.4% for herbivores (Beyer 1994)
American robin	0.35	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for omnivores (Beyer 1994)
Deer mouse	0.07	Deer mouse consumption habits are assumed to be similar to those of the white-footed mouse. Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for the white-footed mouse (Beyer 1994)
Song sparrow	0.1274	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for omnivores (Beyer 1994)
Meadow vole	0.18	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2.4% for the meadow vole (Beyer 1994)
Red-winged blackbird	0.241	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for omnivores (Beyer 1994)
Great blue heron	0.93	Ingestion of sediment (I_{sed}) as percentage of food intake based on 0.7 percent of IR, which is based on studies of the bald eagle (Pascoe and others 1996)
Mallard duck	4.10	Ingestion of sediment (I_{sed}) as percentage of food intake reported at 3.3% for the mallard (Beyer 1994)
Raccoon	14.59	Ingestion of soil/sediment ($I_{soil/sed}$) as percentage of food intake reported at 9.4% for the raccoon (Beyer 1994)
Mink	2.98	Mink food consumption habits are assumed to be similar to those of the raccoon. Ingestion of soil/sediment ($I_{soil/sed}$) as percentage of food intake reported at 9.4% for the raccoon (Beyer 1994)
Coyote	7.03	Coyote food consumption habits are assumed to be similar to those of the red fox. Based on ingestion of soil (I_{soil}) as percentage of food intake reported at 2.8% for the red fox (Beyer 1994)
Northern harrier	0.34	Harrier food consumption habits are assumed to be similar to those of bald eagles. Based on 0.7% of estimated sediment ingestion rate for the bald eagle in Pascoe and others (1996)
Home Range (acres)		
Northern bobwhite	38.55	Urban (1972, as cited in EPA 1993b), based on highest mean home range of postnesting females from southern Illinois
Eastern cottontail	7.39	Dixon and others (1981, as cited in EPA 1993b), based on highest mean range of females during winter in Wisconsin

TABLE 7-4

SUMMARY OF CONSERVATIVE EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Assumptions	Reference and Basis of Value
Home Range (acres) (continued)		
American robin	0.395	Based on mean territory size for both sexes from New York in dense conifers and unspecified forest (Howell 1942, as cited in EPA 1993b)
Deer mouse	0.23	Bowers and Smith (1979, as cited in EPA 1993b), based on highest mean of female range from Idaho desert area
Song sparrow	4.25	Based on the highest home range of adult females in Marin County, California (Halliburton and Mewaldt 1976)
Meadow vole	0.03	Douglass (1976, as cited in EPA 1993b), based on greatest range of both sexes during summer from alluvial bench in Montana
Red-winged blackbird	0.555	Highest mean territory size based on observations in uplands and marshlands (Weatherford and Robertson 1977; Eckert and Weatherford 1977; and Searcy and Yasukawa 1995, all as cited in Yasukawa and Searcy 1995)
Great blue heron	20.76	Largest feeding territory for both sexes in winter in an Oregon estuary (Bayer 1978, as cited in EPA 1993b)
Mallard duck	1,776.65	Dwyer and others (1979, as cited in EPA 1993b), based on highest value for adult females
Raccoon	8,127	Fritzell (1978, as cited in EPA 1993b), based on highest male and female home ranges in North Dakota prairie pothole area
Mink	4,524	Mitchell (1961, as cited in EPA 1993b and http://www.sibr.com/mammals/M158.html), based on highest male home ranges in Montana from heavy and sparse vegetation riverine area
Coyote	7,240.00	Woodruff and Keller (1982)
Northern harrier	3,706.50	Highest home range of eight studies (Smith and Murphy 1973; Rees 1976; Toland 1985a; Martin 1987; Serrantino 1987, all as cited in MacWhirter and Bildstein 1996)

Notes:

BW Body weight
EPA U.S. Environmental Protection Agency
IR Ingestion rate
kg Kilogram

TABLE 7-5

SUMMARY OF MEAN EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Mean	Reference and Basis of Value
Body Weight (gram or kilogram)		
Northern bobwhite	191.13/0.191	Robel (1969, as cited in EPA 1993b) based on average body weight of both sexes for three seasons from Kansas
Eastern cottontail	1,231.0/1.231	Lord (1963, as cited in EPA 1993b) based on mean for both sexes from Illinois
American robin	77.3/0.077	Based on the mean body weight of an adult robin from Pennsylvania (Clench and Leberman 1978, as cited in EPA 1993b)
Deer mouse	21.0/0.021	Millar (1989, as cited in EPA 1993b) based on body weights for both males and females from North America
Song sparrow	23.48/0.0235	Smith and Arcese (1988)
Meadow vole	37.25/0.037	Myers and Krebs (1971, as cited in EPA 1993b) based on average body weights of males and females from collections made all year from south Indiana
Red-winged blackbird	59.0/0.059	Beletsky (1996)
Great blue heron	2,090.0/2.09	Body weight (Butler 1992)
Mallard duck	1,134.0/1.134	Nelson and Martin (1953, as cited in EPA 1993b) based on average of mean body weights for both males and females from throughout the U.S.
Raccoon	6,666/6.7	Sanderson (1984, as cited in EPA 1993b) based on mean body weights of wild caught males and females from Illinois
Mink	852/0.852	Mitchell (1961, as cited in EPA 1993b) based on the average of mean body weights for both males and females for summer and fall from Montana
Coyote	10,500/10.5	Based on females from Minnesota (Windberg and others 1997; Berg and Chesness 1978)
Northern harrier	513.0 /0513	Bildstein (1988, as cited in MacWhirter and Bildstein 1996)
Dietary Composition		
Northern bobwhite	85.6% Vegetation and 14.4% invertebrates	Handley (1931, as cited in EPA 1993b) based on average percentage from birds in the southeastern United States
Eastern cottontail	100% Vegetation	EPA (1993)
American robin	50% Vegetation and 50% invertebrates	EPA (1993)
Deer mouse	54.5% Vegetation and 45.5% invertebrates	Flake (1973, as cited in EPA 1993b) based on average of four seasons diet for mice from Colorado short grass prairie

TABLE 7-5

SUMMARY OF MEAN EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Mean	Reference and Basis of Value
Dietary Composition (continued)		
Song sparrow	Primarily herbivorous and granivorous; may consume insects and other invertebrates during yoke formation	University of Michigan (2000) (http://aniumaldiversity.ummz.umich.edu/accounts/melospiza/m._melodia$narrative.html)
Meadow vole	98% Vegetation and 2% invertebrates	Lindroth and Batzli (1984, as cited in EPA 1993b) based on average of two studies during four seasons in Illinois
Red-winged blackbird	90% plant material, seeds, and brains in fall and winter; 70% insects and 17% grain during the breeding season	Diet during fall and winter taken from Brent (1985), Martin and others (1961), and Crase and DeHaven (1978), all as cited in Ziener and others (1990) Diet of males and females during breeding season in agricultural and nonagricultural land based on McNicholl (1987)
Great blue heron	72% Fish, 17% invertebrates, and 11% miscellaneous	Prey ingestion percentages (Zeiner and others 1990)
Mallard duck	25.3% Vegetation and 74.7% invertebrates	Swanson and others (1985, as cited in EPA 1993b), based on spring breeding season in south central North Dakota prairie pothole area
Raccoon	48.48% Vegetation, 31.78% invertebrates, 9.28% mammals, 6.33% reptiles/amphibians, 1.75% fish, 1.5% birds, and 0.91% other not identified	Tabatabai and Kennedy (1988) and Hamilton (1951), as cited in EPA (1993b), based on average of percent wet volume of digestive tract or stomach contents of raccoons from Tennessee (four seasons) and New York (summer only)
Mink	54% Trout, 19% other fish, 7.5% invertebrates., 2.5% amphibians, 5.5% birds and mammals, 9% vegetation, and 2.5% unidentified	Alexander (1977, as cited in EPA 1993b), based on stomach contents for four seasons from Michigan streams and rivers

TABLE 7-5

SUMMARY OF MEAN EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Mean	Reference and Basis of Value
Dietary Composition (continued)		
Coyote	90% Mice, rats, rabbits, squirrels, and carrion. Some deer and ground nesting birds. Various fruits, berries, seeds, and grasses consumed when available.	Omnivorous, based on http://www.ukans.edu/~mammals/canis -latr.html
Northern harrier	80% Mammals, 15% birds, 3% reptiles and amphibians, and 2% invertebrates	Bildstein (1987), based on pellet content in the northern part of the harrier range and another study by Brown and Amadon (1968)
Food Ingestion Rate (gram per gram per day)		
Northern bobwhite	26.83	Published value of 0.078 g/g/day in Koerth and Guthery (1991, as cited in EPA 1993b), based on average of ingestion rates for both sexes over four seasons from captive breed birds in southern Texas. Value shown is calculated using mean body weight (BW = 191.13 grams [g]) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in g]$^{0.681}$)/14 (Nagy and others 1999)
Eastern cottontail	78.73	Value shown is calculated using mean body weight (BW = 1,231 g) in an allometric equation for herbivorous mammals, food requirements for herbivores (7.94 x [BW in g]$^{0.646}$)/10 (Nagy and others 1999)
American robin	14.48	Value shown is calculated using mean body weight (BW = 77.3 g) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in g]$^{0.681}$)/14 (Nagy and others 1999)
Deer mouse	3.42	Published value of 0.27 g/g/day based on average of five studies of nonbreeding and lactating females and one nonbreeding male (EPA 1993b). Value shown is calculated using mean body weight (BW = 21 g) in an allometric equation for rodents, food requirements for omnivores (5.48 x [BW in g]$^{0.712}$)/14 (Nagy and others 1999)
Song sparrow	6.43	Value shown is calculated using mean body weight (BW = 23.48 g) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in g]$^{0.681}$)/14 (Nagy and others 1999)
Meadow vole	7.201	Published value of 0.325 g/g/day Ognev (1950, as cited in EPA 1993b), based on midpoint of mean from study in Russia. Value shown is calculated using mean body weight (BW = 37.25 g) in an allometric equation for rodents, food requirements for herbivores (5.48 x [BW in g]$^{0.712}$)/10 (Nagy and others 1999)

TABLE 7-5

SUMMARY OF MEAN EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Mean	Reference and Basis of Value
Food Ingestion Rate (gram per gram per day) (continued)		
Red-winged blackbird	12.05	Value shown is calculated using mean body weight (BW = 59.0 g) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in g]$^{0.681}$)/14 (Nagy and others 1999)
Great blue heron	118.22	Value shown calculated using mean body weight (BW = 2,090 g) in an allometric equation for all birds, food requirements for piscivores (10.5 x [BW in g]$^{0.681}$)/16.2 (Nagy and others 1999)
Mallard duck	90.21	Value shown calculated using mean body weight (BW = 1,134 g) in an allometric equation for all birds, food requirements for omnivores (10.5 x [BW in g]$^{0.681}$)/14 (Nagy and others 1999)
Raccoon	168.56	Value shown is calculated using mean body weight (BW = 6,666 g) in an allometric equation for omnivorous mammals, food requirements for omnivores (6.03 x [BW in g]$^{0.678}$)/14 (Nagy and others 1999)
Mink	41.79	Published value of 0.22 g/g/day (EPA 1993b) estimated value for male for year-round. Value shown is calculated using mean body weight (BW = 852.25 g) in an allometric equation for omnivorous mammals, food requirements for omnivores (6.03 x [BW in g]$^{0.678}$)/14 (Nagy and others 1999)
Coyote	229.38	Value shown is calculated using mean body weight (BW = 10,500 g) in an allometric equation for omnivorous mammals, food requirements for omnivores (6.03 x [BW in g]$^{0.678}$)/14 (Nagy and others 1999)
Northern harrier	40.88	Calculated using mean body weight (BW = 513.0 g) in an allometric equation for all birds, food requirements for all birds (10.5 x [BW]$^{0.681}$)/18 (Nagy and others 1999)
Water Ingestion Rate (liter per day)		
Northern bobwhite	0.019	Reported value of 0.105 g/g/day from EPA (1993b), based on estimate for male and female in summer. Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Eastern cottontail	0.12	Published value of 0.097 g/g/day, based on estimate for both sexes (EPA 1993b). Value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
American robin	0.011	Published value of 0.14 g/g/day (EPA 1993b). Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Deer mouse	0.31	Published value of $IR_{water} = 0.19$ g/g/day, based on Ross (1930); Dice (1922, as cited in EPA 1993b) based on two laboratory studies in Illinois for both sexes. Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Song sparrow	0.0053	Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Meadow vole	0.005	Published value of 0.14 g/g/day EPA (1993) based on estimated value for both sexes. Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)

TABLE 7-5

SUMMARY OF MEAN EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Mean	Reference and Basis of Value
Water Ingestion Rate (liter per day) (continued)		
Red-winged blackbird	0.0089	Value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Great blue heron	0.097	Published value of 0.045 g/g/day, based on estimated value for both sexes (EPA 1993b). Actual value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Mallard duck	0.064	Actual value shown is based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Raccoon	0.553	Published value of 0.083 g/g/day (EPA 1993b), based on estimated rate for the female. Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Mink	0.0857	Published value of 0.11 g/g/day (EPA 1993b), based on estimated rate for the fema le. Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Coyote	0.822	Actual value shown is based on the following equation: $IR_{water} = 0.099 \times BW(kg)^{0.90}$ (EPA 1993b)
Northern harrier	0.0377	Estimated based on the following equation: $IR_{water} = 0.059 \times BW(kg)^{0.67}$ (EPA 1993b)
Soil/Sediment Ingestion Rate (gram per day)		
Northern bobwhite	0.54	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for omnivores (Beyer 1994)
Eastern cottontail	1.89	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2.4% for herbivores (Beyer 1994)
American Robin	0.29	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for omnivores (Beyer 1994)
Deer mouse	0.07	Deer mouse consumption habits are assumed to be similar to those of the white-footed mouse. Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for the white-footed mouse (Beyer 1994)
Song sparrow	0.1286	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for the white-footed mouse (Beyer 1994)
Meadow vole	0.173	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2.4% for the meadow vole (Beyer 1994)
Red-winged blackbird	0.241	Ingestion of soil (I_{soil}) as percentage of food intake reported at 2% for the white-footed mouse (Beyer 1994)
Great blue heron	0.83	Ingestion of sediment (I_{sed}) as percentage of food intake based on 0.7%of IR, which is based on studies of the bald eagle (Pascoe and others 1996)
Mallard duck	2.98	Ingestion of sediment (I_{sed}) as percentage of food intake reported at 3.3% for the mallard (Beyer 1994)

TABLE 7-5

SUMMARY OF MEAN EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Mean	Reference and Basis of Value
Soil/Sediment Ingestion Rate (gram per day) (continued)		
Raccoon	15.84	Ingestion of soil/sediment ($I_{soil/sed}$) as percentage of food intake reported at 9.4% for the raccoon (Beyer 1994)
Mink	3.92	Mink food consumption habits are assumed to be similar to those of the raccoon. Ingestion of soil/sediment ($I_{soil/sed}$) as percentage of food intake reported at 9.4% for the raccoon (Beyer 1994)
Coyote	6.42	Coyote food consumption habits are assumed to be similar to those of the red fox. Based on ingestion of soil (I_{soil}) as percentage of food intake reported at 2.8% for the red fox (Beyer 1994)
Northern harrier	0.286	Harrier food consumption habits are assumed to be similar to those of bald eagles. Based on 0.7% of estimated sediment ingestion rate for the bald eagle in Pascoe and others (1996)
Home Ranges (acres)		
Northern bobwhite	28.61	Urban (1972, as cited in EPA 1993b), based on average of mated and unmated males, nesting and postnesting females from southern Illinois
Eastern cottontail	5.96	Trent and Rongstad (1974) and Dixon and others (1981, all as cited in EPA 1993b), based on average of males and females during summer, spring, and winter in Wisconsin
American robin	0.395	Based on adults of both sexes from New York in dense conifers and unspecified forest (Howell 1942, as cited in EPA 1993b)
Deer mouse	0.279	Bowers and Smith (1979, as cited in EPA 1993b), based on average of male and female ranges from Idaho desert area
Song sparrow	3.34	Based on the home range of adult males and females in Marin County, California (Halliburton and Mewaldt 1976)
Meadow vole	0.018	Douglass (1976, as cited in EPA 1993b), based on average of both sexes during summer and winter from alluvial bench in Montana
Red-winged blackbird	0.494	Mean territory size based on observations in uplands and marshlands (Weatherford and Robertson 1977; Eckert and Weatherford 1977, and Searcy and Yasukawa 1995 as cited in Yasukawa and Searcy 1995)
Great blue heron	20.75	Foraging home range based on Krebs (1974, as cited in Zeiner and others 1990)
Mallard duck	1,074.9	Dwyer and others (1979); Kirby and others (1985, as cited in EPA 1993b), based on mean of reported mean values for adult males and females
Raccoon	4,159	Fritzell (1978, as cited in EPA 1993b), based on mean adult male and female home ranges during the spring and summer in North Dakota prairie pothole area
Mink	1,532	Mitchell (1961, as cited in EPA 1993b and http://www.sibr.com/mammals/M158.html), based on male and female home ranges in Montana from heavy and sparse vegetation riverine area

TABLE 7-5

SUMMARY OF MEAN EXPOSURE PARAMETERS FOR BIRDS AND MAMMALS

Exposure Parameter	Mean	Reference and Basis of Value
Home Ranges (acres) (continued)		
Coyote	7,240.0	Woodruff and Keller (1982)
Northern harrier	642.5	Median home range of eight studies (Smith and Murphy 1973; Rees 1976; Toland 1985a; Martin 1987; Serrantino 1987, all as cited in MacWhirter and Bildstein 1996)

Notes:

BW Body weight
EPA U.S. Environmental Protection Agency
g/g/day Gram per gram day
IR Ingestion rate
kg Kilogram

TABLE 7-6

TOXICITY REFERENCE VALUES FOR BIRDS AND MAMMALS

(Page 1 of 2)

COPEC		Mammal TRV (mg/kg/day)	Bird TRV (mg/kg/day)
Aluminum	Dose	1.93	109.7
	Reference	Ondreicka and others (1966)	Carriere and others (1986)
Antimony	Dose	0.125	NA
	Reference	Schroeder and others (1968b)	NA
Arsenic	Dose	0.32	5.5[1]
	Reference	Schroeder and others (1968a)	Stanley and others (1994)
Barium	Dose	5.1	20.8
	Reference	Perry and others (1983)	Johnson and others (1960)
Beryllium	Dose	0.66	NA
	Reference	Schroeder and Mitchener (1975)	NA
Boron	Dose	28.0	28.8
	Reference	Weir and Fisher (1972)	Smith and Anders (1989)
Cadmium	Dose	0.06	0.08[2] (0.78)
	Reference	Webster (1988)	Cain and others (1983)
Chromium III	Dose	2,737.0	1.0
	Reference	Ivankovic and Preussmann (1975)	Haseltine and others (Unpublished data, as cited in Sample and others 1996)
Chromium VI	Dose	3.28	1.0[7]
	Reference	MacKenzie and others (1958)	Haseltine and others (Unpublished data, as cited in Sample and others 1996)
Copper	Dose	2.67[3,4] (26.67)	2.3 [3, 5] (22.99)
	Reference	Pocino and others (1991)	Norvell and others (1975)
Lead	Dose	8.0	1.13
	Reference	Azar and others (1973)	Edens and others (1976)
Mercury	Dose	0.25 – rodents 0.027 [2] (0.27) – large mammals	0.039[6] (0.078)
	Reference	EPA (1995), Khera and Tabacova (1973)	EPA-Great Lakes, Heinz (1974, 1975, 1976, 1979)
Molybdenum	Dose	0.26	3.5
	Reference	Schroeder and Mitchener (1971)	Lepore and Miller (1965)
Nickel	Dose	0.133[2] (1.33)	1.38[3] (13.79)
	Reference	Smith and others (1993)	Cain and Pafford (1981)
Selenium	Dose	0.05	0.23
	Reference	Harr and others (1966)	Heinz and others (1989)
Thallium	Dose	0.48	NA
	Reference	Downs and others (1960)	NA
Uranium	Dose	3.07	16.0
	Reference	Paternain and others (1989)	Haseltine and Sileo (1983)
Vanadium	Dose	0.21	11.4
	Reference	Domingo and others (1986)	White and Dieter (1978)
Zinc	Dose	9.60[2,4] (96.03)	17.2[2] (172.0)
	Reference	Aughey and others (1977)	Gasaway and Buss (1972)

TABLE 7-6

TOXICITY REFERENCE VALUES FOR BIRDS AND MAMMALS

Notes:

COPEC	Chemical of potential ecological concern
EPA	U.S. Environmental Protection Agency
mg/kg/day	Milligram per kilogram per day
NA	Not available
TRV	Toxicity reference value

[1] The diversity of test organisms in the cadmium data set was limited. There is high confidence in the toxicity reference value (TRV) for waterfowl, but lower confidence if the TRV is applied to other birds.

[2] The uncertainty factor (UF) of 10 for low-effect to no-effect level conversion is applied to arrive at a TRV.

[3] The UF of 10 for subchronic to chronic conversion is applied to arrive at a TRV.

[4] TRV was adjusted for, or is close to, nutritional requirements.

[5] This TRV is very conservative for granivorous birds.

[6] A UF of 2 has been applied to the dose for low-effect level conversion.

[7] There is no TRV for birds for chromium VI so the TRV for chromium III was used as a surrogate.

[8] The unadjusted TRV appears in parenthesis. This dose is the TRV without UFs applied. This TRV represents the no observed adverse effects level. The TRV used is based primarily on U.S. Department of the Navy (1998) and secondarily on Sample and others (1996) except for lead, which has some inherent problems. Presently the U.S. Environmental Protection Agency (EPA) Region 9 Biological Technical Assistance Group (BTAG) is considering revising the lead TRV.

TABLE 7-7

TIER 1 SUMMARY OF CADMIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotient
Northern Bobwhite	Overall	91.6
American Robin	Overall	95.0
Deer Mouse	Overall	147
Eastern Cottontail	Overall	95
Coyote	Overall	5.7
Song Sparrow	Riparian	419
Red-winged Blackbird	Riparian	321
Meadow Vole	Riparian	212
Mink	Riparian	26
Raccoon	Riparian	34

TABLE 7-8

TIER 1 SUMMARY OF CHROMIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotient
Northern Bobwhite	Overall	14
American Robin	Overall	3.2
Northern Harrier	Overall	1.7
Song Sparrow	Riparian	44
Red-winged Blackbird	Riparian	34
Mallard Duck	Riparian	2.9

TABLE 7-9

TIER 1 SUMMARY OF COPPER HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotient
Northern Bobwhite	Overall	5.6
American Robin	Overall	1.2
Deer Mouse	Overall	4.2
Eastern Cottontail	Overall	4.9
Song Sparrow	Riparian	18.8
Red-winged Blackbird	Riparian	12.8
Meadow Vole	Riparian	6.4
Mink	Riparian	1.2
Raccoon	Riparian	1.1

TABLE 7-10

TIER 1 SUMMARY OF NICKEL
HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotient
Northern Bobwhite	Overall	3.5
Deer Mouse	Overall	28.4
Eastern Cottontail	Overall	34.3
Coyote	Overall	4.1
Song Sparrow	Riparian	13
Red-winged Blackbird	Riparian	9.2
Mallard Duck	Riparian	1.5
Meadow Vole	Riparian	48.4
Mink	Riparian	28.6
Raccoon	Riparian	20.3

TABLE 7-11

TIER 1 SUMMARY OF SELENIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotient
Northern Bobwhite	Overall	316
American Robin	Overall	54
Northern Harrier	Overall	13.9
Deer Mouse	Overall	934
Eastern Cottontail	Overall	1,423
Coyote	Overall	74.3
Song Sparrow	Riparian	1,442
Red-winged Blackbird	Riparian	941
Great Blue Heron	Riparian	9.6
Mallard Duck	Riparian	26.4
Meadow Vole	Riparian	2,302
Mink	Riparian	332
Raccoon	Riparian	326

TABLE 7-12

TIER 1 SUMMARY OF VANADIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotient
Deer Mouse	Overall	44.4
Eastern Cottontail	Overall	32.8
Coyote	Overall	5.6
Song Sparrow	Riparian	2.4
Red-winged Blackbird	Riparian	2.3
Meadow Vole	Riparian	45
Mink	Riparian	36.9
Raccoon	Riparian	23.9

TABLE 7-13

TIER 1 SUMMARY OF ZINC
HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotient
Northern Bobwhite	Overall	6.4
American Robin	Overall	1.4
Deer Mouse	Overall	9.4
Eastern Cottontail	Overall	10.7
Song Sparrow	Riparian	28
Red-winged Blackbird	Riparian	18.6
Meadow Vole	Riparian	18.3
Mink	Riparian	3.3
Raccoon	Riparian	2.9

TABLE 7-14

TIER 1 OVERALL SUMMARY OF HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Cd	Cr	Cu	Ni	Se	V	Zn
Northern Bobwhite	Overall	✓	✓	✓	✓	✓		✓
American Robin	Overall	✓	✓	✓		✓		✓
Northern Harrier	Overall		✓			✓		
Deer Mouse	Overall	✓		✓	✓	✓	✓	✓
Eastern Cottontail	Overall	✓		✓	✓	✓	✓	✓
Coyote	Overall	✓			✓	✓	✓	
Song Sparrow	Riparian	✓	✓	✓	✓	✓	✓	✓
Red-winged Blackbird	Riparian	✓	✓	✓	✓	✓	✓	✓
Great Blue Heron	Riparian					✓		
Mallard Duck	Riparian		✓		✓	✓		
Meadow Vole	Riparian	✓		✓	✓	✓	✓	✓
Mink	Riparian	✓		✓	✓	✓	✓	✓
Raccoon	Riparian	✓		✓	✓	✓	✓	✓

Notes:

Cd cadmium
Cr chromium
Cu copper
Ni nickel
Se selenium
V vanadium
Z zinc

TABLE 7-15

TIER 2 SUMMARY OF CADMIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotients			
		Blackfoot/ Little Blackfoot Watershed	Georgetown Watershed	Salt Watershed	Background
Northern Bobwhite	Overall	3.4	3.2	3.1	3.0
American Robin	Overall	12.1	11.9	11.8	11.7
Deer Mouse	Overall	8.0	7.8	7.7	7.7
Eastern Cottontail	Overall	1.0	0.82	0.77	0.75
Song Sparrow	Riparian	5.9	6.8	5.0	4.8
Red-winged Blackbird	Riparian	8.1	9.2	7.6	7.4
Meadow Vole	Riparian	3.1	3.6	2.7	2.6
Mink	Riparian	1.0	1.1	0.9	0.8
Raccoon	Riparian	1.8	1.9	1.6	1.5

TABLE 7-16

TIER 2 SUMMARY OF CHROMIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotients			
		Blackfoot/Little Blackfoot Watershed	Georgetown Watershed	Salt Wateshed	Background
American Robin	Overall	1.9	1.8	1.8	1.8
Song Sparrow	Riparian	1.8	1.9	1.7	1.7
Red-winged Blackbird	Riparian	1.5	1.6	1.5	1.5

TABLE 7-17

TIER 2 SUMMARY OF COPPER HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotients			
		Blackfoot/ Little Blackfoot Watershed	Georgetown Watershed	Salt Watershed	Background
American Robin	Overall	1.4	1.4	1.4	1.4
Song Sparrow	Riparian	1.6	1.7	1.6	1.6
Red-winged Blackbird	Riparian	1.2	1.3	1.2	1.2

TABLE 7-18

TIER 2 SUMMARY OF NICKEL
HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotients			
		Blackfoot/ Little Blackfoot Watershed	Georgetown Watershed	Salt Watershed	Background
Deer Mouse	Overall	3.0	2.9	2.9	2.9
Eastern Cottontail	Overall	1.10	1.03	1.01	1.00
Song Sparrow	Riparian	0.9	1.0	0.9	0.8
Meadow Vole	Riparian	3.2	3.3	3.1	3.0
Mink	Riparian	1.5	1.3	1.5	1.4
Raccoon	Riparian	2.1	1.3	1.4	1.3

TABLE 7-19

TIER 2 SUMMARY OF SELENIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotients			
		Blackfoot/ Little Blackfoot Watershed	Georgetown Watershed	Salt Watershed	Background
Northern Bobwhite	Overall	2.1	1.8	1.8	1.7
American Robin	Overall	9.1	8.9	8.7	8.6
Deer Mouse	Overall	19.4	18.9	18.5	18.4
Eastern Cottontail	Overall	1.1	0.66	0.51	0.44
Song Sparrow	Riparian	2.7	2.8	1.6	1.0
Red-winged Blackbird	Riparian	7.7	8.5	7.0	6.7
Great Blue Heron	Riparian	2.9	2.3	2.1	1.8
Mallard Duck	Riparian	1.3	1.0	0.75	0.41
Meadow Vole	Riparian	5.0	5.7	3.6	3.0
Mink	Riparian	16.4	14.1	12.5	10.8
Raccoon	Riparian	7.0	7.3	6.1	5.8

TABLE 7-20

TIER 2 SUMMARY OF VANADIUM HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotients			
		Blackfoot/ Little Blackfoot Watershed	Georgetown Watershed	Salt Watershed	Background
Deer Mouse	Overall	5.5	5.5	5.5	5.5
Meadow Vole	Riparian	2.3	2.3	2.2	2.2
Mink	Riparian	1.5	1.6	1.6	1.5
Raccoon	Riparian	2.3	1.7	1.7	1.6

TABLE 7-21

TIER 2 SUMMARY OF ZINC
HAZARD QUOTIENTS GREATER THAN 1.0

(Page 1 of 1)

Receptor	Habitat	Hazard Quotients			
		Blackfoot/ Little Blackfoot Watershed	Georgetown Watershed	Salt Watershed	Background
American Robin	Overall	2.2	2.2	2.2	2.2
Deer Mouse	Overall	1.9	1.9	1.9	1.9
Song Sparrow	Riparian	1.7	1.7	1.6	1.5
Red-winged Blackbird	Riparian	1.7	1.7	1.6	1.6

TABLE 7-22

TIER 2 OVERALL SUMMARY OF HAZARD QUOTIENTS GREATER THAN 1.0 AND ABOVE BACKGROUND HAZARD QUOTIENT

Receptor	Habitat	Hazard Quotients			
		Blackfoot/ Little Blackfoot Watershed	Georgetown Watershed	Salt Watershed	Background
Cadmium					
Song Sparrow	Riparian	5.9	6.8	5.0	4.8
Red-winged Blackbird	Riparian	8.1	9.2	7.6	7.4
Meadow Vole	Riparian	3.1	3.6	2.7	2.6
Selenium					
American Robin	Overall	9.1	8.9	8.7	8.6
Deer Mouse	Overall	19.4	18.9	18.5	18.4
Eastern Cottontail	Overall	1.1	0.66	0.51	0.44
Song Sparrow	Riparian	2.7	2.8	1.6	1.0
Red-winged Blackbird	Riparian	7.7	8.5	7.0	6.7
Great Blue Heron	Riparian	2.9	2.3	2.1	1.8
Mallard Duck	Riparian	1.3	1.0	0.75	0.41
Meadow Vole	Riparian	5.0	5.7	3.6	3.0
Mink	Riparian	16.4	14.1	12.5	10.8
Raccoon	Riparian	7.0	7.3	6.1	5.8
Zinc					
Deer Mouse	Overall	1.9	1.9	1.9	1.9

TABLE 7-23

TIER 1 FISH TISSUE DATA COMPARISON

(Page 1 of 1)

Analyte	Reference Value (mg/kg)	Background Maximum Data (mg/kg)	Background Mean Data (mg/kg)	Tier 1 Maximum Data (mg/kg)	Tier 1 Mean Data (mg/kg)
Cadmium	0.47	0.23	0.13	1.5	0.5
Chromium	0.18	2.2	1.6	3.6	2.78
Copper	0.5	5.3	3.7	7.7	5.78
Nickel	0.82	0.57	0.36	1.2	0.86
Selenium	0.44	17.8	8.3	33	22.78
Vanadium	0.41	0.26	0.23	0.3	0.25
Zinc	15	81.4	75.18	124	106.35

Note:

mg/kg Milligram per kilogram

TABLE 7-24

TIER 2 FISH TISSUE DATA COMPARISON

(Page 1 of 1)

Analyte	Reference Value (mg/kg)	Blackfoot/Little Blackfoot Watershed Data (mg/kg)	Salt Watershed Data (mg/kg)	Georgetown Creek, Bear River Watershed Data (mg/kg)
Cadmium	0.47	0.25	0.16	NFC
Chromium	0.18	2.00	1.71	NFC
Copper	0.50	4.40	3.89	NFC
Nickel	0.82	0.53	0.41	NFC
Selenium	0.44	13.19	9.63	NFC
Vanadium	0.41	0.23	0.23	NFC
Zinc	15.00	85.68	78.06	NFC

Note:

mg/kg Milligram per kilogram

NFC No fish collected. For hazard quotient calculations, area-weighted average concentrations were calculated based on tissue data from Blackfoot/Little Blackfoot and Salt watersheds. This data was used as surrogate fish-tissue concentrations for the Georgetown Creek and Bear River watershed.

TABLE 7-25

FISH TISSUE DATA REFERENCE VALUES

(Page 1 of 1)

Analyte	Species	Tissue Analyzed	Value (mg/kg)	Result	Reference
Cadmium	*Oncorhynchus mykiss*	whole body	0.47	growth - no effect	1
Chromium	*Oncorhynchus mykiss*	whole body	0.18	No difference in mitochondrial cytochrome oxidase and succinate cytochrome activity in liver, kidney, brain, and gill tissue.	2
Copper	*Oncorhynchus mykiss*	muscle	0.5	survival - no effect	3
Nickel	*Oncorhynchus mykiss*	muscle	0.82	survival - no effect	4
Selenium	*Oncorhynchus mykiss*	whole body	0.44	survival, growth - no effect	5
Vanadium	*Oncorhynchus mykiss*	carcass	0.41	growth - no effect	6
Zinc	*Oncorhynchus mykiss*	liver	15	survival - no effect	7

Note:

mg/kg Milligram per kilogram

[1] Kumada, H., Kimura, S., Yokote, M., and Matida, Y. 1973. "Acute and Chronic Toxicity, Uptake and Retention of Cadmium in Freshwater Organisms." *Bulletin of Freshwater Fisheries Research Laboratory. Tokyo.* 22:157-165.

[2] Buhler, D.R., Stokes, R.M., and Caldwell, R.S.. 1977. *Journal of the Fisheries Research Board of Canada.* 34:9-18.

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[4] Calamari, D., Gaggino, C.F., and Pacchetti, G. 1982. "Toxicokinetics of Low Levels of Cadmium, Chromium, Nickel and Their Mixture in Long-term Treatment on *Salmo gairdneri." Chemosphere.* 11:59-70.

[5] Hodson, P.V., Spry, D.J., and Blunt, B.R. 1980. "Effects on Rainbow Trout (*Salmo gairdneri*) of a Chronic Exposure to Waterborne Selenium." *Canadian Journal of Fisheries and Aquatic Sciences.* 37:233-240.

[6] Hilton, J.W., and Bettger, W.J.. 1988. *Aquatic Toxicology.* 12: 63-71.

[7] Hogstrand, C., Wilson, R.W., Polgar, D., and Wood, C.M. 1994. "Effects of Zinc on the Kinetics of Branchial Calcium Uptake in Freshwater Rainbow Trout During Adaptation to Waterborne Zinc." *Journal of Experimental Biology.* 186: 55-73.

TABLE 7-26

TIER 1 EXPOSURE PARAMETERS AND THEIR EFFECTS ON RISK CALCULATIONS

(Page 1 of 1)

Exposure Parameter	Estimate	Effect on Risk Calculation
Receptor body weight	Lowest in the literature	Overestimate
Food ingestion rate	Highest in the literature	Overestimate
Soil, Sediment ingestion rate	Highest in the literature	Overestimate
Prey items	Use maximum value	Overestimate
Soil, Sediment, and Surface Water	Use maximum value	Overestimate
Area use factor for foraging	100 percent of the study area	Overestimate
Toxicity reference values	Use no observable adverse effect levels	Overestimate

FIGURES

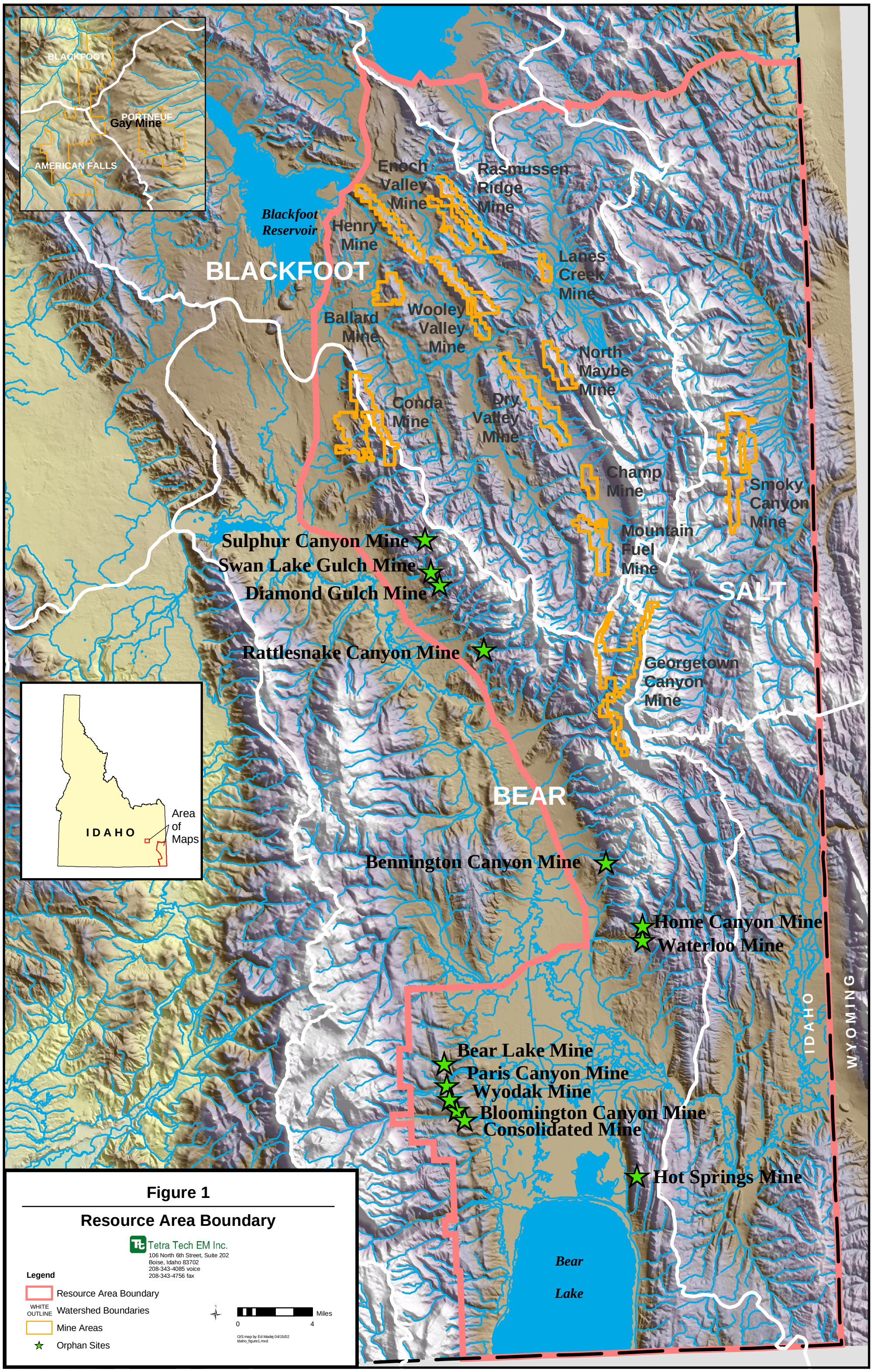

Figure 1

Resource Area Boundary

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Process

Tier 1

Purpose: Initial screening of all potentially complete exposure scenarios (see Figure 3 - Human Health CSM)

Data: Medium- specific 2001 analytical data (see Table 2-2)

EPCs: Maximum detected medium/scenario - specific concentrations

Exposure Parameters: RME (Table 6-1)

Tier 2

Purpose: Area-wide assessment - risks and hazards characterized under both RME and CTE conditions

Detail: Category 2a - Exposure pathways that extend (or could extend) beyond stream -, riparian area -, or mine-specific exposure areas, including ingestion of (1) fish, (2) wild game, (3) beef cattle, (4) aquatic and terrestrial plants, (5) tea brewed from aquatic and terrestrial plants, and (6) surface water
Category 2b - exposure pathways with stream -, riparian area -, and mine-specific exposure areas including (1) ingestion of home grown produce, (2) ingestion of surface soil, and (3) inhalation of fugitive dust

Data: 2001 analytical data only (see Table 2-2)

EPCs: For the fish ingestion exposure pathway, EPCs, were calculated under both RME and CTE conditions as area-wide averages weighted by stream-specific productivity. For all other exposure pathways, EPCs were calculated according to EPA (1992) -- RME - lesser of maximum and UCL_{95}; CTE - mean

Exposure Parameters: RME (Table 6-1), CTE (Table 6-2)

Tier 3

Purpose: Watershed-specific evaluations of the (1) fish ingestion and (2) surface water ingestion exposure pathways based on historical data [Note: detailed stream-specific evaluations were performed as necessary based on professional judgement]

Data: Historical and 2001 (see Table 2-2) analytical data sets

EPCs: Calculated for each data set per EPA (1992) as described in Tier 2

Exposure Parameters: RME (Table 6-1), CTE (Table 6-2)

Decision Points

Select medium-specific COPCs

Identify exposure pathways associated with insignificant risks (<1E-06) and hazards (HI<1). Eliminate COPCs associated with risks less than 1E-07 and HI less than 0.1

Based on RME results only - exposure scenarios with insignificant risks (<1E-06) and hazards (HI<1) are not further evaluated

Notes:

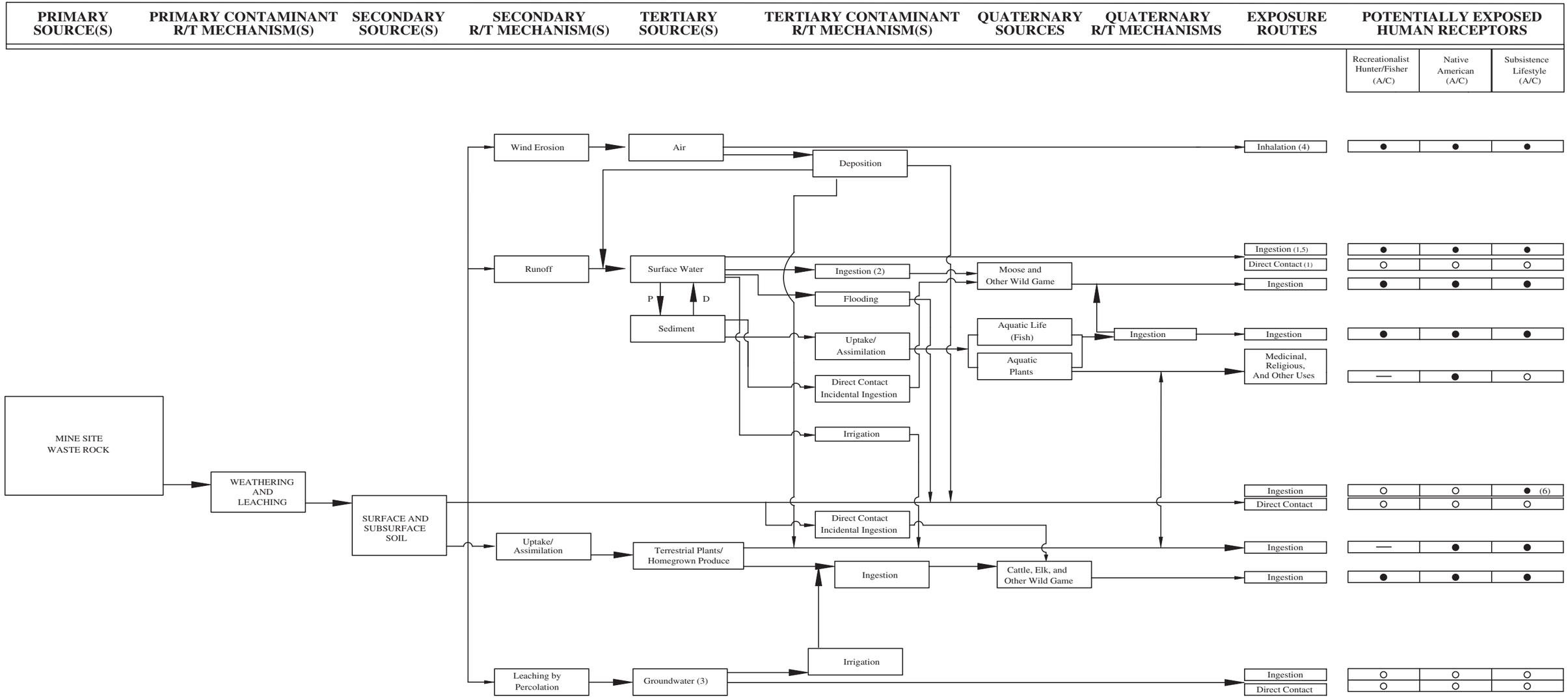
Additional exposure, risks, and hazards due to background dietary and nutrient supplements were factored into both exposure pathway - specific and total exposure results. U.S. Environmental Protection Agency (EPA), 1992. "Supplemental Guidance to RAGS: Calculating the Concentration Term." Office of Solid Waste and Emergency Response. Publication 9285.7-48I. May.

EPC	Exposure point concentration
COPC	Chemicals of potential concern
CSM	Conceptual site model
CTE	Central tendency exposure
RME	Reasonable maximum exposure
UCL_{95}	95 percent upper confidence limit
HI	Hazard index

SOUTHEAST IDAHO PHOSPHATE MINING RESOURCE AREA

FIGURE 2
TIERED APPROACH FOR THE AREA WIDE HUMAN HEALTH RISK ASSESSMENT

Tetra Tech EM Inc.



1 = Includes exposure to both surface water and sediment

2 = Includes ingestion of surface water by moose, elk, cattle, and other wild game

3 = Groundwater also may be hydraulically connected to surface water in the study area. However, this R/T mechanism is expected to be less significant than other R/T mechanisms and therefore is not shown in this figure.

4 = Includes exposure to fugitive dust from waste rock piles only

5 = Includes exposure to surface water during recreational activities (e.g. hunting, fishing, etc.) only

6 = Includes exposure to riparian area soil at the receptor's residence only

● = Potentially complete exposure pathways - considered quantitatively in the HHRA

○ = Potentially complete, but de minimus exposure pathway - considered qualitatively in the HHRA

— = Incomplete exposure pathway - not considered further in the HHRA

NOTES

A/C = Adult and Child Receptors

D = Dissolution

P = Precipitation

R/T = Release and Transport

HHRA = Human Health Risk Assessment

SOUTHEAST IDAHO PHOSPHATE MINING RESOURCE AREA

FIGURE 3
HUMAN HEALTH CONCEPTUAL SITE MODEL

Tetra Tech EM Inc.

FIGURE 4

HUMAN HEALTH EXPOSURE DOSE EQUATIONS

AQUATIC AND TERRESTRIAL PLANTS (INCLUDING HOMEGROWN PRODUCE)

Ingestion

$$ADD_{(mg/kg\ /\ day)} = \frac{EPC_{ap/tp} \times IR_{ap/tp} \times EF \times ED \times CF1 \times FI_{pt}}{AT_{non}}$$

$$LADD_{(mg/kg/\ day)} = \frac{EPC_{ap/tp} \times IR_{ap/tp} \times EF \times ED \times CF1 \times FI_{pt}}{AT_{carc}}$$

Ingestion – Tea

$$ADD_{(mg/kg\ /day)} = \frac{EPC_{pt} \times IR_{pt} \times EF_{pt} \times ED \times FI_{pt}}{BW \times AT_{non}}$$

$$LADD_{(mg/kg/day)} = \frac{EPC_{pt} \times IR_{pt} \times EF_{pt} \times ED \times FI_{pt}}{BW \times AT_{carc}}$$

AQUATIC LIFE

$$ADD_{(mg/kg\ /\ day)} = \frac{EPC_{al} \times IR_{al} \times FI_{al} \times EF \times ED \times CF1}{BW \times AT_{non}}$$

Ingestion

$$LADD_{(mg/kg\ /day)} = \frac{EPC_{al} \times IR_{al} \times FI_{al} \times EF \times ED \times CF1}{BW \times AT_{carc}}$$

CATTLE

$$ADD_{(mg/kg\ /\ day)} = \frac{EPC_{c} \times IR_{c} \times FI_{c} \times EF \times ED \times CF1}{AT_{non}}$$

Ingestion

$$LADD_{(mg/kg/day)} = \frac{EPC_{c} \times IR_{c} \times FI_{c} \times EF \times ED \times CF1}{AT_{carc}}$$

FIGURE 4 (continued)

HUMAN HEALTH EXPOSURE DOSE EQUATIONS

WILD GAME

$$ADD_{(mg/kg/day)} = \frac{EPC_{wg} \times IR_{wg} \times FI_{wg} \times EF \times ED \times CF}{AT_{non}}$$

$$LADD_{(mg/kg/day)} = \frac{EPC_{wg} \times IR_{wg} \times FI_{wg} \times EF \times ED \times CF}{AT_{carc}}$$

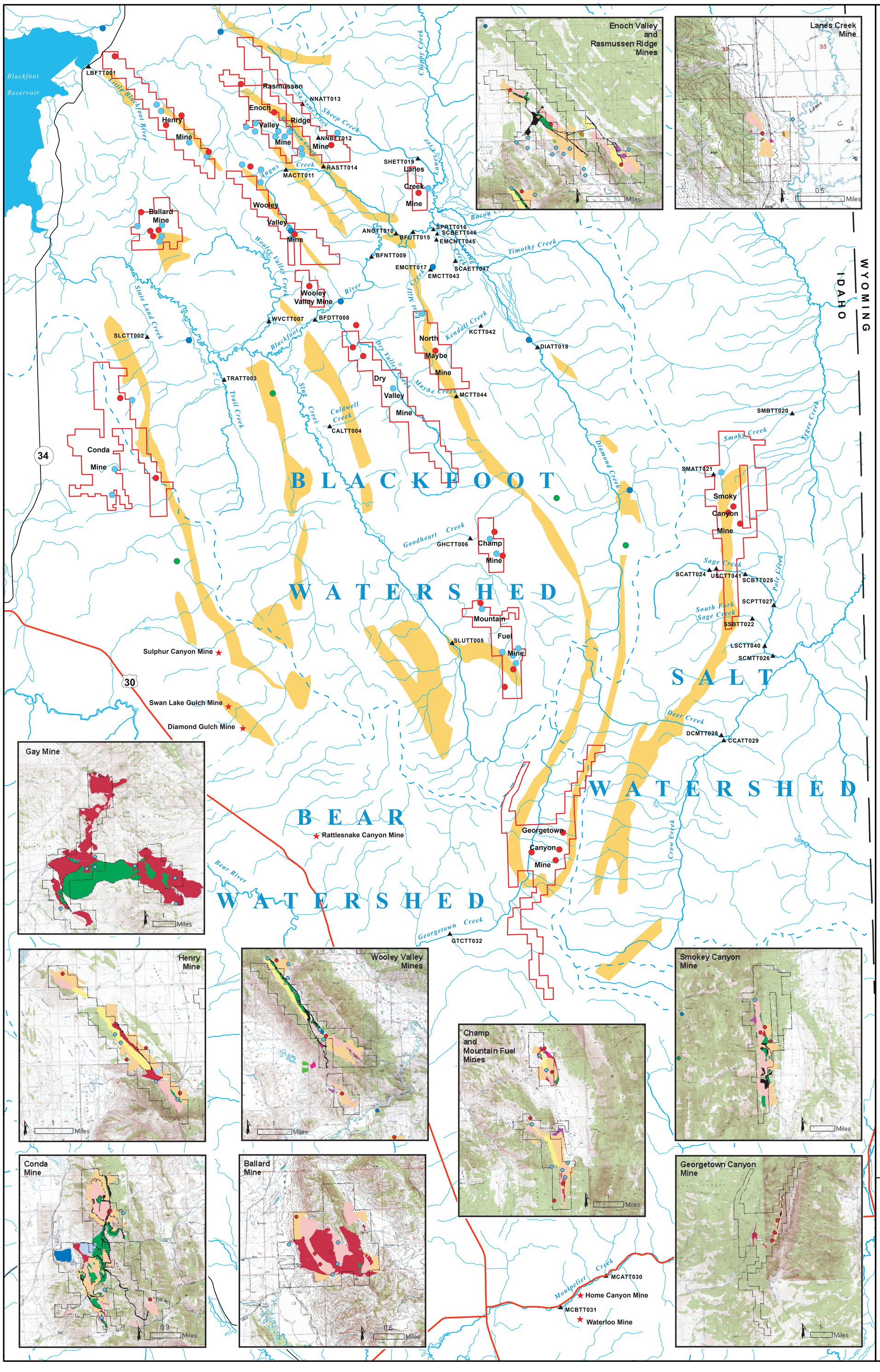
SOIL

$$ADD_{(mg/kg/day)} = \frac{EPCs \times IRs \times EF \times ED \times CF2}{BW \times AT_{non}}$$

$$LADD_{(mg/kg/day)} = \frac{EPCs \times IRs \times EF \times ED \times CF2}{BW \times AT_{carc}}$$

Notes:

ADD	Average daily dose
AT	Averaging time
BW	Body weight
CF	Conversion factor
ED	Exposure duration
EF	Exposure frequency
EPC	Exposure point concentration
FI	Fraction ingested
InR	Inhalation rate
IR	Ingestion rate
LADD	Lifetime average daily dose
mg/kg/day	Milligram per kilogram per day



Legend for Main Map

- Tetra Tech EM Inc. Sample Stations
- **Risk Assessment Sample Stations**
  - Upland Background
  - Riparian zones
  - Stock Pond
  - Waste Rock Dumps
- U.S. Highway
- State Highway
- Streams
- Lakes
- Watershed Boundaries
- Orphan Mine Sites
- Mine Areas
- Phosphoria Outcrops (from USGS Open File Report 95-681)

Legend for Inset Maps

- **Risk Assessment Sample Stations**
  - Upland Background
  - Riparian Zones
  - Stock Pond
  - Waste Rock Dumps
- **Mine Features** (from USGS Open File Report 01-142)
  - Mine Permit Areas
  - Adit and Dump
  - Backfilled Mine Pit
  - Disturbed Land
  - Facilities
  - Mine Pit
  - Ore Stockpile
  - Railroad
  - Road
  - Sediment Catchment
  - Tailings or Tailings Pond
  - Topsoil Stockpile
  - Undisturbed
  - Waste Dump
  - Water Reservoir

N

0 1 2 3 4 Miles

GIS map by Ed Madej 04/29/02
2001IMA_042902.ai
2001IMA.mxd

Figure 6

2001 Sampling Locations

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IDENTIFICATION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

PROCESS

Tier 1

Purpose: Initial screening of COPECs.

Data: Maximum concentrations for sediment, surface water, and soil were evaluated for chemicals present at background levels in the waste rock.

Process: Chemicals compared to 2 times the mean background level for the western U.S.

Results: Barium, lead, manganese, and thallium eliminated from further consideration.

Tier 2

Purpose: Secondary screening against area specific background levels.

Data: Maximum concentrations for sediment, surface water, and soils.

Process: Chemicals compared to 2 times the mean area-specific background level for each chemical.

Results: The only chemicals removed at this step were arsenic, beryllium, and uranium.

Tier 3

Purpose: Screening of COPECs that remained after the Tier 2 analysis were compared to specific benchmarks.

Data: Maximum concentrations for sediment, surface water, and soils.

Process: Soils were screened against the EPA EcoSSLs as available, then screened against the EPA Region 4 soil screening levels. Sediments were screened against the lowest available benchmark, TEL, PEL, or UEL. Surface water was screened against ambient water quality criteria chronic criterion.

Results: A COPEC may not be eliminated based on one media, but may not pass the screening criteria for another media.

Tier 4

Purpose: Evaluation of the COPEC to determine any additional information that would provide additional weight-of-evidence for retaining or rejecting a chemical as a COPEC.

Data: Data for sediment, surface water, and soils.

Process: Data was reviewed based on a full evaluation of results of the media specific screening.

Results: The chemicals remaining for the ERA were cadmium, chromium, copper, nickel, selenium, vanadium, and zinc.

DECISION POINTS

If maximum concentration of chemical greater than 2 times mean background level for the western U.S., go to Tier 2.

If maximum concentration of COPEC greater than 2 times area-specific background level for each COPEC, go to Tier 3.

If maximum concentration of COPEC exceeds either one or more of the soil, sediment, or surface water screening criteria, go to Tier 4.

COPEC	Chemical of potential ecological concern
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
HQ	Hazard quotient
PEL	Probable effects level
EcoSSL	Ecological soil screening level
TEL	Threshold effects level
UEL	Upper effects level
U.S.	United States

AREA WIDE ECOLOGICAL RISK ASSESSMENT PROCESS

PROCESS

Tier 1

Purpose: Screening level risk assessment to look at the worst-case scenario. Directed at eleminating any chemicals that present negligible risks, chemicals that occur at background levels with no increased concentrations associated with mining or chemicals that occur near or below the detection limits of laboratory instrumentation.

Data: Data collected in 2001.

EPC: Highest observed concentration for each medium and chemical.

Exposure Parameters: Most conservative as shown in Table 7-4.

Results: Results for the Tier I process are presented in Tables 7-7 through 7-13 and summarized in Table 7-14.

Tier 2

Purpose: Chemicals and receptors not eliminated in Tier 1 will be evaluated on an area-wide basis.

Data: Data collected in 2001.

EPC: Use of area-weighted EPCs for each medium, as represented by average values from impacted and unimpacted data sets for aquatic and riparian areas and impacted and background for overall aquatic, riparian, and terrestrial areas as discussed in Section 7.1.2.

Exposure Parameters: Mean values as presented in Table 7-5.

Results: Results for the Tier 2 process are presented in Tables 7-15 through 7-21 for each COPEC and summarized in Table 7-22.

Tier 3

Purpose: Provides additional assessments to analyze the uncertainties of various parameter values used in the risk assessment calculations, including running separate calculations based on mean concentrations of COPECs from historical data and assessing uncertainties in the exposure parameters to evaluate their effects on the HQ values calculated in Tier 2.

Data: Use of data collected before 2001.

EPC: Varied with the data sets and analyses conducted.

Exposure Parameters: Mean values as presented in Table 7-5 or as appropriate for the analysis.

DECISION POINTS

If any chemical does not present a risk, it can be eliminated from further consideration.

If the chemical poses a risk, it is then carried to Tier 2 analysis.

HQs derived from these data sets place the calculated risks in an appropriate context to represent the average risk in the Resource Area.

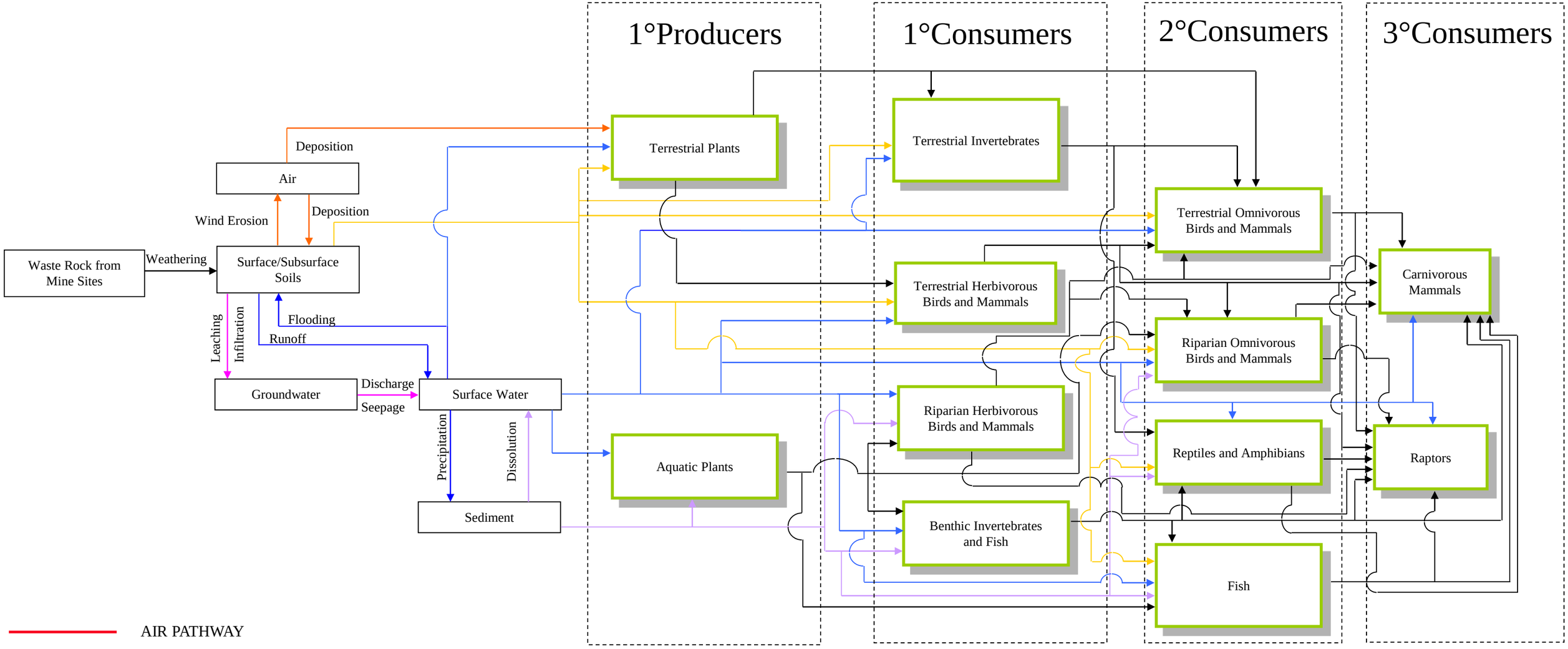
For HQs greater than 1.0, data may be further refined or examined in Tier 3.

SOUTHEAST IDAHO PHOSPHATE MINING RESOURCE AREA

FIGURE 5
TIERED APPROACH FOR THE AREA WIDE ECOLOGICAL RISK ASSESSMENT

Tetra Tech EM Inc.

L:\S-state\S10922\Final Human Health Risk Assessment\Tiered Approach.dwg, joel.peters



AIR PATHWAY

GROUNDWATER PATHWAY

SURFACE WATER PATHWAY

SEDIMENT PATHWAY

FOOD INGESTION PATHWAY

SOIL PATHWAY

SOUTHEAST IDAHO PHOSPHATE MINING RESOURCE AREA

FIGURE 6

ECOLOGICAL CONCEPTUAL SITE MODEL

Tetra Tech EM Inc.

1°Producers

Terrestrial Plants
- Blue joint grass – *Calamagrostis canodensis*
- Blue bunch wheat grass – *Agrophyron spicatum*
- Brome grass – *Bromus* species
- Idaho fescue – *Festuca idahoensis*
- Meadow milk vetch – *Astragalus diversitollus*
- Big sagebrush – *Artemisia tridentata*
- Antelope bitterbrush – *Purshia tridentata*
- Willow – *Salix* species
- Quaking aspen – *Populus tremuloides*
- Rabbitbrush – *Chrysthamnus viscidiflorus*
- Alfalfa - *Medicago sativa*
- Wheat grass – *Agrophyron* species
- Indian paintbrush – *Castelleja* species

Aquatic Plants (Semi-aquatic marsh plants are also listed below)
- Periphyton
- Common spike rush – *Eleocharis palustis*
- Bulrush – *Scirpus* species
- Elk sedge – *Carex geyeri*
- Needle spike rush – *Eleocharis aciculans*

1°Consumers

Terrestrial Invertebrates
- Grasshoppers
- Insect larvae
- Beetle larvae

Herbivorous Birds
- Chipping sparrow – *Spizella passerina*
- Northern bobwhite – *Colinus virginianus (surrogate)*
- House finch – *Carpodacus mexicanus*
- Grey partridge – *Perdix perdix*
- Morning dove – *Zenaida macroura*
- Cassin's finch – *Carpodacus cassinnii*
- Pine grosbeak – *Pinicola enucleator*
- White-winged crossbill – *Loxia leucoptera*
- Song Sparrow – *Melospiza melodia*

Terrestrial Herbivorous Mammals
- Black-tailed jackrabbit – *Lepus californicus*
- Eastern cottontail – *Sylvilagus floridanus (surrogate)*
- Elk – *Cervus elaphus*
- Moose – *Alces alces*
- Mule deer – *Odocoileus hemionus*
- Long-tailed vole – *Microtus longicaudus*
- Meadow vole – *Microtus pennsylvanicus* (surrogate)
- Yellow-bellied marmot - *Marmota flaviventris*
- Least chipmunk – *Eutamias minimus*
- Richardson ground squirrel – *Spermophilus richardsoni*

Benthic Invertebrates
- Insect larvae
- Oligochaetes

Benthic Fish
- Common carp – *Cyprinus carpio*
- Bear Lake sculpin – *Cottus extensus*
- Longnose sucker – *Catostomus catostomus*
- Mountain sucker – *Catostomus platyrhynchus*
- White sucker – *Catostomus commersoni*

Domestic Livestock
- Cattle
- Horses
- Sheep

Highlighting denotes indicator species

2°Consumers

Terrestrial Omnivorous Birds
- American robin – Turdus migratorius
- Western meadowlark – *Sturnella neglecta*
- Loggerhead shrike – *Lanius ludovicianus*
- Long-billed curlew – *Numenius americanus*
- Black-billed magpie – *Pica pica*
- Northern oriole – *Icterus galbula*
- Ring necked pheasant – *Phasianus colchicus*
- Red-winged blackbird – *Agelaius phoeniceus (surrogate)*
- Yellow-headed blackbird –*Xanthocephalus xanthocephalus*
- Gadwall duck – *Anas strepera*
- Mallard – *Anas platyrhynchas*
- Canada goose – *Branta canadensis*
- American coot – *Fulica americana*

Aquatic and Riparian Piscivorous Birds
- Great blue heron – *Ardea herodias*

Omnivorous Mammals
- Deer mouse – *Peromyscus maniculatus (Terrestrial)*
- Northern pocket gopher – *Thomomys talpoides*
- Great Basin pocket mouse – *Perognathus parvus*
- Townsend's ground squirrel – *Spermophilus townsendii*
- Wolverine – *Gulo gulo*
- Raccoon – *Procyon lotor (Aquatic and riparian)*
- Muskrat – *Ondatra zibethica*
- Striped skunk – *Mephitis mephitis*

Reptiles and Amphibians
- Western toad – *Bufo boreas*
- Leopard frog – *Rana pipens*
- Gopher snake – *Pituophis melanoleucus*
- Western garter snake – *Thamnophis elegans*

Fish
- Yellowstone cutthroat trout – *Onchorhynchus clarki bouvieri*
- Rainbow trout – *Onchorhynchus mykiss (surrogate)*
- Mountain whitefish – *Prosopium williamsoni*

Highlighting denotes indicator species

3°Consumers

Carnivorous Mammals
- Coyote – *Canis latrans*
- Bobcat – *Lynx rufus*
- Badger – *Taxidea taxus*
- Gray wolf – *Canis lupus*
- Black bear – *Ursus americanus*
- Mink – *Mustela vison*

Raptors
- Northern Harrier – *Circus cyaneus*
- American kestrel – *Falco sparverius*
- Peregrine falcon – *Falco peregrinus anatum*
- Red-tailed hawk – *Buteo jamaicensis*
- Golden eagle – *Aquila chrysaetos*

Highlighting denotes indicator species

FIGURE 6 (continued)

ECOLOGICAL

CONCEPTUAL SITE MODEL

Tetra Tech EM Inc.

APPENDIX A

GLOSSARY

Assessment endpoint. An explicit expression of the ecological values that is to be protected.

Benthic. Pertains to those organisms that live and feed on the bottom of a pond, river, lake, or ocean.

Biotransfer factor (BTF). The average facility specific ratio of soil or sediment concentration to tissue concentration

Central tendency exposure (CTE). The average exposure expected to occur at a site. In practice, the CTE is estimated by combining mean or fiftieth percentile exposure parameter values.

Chemical of potential concern (COPC). Chemical that is potentially found at a site under investigation and whose data are of such a quality for use in a quantitative risk assessment.

Chemical of potential ecological concern (COPEC). A substance at a site under investigation that has the potential to affect ecological receptors adversely because of its concentration, distribution, and mode of toxicity.

Community. An assemblage of populations of different species within a specific location and time.

Conceptual site model (CSM). Presents the working hypotheses describing the potential source(s) of stressor chemicals, the mechanisms by which the chemicals may be released into and transported throughout the environment, and the pathways by which human and ecological receptors may be exposed the these chemical stressors. For the ecological risk assessment, the CSM describes ecosystem or ecosystem components at risk, and presents the relationships between measurement and assessment endpoints and exposure pathways. For the human health risk assessment, the CSM identifies the human receptors that may be at risk and presents the receptor-specific exposure pathways.

De minimus. A concentration or level of some attribute that is so low as to be insignificant or of no consequence.

Ecological risk assessment (ERA). The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors. The ecological risk assessment process follows the guidance as provided by the U.S. Environmental Protection Agency's "Ecological Risk Assessment Guidance for Superfund" (EPA 1997b).

Essential nutrient. A compound that is required to support human metabolic function.

Exposure pathway. The course a chemical follows from a source to an exposed organism. Each exposure pathway includes a source, release mechanism, a receiving or transfer mechanisms, an exposure point, an exposure route, and a receptor.

Exposure point concentration (EPC). The concentration of a chemical at an exposure point such as tissue, soil, sediment, or surface water.

Exposure scenario. An exposure pathway associated with a particular receptor (for example, a subsistence lifestyle receptor) and a particular set of exposure conditions (for example, reasonable maximum exposure (RME) conditions).

Food chain. It is the pathway by which substances in tissues of lower-trophic-level organisms are transferred to the higher-level organisms that feed on the lower levels.

Food web. A diagrammatic of the feeding relationships within an ecosystem. It consists of a series of interconnecting food chains. Only some of the many possible relationships are shown.

Fugitive dust. Re-suspended soil particles generated by wind erosion.

Guild. A group of organism of the same class that share a similar feeding requirement.

Hazard index (HI). The sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. The HI is calculated separately for chronic, subchronic, and shorter-duration exposures.

Hazard quotient (HQ). The ratio of an exposure level of a chemical, such as a dose, to a toxicity value selected for the ecological risk assessment for that chemical, such as a no observed adverse effect level.

Herbivorous. Indicates a diet that is composed strictly of plant materials.

Human health risk assessment (HHRA). The process that evaluates the likelihood that adverse effects occur or are could occur to human receptors as a result of exposures to one or more stressors. The HHRA process follows EPA guidance including "Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation manual (Part A)" (EPA 1989).

Lowest observed adverse effect level (LOAEL). The lowest concentration of a stressor evaluated in a toxicity test that causes a statistically significant difference in effect compared with controls or a reference site.

Measurement endpoint. Measurement endpoints are measurable responses to a stressor that are related to the valued assessment endpoint.

No observed adverse effect level (NOAEL). The highest concentration of a stressor evaluated in a toxicity test that causes no statistically significant difference in effect compared with controls or a reference site.

Offal. Waste parts of a butchered animal.

Omnivorous. Indicates a diet composed of both plant and animal matter.

Reasonable maximum exposure (RME). The highest exposure that is reasonably expected to occur at a site. In practice the RME is estimated by combining upper-bound (for example, 90 to 95th percentile) values for some but not all exposure parameters.

Receptor. The ecological entity exposed to a stressor that has the potential to induce an adverse response in that receptor.

Riparian. The particular environment situated along the bank of a stream, lake, or pond.

Site use factor (SUF). The ratio of a species home range, breeding range, or feeding or foraging range to the area of contamination of the site being studied.

Subsistence lifestyle receptor. For the purposes of the area wide HHRA, this term is defined as an individual that obtains a significant proportion of their foodstuffs by their own hand (for example, by

hunting, fishing, and growing their own produce) and not from commercial sources. This receptor is assumed, however, to obtain their drinking water from municipal sources.

Toxicity reference value (TRV). A numerical expression at which a particular biological effect may occur in an organism, based on laboratory toxicological investigations.

APPENDIX B

CHEMICAL OF POTENTIAL CONCERN SCREENING

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1.0 INTRODUCTION

Based on available analytical data and knowledge of the source areas, metals are the chemicals of potential concern (COPC) and selenium is the primary COPC. Data sets collected prior to calendar year 2001 are inadequate to defensibly determine COPCs for the Area Wide Human Health Risk Assessment (AWHHRA) or chemicals of potential ecological concern (COPEC) for the Area Wide Ecological Risk Assessment (AWERA). Additional data have been collected to support the selection of COPCs and COPECs. Based on a comprehensive data set, a screening process was conducted to eliminate those chemicals that pose no significant risk or that are present at background levels. This screening process allowed the risk assessments to focus on those chemicals that pose the greatest risks.

Based on preliminary data, the following is a list of chemicals analyzed in surface water, sediment, soil, and tissue samples in the Southeast Idaho Phosphate Mining Resource Area (Resource Area):

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Thallium
- Uranium
- Vanadium
- Zinc

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2.0 METHODOLOGY

Screening of the data was conducted for the selection of COPCs for humans and COPECs for ecological receptors. A tiered screening approach was conducted that used the following criteria.

2.1 TIER 1 ASSESSMENT

Tier 1 – The results of the waste rock analyses (see Table B-1) were compared to data on the naturally occurring levels found in background soils in the western U.S. (Shacklette and Boerngen 1984). If the maximum detected waste rock concentration was less than two times the mean background level for the western U.S., the chemical concentrations in all other media (sediment, surface water, and soil) were evaluated to determine if there were significantly elevated concentrations. If this data did not indicate a significantly elevated concentration, the chemical was given a high probability of being dropped from consideration as a COPC or COPEC. The chemical concentrations were checked in all other media and if no media was elevated, the chemical was dropped from consideration in the risk assessments. Chemicals were further evaluated in Tiers 2 and 3, if they were above two times the mean background level for the western U.S., or if they exhibited significantly elevated concentrations in other media sample results.

2.2 TIER 2 ASSESSMENT

Tier 2 – The concentrations of the chemicals that passed the Tier 1 assessment were evaluated for riparian soils, surface water, and sediment (see Tables B-2 through B-5) against area-specific background concentrations. If the maximum detected concentration for the media was less than two times the mean area-specific background level for the chemical, the chemical was dropped from consideration as a COPC or COPEC for that media. All chemicals retained after this comparison were evaluated on a media specific basis in Tier 3. Table B-5 separately evaluates on-site surface water data collected from the mines from the off-site surface water data. This will ensure that no COPCs or COPECs were excluded prematurely in the primary screening of off-site surface water.

2.3 TIER 3 ASSESSMENT

Tier 3 – The maximum detected concentrations of chemicals for each media that remained after the Tier 2 screening were compared to media specific benchmarks. The Tier 3 assessment was conducted separately for human health COPCs and COPECs for ecological receptors. For human COPCs, sediments were not

considered since the exposure will be minimal. The following benchmarks were utilized for human health COPC selection.

- Soils – U.S. Environmental Protection Agency (EPA) Region 9 residential preliminary remediation goals (PRG) (EPA 2002)
- Surface Water – EPA Region 9 tap water PRGs (EPA 2002)

If the maximum detected concentration did not exceed the applicable benchmark, the chemical was dropped from consideration for that media as a human health COPC.

The following benchmarks were utilized for ecological COPEC selection.

- Soils – EPA Ecological Soil Screening Levels (EcoSSL) were given priority when they were available for a chemical (EPA 2000). For chemicals without EPA EcoSSLs, EPA Region 4 soil screening levels were used (EPA 2001a).
- Sediments – The lowest available benchmark from the threshold effects level (TEL), probable effects level (PEL), or upper effects threshold (UET) values were used for the comparisons (Buchman 1999).
- Surface Water – The ambient water quality criteria (AWQC) criteria continuous concentration (CCC), representing chronic exposure, were used for the comparisons (Buchman 1999).

If the maximum detected concentration did not exceed the applicable benchmark, the chemical was dropped from consideration for that media as an ecological COPEC. After all media were screened, any chemical retained for any media was considered an ecological COPEC for all media.

2.4 TIER 4 ASSESSMENT

Tier 4 - After all media were screened, a full evaluation was conducted of the information concerning each chemical based on the results of the media-specific screening. The individual data sets were evaluated to determine any additional information that would provide an additional weight-of-evidence for retaining or rejecting a chemical as a human health COPC or ecological COPEC. This also included an evaluation of the on-site surface water results presented in Table B-5 to ensure that chemicals elevated in on-site media were not prematurely eliminated from the risk assessments. Following this evaluation, selection or rejection as a COPC or COPEC was determined for the Area Wide Risk Assessment (AWRA).

3.0 CHEMICALS OF POTENTIAL CONCERN

The following sections discuss the potential impacts from the various COPCs and COPECs.

3.1 ALUMINUM

The following sections discuss the potential for impacts from the release of aluminum during the mining of phosphate ore from the Resource Area.

3.1.1 Waste Rock

The maximum detected concentration of aluminum in the waste rock was 19,000 milligrams per kilogram (mg/kg) with an average concentration of 12,100 mg/kg. These concentrations were compared to the western U.S. mean values as reported by the U.S. Geologic Survey (USGS) for background soil concentrations of aluminum. The mean western U.S. concentration was reported as 58,000 mg/kg. Based on this comparison, the maximum concentration of aluminum in the waste rock did not exceed the western U.S. mean by a factor of 2. None of the samples collected exceeded the mean western U.S. concentration. Based on the waste rock data, aluminum was given a high probability for elimination as a COPC and COPEC.

3.1.2 Sediment

The maximum detected concentration of aluminum in sediment downstream from mining areas (impacted areas) was 41,000 mg/kg with an average impacted concentration of 24,400 mg/kg. These values were compared to the average background concentration of 14,900 mg/kg for areas not impacted by mining activities (background areas). The maximum detected value in the impacted area exceeded the average background concentration by a factor of 3. Therefore, aluminum was not rejected as a COPEC based on comparison to background concentrations.

The only available freshwater sediment criteria for aluminum was the TEL concentration reported in the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRT) tables for *Hyalella azteca* (Buchman 1999). The reported TEL was 25,500 mg/kg. The maximum detected concentration of aluminum was greater than the TEL. Therefore, aluminum was retained as a COPEC for sediment based on comparison to available toxicity benchmarks.

3.1.3 Surface Water

The maximum detected concentration of aluminum in impacted surface water was 1,600 micrograms per liter (µg/L) with an average impacted concentration of 193 µg/L. These values were compared to the average background concentration of 475 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 3. Therefore, aluminum was not rejected as a COPC or COPEC based on comparison to background concentrations. The following paragraphs discuss the further evaluation of aluminum with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for aluminum (36,000 µg/L) was compared to the maximum concentration detected in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, aluminum was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC (87 µg/L) for aluminum was compared to the maximum concentration detected in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the CCC. Therefore, aluminum was retained as a COPEC for surface water.

3.1.4 Riparian Area Soils

The maximum detected concentration of aluminum in impacted riparian area soils was 33,400 mg/kg with an average impacted concentration of 24,200 mg/kg. These values were compared to the average background concentration of 23,400 mg/kg for background areas. The maximum detected value in the impacted area did not exceed the average background concentration by a factor of 2. Therefore, aluminum was rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

3.1.5 Conclusions

In the waste rock, aluminum was determined to not be elevated above the western U.S. mean values. Impacted area sediments had some elevated concentrations over background areas, and the maximum detected value was above the screening benchmark. The maximum detected value in impacted surface water was 4 times the average background level. However, the average of the impacted surface water concentrations was only half the average of the background area concentrations. The maximum detected

value in riparian soils did not exceed the average background level by a factor of 2. Evaluation of the overall data indicates that the impacted data set is similar to the background data set with the exception of a couple of outliers. Based on all available information, aluminum was not retained as a COPC for human health or as a COPEC for ecological receptors in the Resource Area.

3.2 ANTIMONY

The following sections discuss the potential for impacts from the release of antimony during the mining of phosphate ore from the Resource Area.

3.2.1 Waste Rock

The maximum detected concentration of antimony in the waste rock was 23 mg/kg with an average concentration of 14 mg/kg. These concentrations were compared to the western U.S. mean values as reported by the USGS for background soil concentrations of antimony. The mean western U.S. concentration was reported as 0.47 mg/kg. Based on this comparison, the maximum concentration of antimony in the waste rock exceeded the western U.S. mean by a factor of 46. Additionally, 28 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, antimony was not rejected as a COPC or COPEC based on the waste rock data.

3.2.2 Sediment

The maximum detected concentration of antimony in impacted sediments was 3.5 mg/kg with an average impacted concentration of 0.75 mg/kg. These values were compared to the average background area concentration of 0.73 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 5. Therefore, antimony was not rejected as a COPC or COPEC based on comparison to background concentrations. However, antimony was only detected above the detection limit in two of the 19 impacted area samples and one of the 12 background samples.

The only available freshwater sediment criterion for antimony was the UET concentration reported in the NOAA SQuiRT tables based on Microtox® studies (Buchman 1999). The reported UET was 3 mg/kg. The maximum detected concentration in impacted sediments exceeded this concentration. Therefore, antimony was not rejected as a COPEC for sediment based on comparison to available toxicity benchmarks. However, only one impacted sample exceeded the criterion.

3.2.3 Surface Water

Antimony was not detected in surface water during any sampling event. Therefore, antimony was not retained as a COPC for human health or as a COPEC for ecologic al receptors in surface water.

3.2.4 Riparian Area Soils

The maximum detected concentration of antimony in impacted riparian area soils was 17 mg/kg with an average impacted concentration of 2.8 mg/kg. These values were compared to the average background concentration of 1.3 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 13. Therefore, antimony was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations. It should be noted that only four of 11 impacted samples exceeded the average background concentration.

The following paragraphs discuss the further evaluation of antimony with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to antimony (31 mg/kg) in soils was compared to the maximum concentration detected in the riparian soil. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, antimony was not retained as a COPC for human health in riparian area soils.
- For ecological receptors, the EPA Region 4 ecological screening criterion for antimony (3.5 mg/kg) was compared to the maximum concentration in the riparian soil. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, antimony was not rejected as a COPEC for riparian area soils. Evaluation of the individual samples results indicated that only one sample exceeded the benchmark concentrations.

3.2.5 Conclusions

In the waste rock, antimony was determined to be elevated above the western U.S. mean values. The concentrations were determined to be elevated in impacted sediments and a single sample exceeded the applicable screening criteria. Additionally, antimony was only detected in about 15 percent of the impacted sediments and 14 percent of the background sediments. Antimony was not detected in any surface water samples. The maximum detected concentration of antimony in impacted riparian area soils was elevated above the background area average. However, only a single sample exceeded any of the

screening benchmarks. Based on all available information, antimony was not retained as a COPC or COPEC for the Resource Area.

3.3 ARSENIC

The following sections discuss the potential for impacts from the release of arsenic during the mining of phosphate ore from the Resource Area.

3.3.1 Waste Rock

The maximum detected concentration of arsenic in the waste rock was 77 mg/kg with an average concentration of 43 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of arsenic. The mean western U.S. concentration was reported as 5.5 mg/kg. Based on this comparison, the maximum concentration of arsenic in the waste rock exceeded the western U.S. mean by a factor of 14. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, arsenic was not rejected as a COPC or COPEC based on the waste rock data.

3.3.2 Sediment

The maximum detected concentration of arsenic in impacted sediments was 16 mg/kg with an average impacted concentration of 5.6 mg/kg. These values were compared to the average background area concentration of 5.53 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 3. Therefore, arsenic was not rejected as a COPEC based on comparison to background concentrations.

The selected freshwater sediment criterion for arsenic was the TEC reported in MacDonald and others (2000). The reported TEC was 9.8 mg/kg. The maximum detected concentration in impacted sediments exceeded this concentration. Therefore, arsenic was not rejected as a COPEC for sediment based on comparison to available toxicity benchmarks. It should be noted that only 21 percent of the impacted sediments exceeded the benchmark while 25 percent of the background sediment samples exceeded the TEC.

3.3.3 Surface Water

The maximum detected concentration of arsenic in impacted surface water was 5 µg/L with an average impacted concentration of 0.4 µg/L. These values were compared to the average background concentration of 0.3 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 17. Therefore, arsenic was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of arsenic with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for arsenic (0.05 µg/L) was compared to the maximum concentration detected in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas exceeded the screening criteria. Therefore, arsenic was retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC (150 µg/L) for total arsenic was compared to the maximum concentration detected in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas did not exceed the CCC. Therefore, arsenic was not retained as a COPEC for surface water.

3.3.4 Riparian Area Soils

The maximum detected concentration of arsenic in impacted riparian area soils was 29 mg/kg with an average impacted concentration of 9.6 mg/kg. These values were compared to the average background concentration of 6.6 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 4. Therefore, arsenic was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of arsenic with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to arsenic (0.39 mg/kg) in soil was compared to the arsenic concentration in the riparian soil. This comparison indicated that the maximum detected concentration in the impacted areas exceeded the screening criteria. Therefore, arsenic was retained for consideration as a human health COPC for soils.

- For ecological receptors, the EPA EcoSSL (2000) for arsenic was compared to the concentration in the riparian soil. Based on this comparison, the maximum detected concentration in the impacted areas does not exceed the benchmark. Therefore, arsenic was not retained as a COPEC for riparian area soils.

3.3.5 Conclusions

In the waste rock, arsenic was determined to be elevated above the western U.S. mean values. The concentrations were determined to be elevated in impacted sediments and some sample concentrations exceeded applicable screening criteria. However, the percent of exceedances of criteria in the sediment was only 21 percent for impacted sediments versus 25 percent for background sediments. Arsenic was detected in only three of 66 surface water samples. Based on comparison with benchmarks, the maximum concentration detected exceeded the human health criterion but not the ecological criterion. The maximum detected concentration of arsenic in impacted riparian soils was elevated above the background area average. The maximum detected concentration exceeded the human health benchmark but not the ecological benchmark. Based on all available information, arsenic was retained as a COPC for human health but not as a COPEC for ecological receptors for the Resource Area.

3.4 BARIUM

The following sections discuss the potential for impacts from the release of barium during the mining of phosphate ore from the Resource Area.

3.4.1 Waste Rock

The maximum detected concentration of barium in the waste rock was 180 mg/kg with an average concentration of 86 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of barium. The mean western U.S. concentration was reported as 580 mg/kg. Based on this comparison, the maximum concentration of barium in the waste rock did not exceed the western U.S. mean. Therefore, barium was given a high probability of rejection as a COPC and COPEC based on the waste rock data.

3.4.2 Conclusions

Since barium was not elevated in the waste rock, it was deemed unlikely that the low concentrations of barium in the waste rock would cause human health or ecological impacts. The sediment, surface water, and riparian soil data were evaluated and indicated no significant levels of barium present. Therefore, barium was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.5 BERYLLIUM

The following sections discuss the potential for impacts from the release of beryllium during the mining of phosphate ore from the Resource Area.

3.5.1 Waste Rock

The maximum detected concentration of beryllium in the waste rock was 2.1 mg/kg with an average concentration of 1.5 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of beryllium. The mean western U.S. concentration was reported as 0.68 mg/kg. Based on this comparison, the maximum concentration of beryllium in the waste rock exceeded the western U.S. mean by a factor of 3. Additionally, 33 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, beryllium was not rejected as a COPC or COPEC based on the waste rock data.

3.5.2 Sediment

The maximum detected concentration of beryllium in impacted sediments was 1.4 mg/kg with an average impacted concentration of 0.9 mg/kg. These values were compared to the average background area concentration of 0.9 mg/kg. The maximum detected value in the impacted area did not exceed the average background concentration by a factor of 2. Therefore, beryllium was rejected as a COPEC in sediment based on comparison to background concentrations.

3.5.3 Surface Water

The maximum detected concentration of beryllium in impacted surface water was 5 µg/L with an average impacted concentration of 2.4 µg/L. These values were compared to the average background concentration of 2.3 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor greater than two. Therefore, beryllium was not rejected as a COPC or COPEC based on comparison to background concentrations. However, beryllium was detected in only three of 66 impacted area surface water samples and was not detected in background surface water during any sampling event.

The following paragraphs discuss the further evaluation of beryllium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for beryllium (73 µg/L) was compared to the maximum concentration detected in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, beryllium was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC (5.3 µg/L) for beryllium was compared to the maximum concentration detected in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas did not exceed the CCC. Therefore, beryllium was not retained as a COPEC for surface water.

3.5.4 Riparian Area Soils

The maximum detected concentration of beryllium in impacted riparian area soils was 1.7 mg/kg with an average impacted concentration of 1.4 mg/kg. These values were compared to the average background concentration of 1.2 mg/kg for background areas. The maximum detected value in the impacted area did not exceed the average background concentration by a factor of 2. Therefore, beryllium was rejected as a COPC and COPEC in riparian area soils.

3.5.5 Conclusions

In the waste rock, beryllium was determined to be elevated above the western U.S. mean values. The concentrations were determined not to be elevated in impacted sediments above background sediments. Beryllium was detected in less than 5 percent of the surface water and did not exceed applicable

benchmarks. The maximum detected concentration of beryllium in impacted riparian area soils was not elevated above the background area average. Based on all available information, beryllium was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.6 BORON

The following sections discuss the potential for impacts from the release of boron during the mining of phosphate ore from the Resource Area.

3.6.1 Waste Rock

The maximum detected concentration of boron in the waste rock was 76 mg/kg with an average concentration of 32 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of boron. The mean western U.S. concentration was reported as 23 mg/kg. Based on this comparison, the maximum concentration of boron in the waste rock exceeded the western U.S. mean by a factor of 3. Additionally, 20 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, boron was not rejected as a COPC or COPEC based on the waste rock data. However, the maximum detected concentration was within the reported range of concentrations for western U.S. soils.

3.6.2 Sediment

The maximum detected concentration of boron in sediments was 29 mg/kg with an average impacted concentration of 9.2 mg/kg. These values were compared to the average background area concentration of 12.6 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor greater than two. Therefore, boron was not rejected as a COPEC based on comparison to background concentrations. However, only 31 percent of the impacted sediments exceeded the background average while 33 percent of the background sediment samples exceeded the background average.

No freshwater sediment criterion for boron was available. Therefore, boron was not rejected as a COPEC for sediment.

3.6.3 Surface Water

The maximum detected concentration of boron in impacted surface water was 180 µg/L with an average impacted concentration of 71.9 µg/L. These values were compared to the average background concentration of 61.1 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 3. Therefore, boron was not rejected as a COPC and COPEC based on comparison to background concentrations. Only a single sample exceeded the background average by a factor of 2.

The following paragraphs discuss the further evaluation of boron with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for boron (3,300 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, boron was not retained as a COPC for human health in surface water.
- For ecological receptors, no ecological screening benchmark was available for boron in surface water. Therefore, boron was retained as a COPEC for surface water.

3.6.4 Riparian Area Soils

The maximum detected concentration of boron in impacted riparian area soils was 43 mg/kg with an average impacted concentration of 15.9 mg/kg. These values were compared to the average background concentration of 5.7 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 8. Therefore, boron was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations. An evaluation of individual data sets indicates that background and impacted samples fell within the same concentration ranges, with the exception of one sample.

The following paragraphs discuss the further evaluation of boron with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to soil for boron (5,500 mg/kg) was compared to the concentration in the riparian soil. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed

screening criteria. Therefore, boron was not retained for consideration as a human health COPC for soils.

- For ecological receptors, the EPA Region 4 soil screening level for boron (0.5 mg/kg) was compared to the concentration in the riparian soil. Based on this comparison, the maximum detected concentration in the impacted areas exceeds the benchmark. Therefore, boron was retained as a COPEC for riparian area soils. An additional consideration is that all background samples also exceeded this criterion.

3.6.5 Conclusions

In the waste rock, boron was determined to be elevated above the western U.S. mean value. However, all reported concentrations were within the range reported for western U.S. soils. The concentrations were determined to be elevated in impacted sediments based on the criteria established in the work plan. However, a detailed evaluation of the individual data did not indicate any significant differences between the impacted and background data sets. Additionally, the percent of exceedances of the background average concentration in the sediment was only 31 percent for impacted sediments versus 33 percent for background sediments. No benchmarks were available for sediments. Boron was detected in all surface water samples. With the exception of one sample, boron did not exceed two times the background average concentration. The maximum detected concentration of boron in impacted riparian area soils was elevated above the background area average. The maximum detected concentration exceeded the ecological benchmark but not the human health benchmark. Evaluation of the data indicates only a few limited samples that are elevated. Additionally, boron has only a limited toxicity to animals. The concentrations reported are unlikely to represent significant impacts to human or ecological receptors. Based on all available information, boron was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.7 CADMIUM

The following sections discuss the potential for impacts from the release of cadmium during the mining of phosphate ore from the Resource Area.

3.7.1 Waste Rock

The maximum detected concentration of cadmium in the waste rock was 120 mg/kg with an average concentration of 49 mg/kg. No mean western U.S. value was reported in the literature. Therefore, cadmium was not rejected as a COPC and COPEC based on the waste rock data.

3.7.2 Sediment

The maximum detected concentration of cadmium in impacted sediments was 14 mg/kg with an average impacted concentration of 4.4 mg/kg. These values were compared to the average background area concentration of 1.05 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 13. Therefore, cadmium was not rejected as a COPEC based on comparison to background concentrations.

The selected freshwater sediment criterion for cadmium was the TEC reported in MacDonald and others (2000). The reported TEC was 1 mg/kg. The maximum detected concentration in impacted sediments exceeded this concentration. Therefore, cadmium was not rejected as a COPEC for sediment.

3.7.3 Surface Water

The maximum detected concentration of cadmium in impacted surface water was 1.8 µg/L with an average impacted concentration of 0.1 µg/L. These values were compared to the average background concentration of 0.1 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 18. Therefore, cadmium was not rejected as a COPC and COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of cadmium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for cadmium (18 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, cadmium was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC for cadmium (1.1 µg/L) was compared to the concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, cadmium was retained as a COPEC for surface water.

3.7.4 Riparian Area Soils

The maximum detected concentration of cadmium in impacted riparian area soils was 63 mg/kg with an average impacted concentration of 7.7 mg/kg. These values were compared to the average background concentration of 1.1 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 57. Therefore, cadmium was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of cadmium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to soil for cadmium (37 mg/kg) was compared to the maximum concentration in the riparian soil. This comparison indicated that the maximum detected concentration in the impacted areas exceeded the screening criteria. Therefore, cadmium was retained as a COPC for human health in riparian soils.
- For ecological receptors, the EPA EcoSSL for cadmium (29 mg/kg) was compared to the concentration in the riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, cadmium was retained as a COPEC for riparian soils.

3.7.5 Conclusions

Western U.S. mean values were not reported for cadmium. Therefore, it could not be determined if cadmium in the waste rock was elevated. The concentrations were determined to be elevated in impacted sediments and the maximum impacted area concentration exceeded the applicable criterion. The maximum detected concentration of cadmium in surface water was greater than 18 times the average background concentrations and exceeded the applicable screening criteria for ecological concern but not for human health. The maximum detected concentration of cadmium in impacted riparian area soils was elevated above the background area average. The maximum detected concentration exceeded both the human health and ecological benchmarks. Based on all available information, cadmium was retained as a COPC for human health and as a COPEC for ecological receptors for the Resource Area.

3.8 CHROMIUM

The following sections discuss the potential for impacts from the release of chromium during the mining of phosphate ore from the Resource Area.

3.8.1 Waste Rock

The maximum detected concentration of chromium in the waste rock was 1,500 mg/kg with an average concentration of 886 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of chromium. The mean western U.S. concentration was reported as 41 mg/kg. Based on this comparison, the maximum concentration of chromium in the waste rock exceeded the western U.S. mean by a factor of 37. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, chromium was not rejected as a COPC or COPEC based on the waste rock data.

3.8.2 Sediment

The maximum detected concentration of chromium in impacted sediments was 191 mg/kg with an average impacted concentration of 65.6 mg/kg. These values were compared to the average background area concentration of 39.5 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 5. Therefore, chromium was not rejected as a COPEC based on comparison to background concentrations.

The selected freshwater sediment criterion for chromium was the TEC reported in MacDonald and others (2000). The reported TEC was 43.4 mg/kg. The maximum detected concentration in impacted sediments exceeded this concentration. Therefore, chromium was not rejected as a COPEC for sediment based on comparison to available toxicity benchmarks.

3.8.3 Surface Water

The maximum detected concentration of chromium in impacted surface water was 4.6 µg/L with an average impacted concentration of 0.4 µg/L. These values were compared to the average background concentration of 0.6 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 8. Therefore, chromium was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of chromium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for chromium 110 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the benchmark. Therefore, chromium was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC for chromium (11 µg/L) was compared to the concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas did not exceed the benchmark. Therefore, chromium was not retained as a COPEC for surface water.

3.8.4 Riparian Area Soils

The maximum detected concentration of chromium in impacted riparian area soils was 970 mg/kg with an average impacted concentration of 143.5 mg/kg. These values were compared to the average background concentration of 57.7 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 17. Therefore, chromium was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of chromium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to chromium in soil (210 mg/kg) was compared to the maximum concentration in riparian soils. This comparison indicated that the maximum detected concentration in the impacted areas exceeded the screening criteria. Therefore, chromium was retained for consideration as a human health COPC for riparian area soils.
- For ecological receptors, the EPA EcoSSL for chromium (5 mg/kg) was compared to the concentration in the riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeds the benchmark. Therefore, chromium was retained as a COPEC for riparian area soils.

3.8.5 Conclusions

In the waste rock, chromium was determined to be elevated above the western U.S. mean values. The concentrations were determined to be elevated in impacted sediments based on the criteria established in the work plan and the maximum impacted area concentration exceeded the applicable criterion. The maximum detected concentration of chromium in surface water was greater than eight times the average background concentrations but did not exceed the applicable screening criteria for ecological concern or human health. The maximum detected concentration of chromium in impacted riparian area soils was

elevated above the background area average. The maximum detected concentration exceeded both the human health and ecological benchmarks. Based on all available information, chromium was retained as a COPC for human health and as a COPEC for ecological receptors for the Resource Area.

3.9 COBALT

The following sections discuss the potential for impacts from the release of cobalt during the mining of phosphate ore from the Resource Area.

3.9.1 Waste Rock

The maximum detected concentration of cobalt in the waste rock was 8.3 mg/kg with an average concentration of 3.9 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS (Shacklette and Boerngen 1984) for background soil concentrations of arsenic. The mean western U.S. concentration was reported as 7.1 mg/kg. Based on this comparison, the maximum concentration of cobalt in the waste rock did not exceed the western U.S. mean by a factor of 2. Therefore, cobalt was given a high probability of rejection as a COPC or COPEC based on the waste rock data.

3.9.2 Sediment

The maximum detected concentration of cobalt in impacted sediments was 2.7 mg/kg with an average impacted concentration of 2.27 mg/kg. Background sediment data for cobalt was not available. Therefore, cobalt was not rejected as a COPEC based on comparison to background concentrations.

There was no published freshwater sediment criterion for cobalt. Therefore, cobalt was not rejected as a COPEC for sediment based on comparison to available toxicity benchmarks.

3.9.3 Surface Water

The maximum detected concentration of cobalt in impacted surface water was 30 µg/L with an average impacted concentration of 5.07 µg/L. Background surface water data for cobalt was not available. Therefore, cobalt was not rejected as a COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of cobalt with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for cobalt (730 µg/L) was compared to the maximum cobalt concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, cobalt was not retained as a COPC for human health in surface water.
- For ecological receptors, the screening value for cobalt (23 µg/L) was taken from studies conducted for the Blackbird Mine (EPA 2001b) and was compared to the maximum concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, cobalt was retained as a COPEC for surface water. However, cobalt was detected in only two of 177 samples collected.

3.9.4 Riparian Area Soils

The maximum detected concentration of cobalt in impacted riparian area soils was 19 mg/kg with an average impacted concentration of 7.08 mg/kg. Background soil data for cobalt was not available. Therefore, cobalt was not rejected as a COPC and COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of arsenic with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure for cobalt (900 mg/kg) in to soil was compared to the maximum cobalt concentration in the riparian soil. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, cobalt was not retained as a COPC for human health for soils.
- For ecological receptors, the EPA EcoSSL (2000) for cobalt (31.8 mg/kg) was compared to the maximum cobalt concentration in the riparian soil. Based on this comparison, the maximum detected concentration in the impacted areas did not exceed the benchmark. Therefore, cobalt was not retained as a COPEC for riparian area soils.

3.9.5 Conclusions

In the waste rock, cobalt was determined not to be elevated above the western U.S. mean values. Background sediment, surface water, and soil data was not available for cobalt. Screening benchmarks

were not available for cobalt in freshwater sediments. Therefore, cobalt was not rejected as a COPEC in sediments. For surface water, cobalt was detected in only two of 177 samples collected. The maximum detected concentration did not exceed the human health screening benchmark, but did exceed the benchmark for ecological receptors. For riparian soils, the maximum cobalt concentration did not exceed the human health or ecological screening criteria; therefore, cobalt was not retained as a COPC for human health or COPEC for ecological receptors. Based on all available information, cobalt was not retained as a COPC for human health and COPEC for ecological receptors for the Resource Area.

3.10 COPPER

The following sections discuss the potential for impacts from the release of copper during the mining of phosphate ore from the Resource Area.

3.10.1 Waste Rock

The maximum detected concentration of copper in the waste rock was 210 mg/kg with an average concentration of 117 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of copper. The mean western U.S. concentration was reported as 21 mg/kg. Based on this comparison, the maximum concentration of copper in the waste rock exceeded the western U.S. mean by a factor of 10. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, copper was not rejected as a COPC or COPEC based on the waste rock data.

3.10.2 Sediment

The maximum detected concentration of copper in impacted sediments was 44 mg/kg with an average impacted concentration of 14.9 mg/kg. These values were compared to the average background area concentration of 11.3 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 4. Therefore, copper was not rejected as a COPEC based on comparison to background concentrations.

The selected freshwater sediment criterion for copper was the TEC reported in MacDonald and others (2000). The reported TEC was 31.6 mg/kg. The maximum detected concentration in impacted

sediments exceeded this concentration. Therefore, copper was not rejected as a COPEC for sediment based on comparison to available toxicity benchmarks.

3.10.3 Surface Water

The maximum detected concentration of copper in impacted surface water was 5.8 µg/L with an average impacted concentration of 0.6 µg/L. These values were compared to the average background concentration of 0.5 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 12. Therefore, copper was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of copper with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for copper (1,400 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, copper was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC for copper (9 µg/L) was compared to the concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas did not exceed the benchmark. Therefore, copper was not retained as a COPEC for surface water.

3.10.4 Riparian Area Soils

The maximum detected concentration of copper in impacted riparian area soils was 120 mg/kg with an average impacted concentration of 27.7 mg/kg. These values were compared to the average background concentration of 17.4 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 7. Therefore, copper was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of copper with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to copper in soil (2,900 mg/kg) was compared to the copper concentration in riparian soils. This

comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, copper was not retained for consideration as a human health COPC for riparian area soils.

- For ecological receptors, the Region 4 soil-screening criterion for copper (40 mg/kg) was compared to the concentration in the riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeds the benchmark. Therefore, copper was retained as a COPEC for riparian area soils.

3.10.5 Conclusions

In the waste rock, copper was determined to be elevated above the western U.S. mean values. The concentrations were determined to be elevated in impacted sediments based on the criteria established in the work plan and the maximum impacted area concentration exceeded the applicable criterion. The maximum detected concentration of copper in surface water was greater than 12 times the average background concentrations but did not exceed the applicable screening criteria for human health or ecological receptors. The maximum detected concentration of copper in impacted riparian area soils was elevated above the background area average. The maximum detected concentration did not exceed the human health benchmark but exceeded the ecological benchmarks. Based on all available information, copper was not retained as a COPC for human health, but was retained as a COPEC for ecological receptors for the Resource Area.

3.11 LEAD

The following sections discuss the potential for impacts from the release of lead during the mining of phosphate ore from the Resource Area.

3.11.1 Waste Rock

The maximum detected concentration of lead in the waste rock was 11 mg/kg with an average concentration of 8.6 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of lead. The mean western U.S. concentration was reported as 17 mg/kg. Based on this comparison, the maximum concentration of lead in the waste rock did not exceed the western U.S. mean. Therefore, lead was given a high probability of rejection as a COPC and COPEC based on the waste rock data.

3.11.2 Conclusions

Since lead was not elevated in the waste rock, it was deemed unlikely that the low concentrations of lead in the waste rock would cause human health or ecological impacts. The sediment, surface water, and riparian soil data were evaluated and indicated no significant levels of lead present. Therefore, lead was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.12 MANGANESE

The following sections discuss the potential for impacts from the release of manganese during the mining of phosphate ore from the Resource Area.

3.12.1 Waste Rock

The maximum detected concentration of manganese in the waste rock was 650 mg/kg with an average concentration of 157 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of manganese. The mean western U.S. concentration was reported as 380 mg/kg. Based on this comparison, the maximum concentration of manganese in the waste rock did not exceed the western U.S. mean by a factor of 2. Additionally, only two of 34 samples had concentrations that exceeded the mean western U.S. concentration. Therefore, manganese was given a high probability of rejection as a chemical of potential concern based on the waste rock data.

3.12.2 Conclusions

Since manganese was not elevated in the waste rock, it was deemed unlikely that the low concentrations of manganese in the waste rock would cause human health or ecological impacts. The sediment, surface water, and riparian soil data were evaluated and indicated no significant levels of manganese present. Therefore, manganese was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.13 MERCURY

The following sections discuss the potential for impacts from the release of mercury during the mining of phosphate ore from the Resource Area.

3.13.1 Waste Rock

The maximum detected concentration of mercury in the waste rock was 1,000 micrograms per kilogram (µg/kg) with an average concentration of 565 µg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of mercury. The mean western U.S. concentration was reported as 460 µg/kg. Based on this comparison, the maximum concentration of mercury in the waste rock exceeded the western U.S. mean by a factor greater than two. Additionally, 17 of 34 samples of waste rock had concentrations greater than the western U.S. mean. Therefore, mercury was not rejected as a COPC or COPEC based on the waste rock data.

3.13.2 Sediment

The maximum detected concentration of mercury in impacted sediments was 227 µg/kg and the average concentration was 42.6 µg/kg. These values were compared to the average background area concentration of 19.9 µg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 12. Therefore, mercury was not rejected as a COPC or COPEC based on comparison to background concentrations.

The freshwater sediment criterion for mercury is the TEC of 180 µg/kg as presented in MacDonald and others (2000). The maximum concentration for the impacted areas did not exceed this criterion. Therefore, mercury was not retained as a COPEC for sediment based on comparison to available toxicity benchmarks.

3.13.3 Surface Water

The maximum detected concentration of mercury in impacted surface water was 0.009 µg/L with an average impacted concentration of 0.1 µg/L. These values were compared to the average background concentration of 0.1 µg/L for background areas. The maximum detected value in the impacted area did

not exceed the average background concentration. Therefore, mercury was rejected as a COPC or COPEC based on comparison to background concentrations.

3.13.4 Riparian Area Soils

The maximum detected concentration of mercury in impacted riparian area soils was 620 µg/kg with an average impacted concentration of 91.4 µg/kg. These values were compared to the average concentration of 29.2 µg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 21. Therefore, mercury was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations. It should be noted that the value of 620 µg/kg is an outlier and all other concentrations are significantly lower. The second highest detected mercury concentration in impacted riparian soils was 77 µg/kg.

The following paragraphs discuss the further evaluation of mercury with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to mercury in soil (23,000 µg/kg) was compared to the mercury concentration in riparian soils. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, mercury was not retained as a COPC for human health in riparian area soils.
- For ecological receptors, EPA Region 4 ecological screening criterion for mercury (100 µg/kg) in soil was compared to the mercury concentration in riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, mercury was not rejected as a COPEC for riparian area soils. However, with the exception of the one outlier of 620 µg/kg, all other mercury results were below the screening criterion.

3.13.5 Conclusions

In the waste rock, mercury was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments but did not exceed the sediment screening benchmark. In surface water, mercury did not exceed either the human health benchmark or the ecological screening benchmark. The maximum detected concentration of mercury in impacted riparian area soils did exceed the background area average by a factor of 20. However, this maximum value was an extreme outlier that was an order of magnitude higher than any other result. For soils, mercury exceeded the ecological screening criteria, but not the human health criteria. If the single outlier is

removed, no mercury values exceed the ecological screening criterion for soils. Based on the available information, mercury was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.14 MOLYBDENUM

The following sections discuss the potential for impacts from the release of molybdenum during the mining of phosphate ore from the Resource Area.

3.14.1 Waste Rock

The maximum detected concentration of molybdenum in the waste rock was 65 mg/kg with an average concentration of 23 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of molybdenum. The mean western U.S. concentration was reported as 0.9 mg/kg. Based on this comparison, the maximum concentration of molybdenum in the waste exceeded the western U.S. mean by a factor of 72. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, molybdenum was not rejected as a COPC or COPEC based on the waste rock data.

3.14.2 Sediment

The maximum detected concentration of molybdenum in impacted sediments was 5 mg/kg, and the average concentration was 2 mg/kg. These values were compared to the average background area concentration of 1.8 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 3. Therefore, molybdenum was not rejected as a COPEC based on comparison to background concentrations. However, molybdenum was detected in only four of 17 impacted sediment samples and two of 12 background samples.

There is no standard freshwater sediment criterion for molybdenum; therefore, molybdenum is retained as a COPEC for sediment.

3.14.3 Surface Water

The maximum detected concentration of molybdenum in impacted surface water was 10.1 µg/L with an average impacted concentration of 1.4 µg/L. These values were compared to the average background concentration of 1.1 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 9. Therefore, molybdenum was not rejected as a COPC or COPEC based on comparison to background concentrations. However, molybdenum was detected in only five of 66 samples from impacted areas and in two of 29 samples from unimpacted locations.

The following paragraphs discuss the further evaluation of molybdenum with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for molybdenum (180 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, molybdenum was not retained as a COPC for human health in surface water.
- For ecological receptors, there was no surface water criteria derived for molybdenum. Based on this, molybdenum was not rejected as a COPEC for surface water.

3.14.4 Riparian Area Soils

The maximum detected concentration of molybdenum in impacted riparian area soils was 31 mg/kg with an average impacted concentration of 6.1 mg/kg. The average concentration for unimpacted soils was 1.9 mg/kg. Averaging one-half the detection limit for molybdenum, since all sample concentrations were below the detection limit derived this background concentration. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 16. Therefore, molybdenum was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of molybdenum with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to molybdenum (390 mg/kg) in soil was compared to the molybdenum concentration in the riparian soils.

This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, molybdenum was not retained as a COPC for human health in riparian area soils.

- For ecological receptors, the EPA Region 4 ecological screening criterion for molybdenum (2 mg/kg) in soil was compared to the molybdenum concentration in the riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, molybdenum was not rejected as a COPEC for riparian area soils. Evaluation of the individual samples results indicated that only one sample exceeded the benchmark concentration.

3.14.5 Conclusions

In the waste rock, molybdenum was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments but were found to occur at a very low frequency. In surface water, molybdenum occurred at a frequency of five of 66 samples and did not exceed the human health benchmark. There is no ecological screening benchmark for surface water. For impacted soil areas, molybdenum was detected in only one sample and was not above the detection limit in unimpacted soils. Molybdenum did not exceed the screening criteria for human health but exceeded the ecological screening value. Based on the available information, molybdenum was not retained as a COPC for human health or a COPEC for ecological receptors for the Resource Area.

3.15 NICKEL

The following sections discuss the potential for impacts from the release of nickel during the mining of phosphate ore from the Resource Area.

3.15.1 Waste Rock

The maximum detected concentration of nickel in the waste rock was 460 mg/kg with an average concentration of 261 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of nickel. The mean western U.S. concentration was reported as 15 mg/kg. Based on this comparison, the maximum concentration of nickel in the waste exceeded the western U.S. mean by a factor of 31. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, nickel was not rejected as a COPC and COPEC based on the waste rock data.

3.15.2 Sediment

The maximum detected concentration of nickel in impacted sediments was 164 mg/kg with an average concentration of 42.2 mg/kg. These values were compared to the average background area concentration of 19.1 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 8. Therefore, nickel was not rejected as a COPC or COPEC based on comparison to background concentrations.

The selected freshwater sediment criterion for nickel was the TEC reported in MacDonald and others (2000). The reported TEC was 22.7 mg/kg. The maximum detected concentration in impacted sediments exceeded this concentration. Therefore, nickel was retained as a COPEC for sediment based on comparison to available toxicity benchmarks.

3.15.3 Surface Water

The maximum detected concentration of nickel in impacted surface water was 43 µg/L with an average impacted concentration of 1.6 µg/L. These values were compared to the average background concentration of 1 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 43. Therefore, nickel was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of nickel with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for nickel (730 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, nickel was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC for nickel (52 µg/L for unadjusted for hardness) was compared to the concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas did not exceed the CCC. Therefore, nickel was not retained as a COPEC for surface water.

3.15.4 Riparian Area Soils

The maximum detected concentration of nickel in impacted riparian area soils was 280 mg/kg with an average impacted concentration of 56 mg/kg. These values were compared to the average concentration of 24.7 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 11. Therefore, nickel was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of nickel with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to nickel in soil (1,600 mg/kg) was compared to the nickel concentration in riparian soils. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, nickel was not retained as a COPC for human health in riparian area soils.
- For ecological receptors, the EPA EcoSSL for nickel (30.5 mg/kg) in soil was compared to the maximum nickel concentration in riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, nickel was retained as a COPEC for riparian area soils.

3.15.5 Conclusions

In the waste rock, nickel was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments and exceeded the sediment screening benchmark. In surface water, nickel did not exceed the human health or ecological screening benchmark. The maximum detected concentration of nickel in impacted riparian area soils exceeded the background area average by a factor of 12. For riparian soils, nickel did not exceed the human health-screening criterion, but did exceed the ecological screening criteria. Based on the available information, nickel was not retained as a COPC for human health, but was retained as a COPEC for ecological receptors for the Resource Area.

3.16 SELENIUM

The following sections discuss the potential for impacts from the release of selenium during the mining of phosphate ore from the Resource Area.

3.16.1 Waste Rock

The maximum detected concentration of selenium in the waste rock was 1,500 mg/kg with an average concentration of 125 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of selenium. The mean western U.S. concentration was reported as 0.2 mg/kg. Based on this comparison, the maximum concentration of selenium in the waste exceeded the western U.S. mean by a factor of 7,500. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, selenium was not rejected as a COPC or COPEC based on the waste rock data.

3.16.2 Sediment

The maximum detected concentration of selenium in impacted sediments was 188 mg/kg with an average concentration of 18.4 mg/kg. These values were compared to the average background area concentration of 1.2 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 157. Therefore, selenium was not rejected as a COPEC based on comparison to background concentrations.

There is no standard freshwater sediment criterion for selenium. The value used for screening selenium is 4 mg/kg dry weight taken from National Irrigation Water Quality Program Guidelines (Skorupa 1998). The maximum concentration for the impacted areas exceeds this criterion. Therefore, selenium is retained as a COPEC for sediment.

3.16.3 Surface Water

The maximum detected concentration of selenium in impacted surface water was 1,140 µg/L with an average impacted concentration of 23.4 µg/L. These values were compared to the average background concentration of 0.6 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 1,900. Therefore, selenium was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of selenium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for selenium (180 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas exceeded the screening criteria. Therefore, selenium was retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC for selenium (5 µg/L) was compared to the concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the CCC. Therefore, selenium was retained as a COPEC for surface water.

3.16.4 Riparian Area Soils

The maximum detected concentration of selenium in impacted riparian area soils was 150 mg/kg with an average impacted concentration of 16.4 mg/kg. These values were compared to the average concentration of 0.9 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 167. Therefore, selenium was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of selenium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to selenium in soil (380 mg/kg) was compared to the maximum selenium concentration in riparian soils. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, selenium was not retained as a COPC for human health in riparian area soils.
- For ecological receptors, the EPA EcoSSL for selenium (0.8 mg/kg) in soil was compared to the maximum selenium concentration in riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, selenium was not rejected as a COPEC for riparian area soils.

3.16.5 Conclusions

In the waste rock, selenium was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments and did exceed the sediment screening benchmark. In surface water, selenium exceeded both the human health benchmark and the ecological screening benchmark. The maximum detected concentration of selenium in impacted riparian area soils did exceed the background area average by a factor of 167. For soils, selenium did not exceed the human health criterion, but did exceed the ecological screening criteria. Based on the available

information, selenium was retained as a COPC for human health and as a COPEC for ecological receptors for the Resource Area.

3.17 SILVER

The following sections discuss the potential for impacts from the release of silver during the mining of phosphate ore from the Resource Area.

3.17.1 Waste Rock

The maximum detected concentration of silver in the waste rock was 13 mg/kg with an average concentration of 6.4 mg/kg. A mean western U.S. value was not reported in the literature. Therefore, silver was not rejected as a COPC or COPEC based on the waste rock data.

3.17.2 Sediment

The maximum detected concentration of silver in impacted sediments was 2 mg/kg and an average concentration of 0.2 mg/kg. These values were compared to the average background area concentration of 0.1 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 20. Therefore, silver was not rejected as a COPEC based on comparison to background concentrations.

The selected freshwater sediment criterion for silver was the UET of 4.5 mg/kg based on the *Hyalella azteca* toxicity test data from the NOAA SQuiRT tables. The maximum concentration for the impacted areas does not exceed this criterion. Therefore, silver is not retained as a COPEC for sediment based on comparison to available toxicity benchmark.

3.17.3 Surface Water

The maximum detected concentration of silver in impacted surface water was 1.1 µg/L with an average impacted concentration of 0.2 µg/L. These values were compared to the average background concentration of 0.1 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 11. Therefore, silver was not rejected as a

COPC or COPEC based on comparison to background concentrations. However, silver was detected in only eight of 66 samples from impacted areas and from two of 29 samples from unimpacted locations.

The following paragraphs discuss the further evaluation of silver with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for silver (180 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, silver was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC for silver (0.12 µg/L) was compared to the concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the CCC. Therefore, silver was retained as a COPEC for surface water.

3.17.4 Riparian Area Soils

The maximum detected concentration of silver in impacted riparian area soils was 5.2 mg/kg with an average impacted concentration of 0.6 mg/kg. These values were compared to the average concentration of 0.1 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 52. Therefore, silver was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of silver with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to silver (390 mg/kg) in soil was compared to the maximum sliver concentration in riparian soils. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, silver was not retained as a COPC for human health in riparian area soils.
- For ecological receptors, the EPA Region 4 ecological screening criterion for silver (2 mg/kg) in soil was compared to the silver concentration in riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, silver was not rejected as a COPEC for riparian area soils. Evaluation of individual sample results indicated that only one sample exceeded the benchmark concentration.

3.17.5 Conclusions

Silver occurred in the waste rock, but no comparable western U.S. mean value was established. Therefore, silver could not be rejected based upon this criterion. The concentrations were determined to be elevated in impacted sediments, but did not exceed the sediment screening benchmark. In surface water, silver did not exceed the human health benchmark, but did exceed the ecological screening benchmark. The maximum detected concentration of silver in impacted riparian area soils exceeded the background area average by a factor of 52. For soils, silver did not exceed the human health criterion, but did exceed the ecological screening criteria. Only a single sample exceeded the ecological screening criteria for soils. Based on the available information, silver was not retained as a COPC for human health or as a COPEC for ecological receptors in the Resource Area.

3.18 THALLIUM

The following sections discuss the potential for impacts from the release of thallium during the mining of phosphate ore from the Resource Area.

3.18.1 Waste Rock

Thallium was not detected in the waste rock. Therefore, thallium was rejected as a COPC and COPEC based on the waste rock data.

3.18.2 Conclusions

Since thallium was not elevated in the waste rock, it was deemed unlikely that the low concentrations of thallium in the waste rock would cause human health or ecological impacts. The sediment, surface water, and riparian soil data were evaluated and indicated no significant levels of thallium present. Therefore, thallium was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.19 URANIUM

The following sections discuss the potential for impacts from the release of uranium during the mining of phosphate ore from the Resource Area.

3.19.1 Waste Rock

The maximum detected concentration of uranium in the waste rock was 63 mg/kg with an average concentration of 35 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of uranium. The mean western U.S. concentration was reported as 3 mg/kg. Based on this comparison, the maximum concentration of uranium in the waste exceeded the western U.S. mean by a factor of 21. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, uranium was not rejected as a COPC or COPEC based on the waste rock data.

3.19.2 Sediment

The maximum detected concentration of uranium in impacted sediments was 20 mg/kg with an average impacted concentration of 8.7 mg/kg. These values were compared to the average background area concentration of 4.4 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 5. Therefore, uranium was not rejected as a COPEC based on comparison to background concentrations. Uranium was detected above the detection limit in all of the impacted and background samples.

No available freshwater sediment criterion for uranium is available. Therefore, uranium is retained as a COPEC for sediment.

3.19.3 Surface Water

The maximum detected concentration of uranium in impacted surface water was 5.4 µg/L with an average impacted concentration of 1 µg/L. These values were compared to the average background concentration of 0.6 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 9. Therefore, uranium was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of uranium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for uranium (7.3 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, uranium was not retained as a COPC for human health in surface water.
- For ecological receptors, there was no surface water criteria derived uranium. Based on this, uranium was not rejected as a COPEC for surface water.

3.19.4 Riparian Area Soils

The maximum detected concentration of uranium in impacted riparian area soils was 11 mg/kg with an average impacted concentration of 6.4 mg/kg. These values were compared to the average background concentration of 6.6 mg/kg for background areas. The maximum detected value in the impacted area did not exceed the average background concentration by a factor of 2. Therefore, uranium was rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

3.19.5 Conclusions

In the waste rock, uranium was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments but could not be compared to any sediment benchmark. Even though uranium in sediments was slightly elevated in impacted area sediments, only four of the samples exceeded the background range. Uranium in surface water did not exceed the human health benchmark, but no applicable ecological screening criteria were available. For soils, uranium detected in impacted soils did not exceed the background uranium concentrations. Based on the available information, uranium was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

3.20 VANADIUM

The following sections discuss the potential for impacts from the release of vanadium during the mining of phosphate ore from the Resource Area.

3.20.1 Waste Rock

The maximum detected concentration of vanadium in the waste rock was 1,200 mg/kg with an average concentration of 510 mg/kg. These concentrations were compared to the western U.S. mean values as

reported by USGS for background soil concentrations of vanadium. The mean western U.S. concentration was reported as 70 mg/kg. Based on this comparison, the maximum concentration of vanadium in the waste exceeded the western U.S. mean by a factor of 17. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, vanadium was not rejected as a COPC and COPEC based on the waste rock data.

3.20.2 Sediment

The maximum detected concentration of vanadium in impacted sediments was 133 mg/kg with an average impacted concentration of 54.3 mg/kg. These values were compared to the average background area concentration of 35.3 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 4. Therefore, vanadium was not rejected as a COPEC based on comparison to background concentrations. Vanadium was detected above the detection limit in all of the impacted and background samples.

No available freshwater sediment criterion for vanadium is available. Therefore, vanadium is retained as a COPEC for sediment.

3.20.3 Surface Water

The maximum detected concentration of vanadium in impacted surface water was 6.2 µg/L with an average impacted concentration of 1.1 µg/L. These values were compared to the average background concentration of 1.1 µg/L for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 6. Therefore, vanadium was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of vanadium with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for vanadium (260 µg/L) was compared to the concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, vanadium was not retained as a COPC for human health in surface water.
- For ecological receptors, there was no surface water criteria derived vanadium. Based on this, vanadium was not rejected as a COPEC for surface water.

3.20.4 Riparian Area Soils

The maximum detected concentration of vanadium in impacted riparian area soils was 500 mg/kg with an average impacted concentration of 103.5 mg/kg. These values were compared to the average background concentration of 54.9 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 9. Therefore, vanadium was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of aluminum with the appropriate screening value for human health and ecological receptors.

- For human health, on the EPA Region 9 PRG for residential exposure to vanadium (550 mg/kg) in soil compared to the maximum vanadium concentration in riparian soils. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, vanadium was not retained as a COPC for human health in riparian area soils.
- For ecological receptors, the EPA Region 4 ecological screening criterion for vanadium (2 mg/kg) in soil was compared to the maximum vanadium concentration in the riparian soil. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, vanadium was not rejected as a COPEC for riparian area soils. Evaluation of individual samples results indicated that all samples exceeded the benchmark concentration.

3.20.5 Conclusions

In the waste rock, vanadium was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments but could not be compared to any sediment benchmark. Vanadium did not exceed the human health benchmark in surface water and there were no applicable ecological screening criteria. The maximum detected concentration of vanadium in impacted riparian area soils exceeded the background area average by a factor of 9. For riparian soils, vanadium did not exceed the human health-screening criterion, but did exceed the ecological screening criteria. Based on the available information, vanadium was not retained as a COPC for human health, but was retained as a COPEC for ecological receptors for the Resource Area.

3.21 ZINC

The following sections discuss the potential for impacts from the release of zinc during the mining of phosphate ore from the Resource Area.

3.21.1 Waste Rock

The maximum detected concentration of zinc in the waste rock was 2,000 mg/kg with an average concentration of 1,054 mg/kg. These concentrations were compared to the western U.S. mean values as reported by USGS for background soil concentrations of zinc. The mean western U.S. concentration was reported as 55 mg/kg. Based on this comparison, the maximum concentration of zinc in the waste rock exceeded the western U.S. mean by a factor of 36. Additionally, 34 of 34 samples of waste rock had concentrations that exceeded the western U.S. mean. Therefore, zinc was not rejected as a COPC or COPEC based on the waste rock data.

3.21.2 Sediment

The maximum detected concentration of zinc in impacted sediments was 866 mg/kg with an average impacted concentration of 200.8 mg/kg. These values were compared to the average background area concentration of 84.2 mg/kg. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 10. Therefore, zinc was not rejected as a COPEC based on comparison to background concentrations. Zinc was detected above the detection limit in all of the impacted area samples and background samples.

The freshwater sediment criterion for zinc was the TEL concentration reported in Buchman (1999), which was 123 mg/kg. The maximum detected concentration of zinc in the impacted areas is about seven times the sediment screening value. Therefore, zinc was retained as a COPEC for sediment based on comparison to available toxicity benchmarks.

3.21.3 Surface Water

The maximum detected concentration of zinc in impacted surface water was 110 µg/L with an average impacted concentration of 22.9 µg/L. These values were compared to the average background concentration of 16.4 µg/L for background areas. The maximum detected value in the impacted area

exceeded the average background concentration by a factor of 7. Therefore, zinc was not rejected as a COPC or COPEC based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of zinc with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for ingestion of tap water for zinc (11,000 µg/L) was compared to the maximum concentration in the surface water. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, zinc was not retained as a COPC for human health in surface water.
- For ecological receptors, the freshwater CCC for chromium (120 µg/L) was compared to the concentration in the surface water. Based on this comparison, the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, zinc was not retained as a COPEC for ecological receptors in surface water.

3.21.4 Riparian Area Soils

The maximum detected concentration of zinc in impacted riparian area soils was 1,400 mg/kg with an average impacted concentration of 245 mg/kg. These values were compared to the average background concentration of 106 mg/kg for background areas. The maximum detected value in the impacted area exceeded the average background concentration by a factor of 13. Therefore, zinc was not rejected as a COPC and COPEC in riparian area soils based on comparison to background concentrations.

The following paragraphs discuss the further evaluation of zinc with the appropriate screening value for human health and ecological receptors.

- For human health, the EPA Region 9 PRG for residential exposure to zinc (23,000 mg/kg) in soil was compared to the zinc concentration in riparian soils. This comparison indicated that the maximum detected concentration in the impacted areas did not exceed the screening criteria. Therefore, zinc was not retained as a COPC for human health in riparian area soils.
- For ecological receptors, the EPA EcoSSL for zinc in soil was compared to the zinc (190 mg/kg) concentration in riparian soils. Based on this comparison, the maximum detected concentration in the impacted areas exceeded the benchmark. Therefore, zinc was retained as a COPEC for riparian area soils.

3.21.5 Conclusions

In the waste rock, zinc was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments and exceeded applicable screening criteria. Additionally, zinc was detected in all sediment samples. Zinc was detected in surface water samples, but did not exceed applicable screening criteria. The maximum detected concentration of zinc in impacted riparian area soils was elevated above the background area average and exceeded the applicable ecological screening criterion, but not the human health criterion. Based on the available information, zinc was not retained as a COPC for human health, but was retained as a COPEC for ecological receptors for the Resource Area.

3.22 RADIONUCLIDE INDICATORS

Because of the potential presence of radionuclides in the waste rock, gross alpha and gross beta analyses were performed during the first round of surface water sampling conducted in May 2001. A total of 27 impacted and nine background analyses were conducted.

Gross alpha results ranged from a maximum of 9 picocuries per liter (pCi/L) to a minimum below the laboratory detection limit with an average of 2.4 pCi/L in the impacted area samples. Gross alpha results for background samples ranged from a maximum of 3.7 pCi/L to a minimum below the laboratory detection limit with an average of 1.5 pCi/L. The human health maximum contaminant level (MCL) is 15 pCi/L. There are no ecological criteria for gross alpha results since they are indicator analyses.

Gross beta results ranged from a maximum of 8.4 pCi/L to a minimum below the laboratory detection limit with an average of 2.3 pCi/L in the impacted area samples. Gross alpha results for background samples ranged from a maximum of 4.6 pCi/l to a minimum below the laboratory detection limit with an average of 2.2 pCi/L. There are no criteria for human health or ecological receptors for gross beta.

Evaluation of laboratory reports indicates that error ranges for the data are in excess of plus or minus 2 pCi/L for all analyses. Based on the data available from the surface water sampling, there appears to be only a slight elevation in the indicator analyses of impacted areas when compared to background areas. In addition, the maximum detected concentration was well below the gross alpha MCL. Overall evaluation of the gross alpha and gross beta results does not indicate a significant issue with radionuclides and therefore, radionuclides has been dropped from further consideration as chemicals of concern.

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4.0 MISCELLANEOUS CHEMICAL SELECTION ISSUES

Based on some of the human health exposure scenarios, some chemicals that were not selected as COPCs for the Resource Area as a whole will be evaluated for specific exposure scenarios in the human health risk assessment to present a complete picture of the potentia l risks. The reason for this is that plant tissue-specific risk-based screening levels are not available for all chemicals. Only those chemicals that are present in elevated concentrations in the waste rock and in the medium, in which the plant is growing, will be considered as a plant tissue COPC. The following sections describe these special or secondary COPCs.

4.1 HOME GROWN PRODUCE AND HARVESTED NATIVE PLANTS

In addition to the COPCs selected as resource area concerns for human health for all scenarios, other considerations are warranted for evaluation of plant tissues consumed by human receptors. Currently, there are no established PRGs for chemicals in plant tissue that are ingested by humans and ecological receptors. Additional evaluation was conducted to evaluate the potential uptake and concentration of chemicals by plants growing in impacted soils or sediments. Based on this evaluation, some level of concentration was observed in the impacted areas for chemicals that were not selected as Resource Area COPCs. Therefore, any of these additional chemicals that were present in soil (terrestrial plants) and sediment (aquatic plants) at maximum concentrations greater than 2 times average background concentrations and the plant tissue concentrations were greater than 2 times average soil or sediment background were selected as secondary COPCs for evaluation only in plant ingestion scenarios to ensure completeness of the AWHHRA. However, because these exposure routes are not significant in overall exposure, these additional compounds were not considered as COPCs for other media. Therefore, the following list of secondary COPCs will be evaluated for human plant ingestion only.

- Aluminum (aquatic plant only)
- Antimony (aquatic plant only)
- Cobalt (aquatic plant only)
- Copper (aquatic plant only)
- Nickel (terrestrial plant only)
- Uranium (terrestrial plant only)
- Vanadium
- Zinc

4.2 INHALATION OF FUGITIVE DUST

Since the recreational scenario for human exposure includes a fugitive dust component, all chemicals determined to be elevated in waste rock that are not area-wide COPCs were evaluated for the fugitive dust component only.

5.0 CONCLUSIONS

Based on the evaluation of each of the above elements, the following sections list the COPCs for the AWHHRA and the COPECs for the AWERA.

5.1 HUMAN HEALTH CHEMICALS OF POTENTIAL CONCERN

The following chemicals were retained as Resource Area COPCs for evaluation of risk to humans:

- Arsenic
- Cadmium
- Chromium
- Selenium

5.2 ECOLOGICAL CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

The following chemicals were retained as Resource Area COPECs for evaluation of risk to ecological receptors:

- Cadmium
- Chromium
- Copper
- Nickel
- Selenium
- Vanadium
- Zinc

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6.0 REFERENCES

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EPA. 2002. "Preliminary Remediation Goals." Office of Waste Programs. San Francisco, California. On-Line Address: http://www.epa.gov/region09/waste/sfund/prg.

TABLES

TABLE B-1

CHEMICAL OF POTENTIAL CONCERN TIER 1 SCREENING CRITERIA FOR WASTE ROCK DATA

(Page 1 of 4)

COPC or COPEC	Summary Statistic	Concentrations from all Waste Rock Sample Stations (mg/kg)	Mean Western U.S. Concentration[1] (mg/kg)	Established Range[1] (mg/kg)	Number of Samples that Exceed Mean Western U.S. Concentration/Number of Samples Analyzed	Maximum Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Greater Than Established Range (Yes/No)	Retain (Yes/No)
Aluminum	Average	1.21E+04	5.80E+04	5.00E+03 to 1.00E+05	0/14	NO	NO	NO	NO
	Minimum	8.60E+03							
	Maximum	1.90E+04							
	FOD	14/14							
Antimony	Average	1.40E+01	4.70E-01	1.00E+00 to 8.80E+00	28/34	YES	YES	YES	YES
	Minimum	4.00E-01							
	Maximum	2.30E+01							
	FOD	42/53							
Arsenic	Average	4.30E+01	5.50E+00	1.00E+00 to 5.00E+01	34/34	YES	YES	NO	YES
	Minimum	1.70E+01							
	Maximum	7.70E+01							
	FOD	53/53							
Barium	Average	8.60E+01	5.80E+02	1.00E+02 to 3.00E+03	0/34	NO	NO	NO	NO
	Minimum	2.80E+01							
	Maximum	1.80E+02							
	FOD	53/53							
Beryllium	Average	1.50E+00	6.80E-01	2.00E-01 to 1.00E+01	33/34	YES	YES	NO	YES
	Minimum	6.00E-01							
	Maximum	2.10E+00							
	FOD	53/53							
Boron	Average	3.20E+01	2.30E+01	2.00E+00 to 1.00E+02	20/34	YES	NO	NO	YES
	Minimum	2.20E+00							
	Maximum	7.60E+01							
	FOD	48/53							

TABLE B-1

CHEMICAL OF POTENTIAL CONCERN TIER 1 SCREENING CRITERIA FOR WASTE ROCK DATA

COPC or COPEC	Summary Statistic	Concentrations from all Waste Rock Sample Stations (mg/kg)	Mean Western U.S. Concentration[1] (mg/kg)	Established Range[1] (mg/kg)	Number of Samples that Exceed Mean Western U.S. Concentration/Number of Samples Analyzed	Maximum Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Greater Than Established Range (Yes/No)	Retain (Yes/No)
Chromium	Average	8.86E+02							
	Minimum	2.60E+02							
	Maximum	1.50E+03		5.00+00 to 1.00E+03					
	FOD	53/53	4.10E+01		34/34	YES	YES	NO	YES
Cobalt	Average	3.90E+00							
	Minimum	1.70E+00		<3.00E+00 to 5.00E+01					
	Maximum	8.30E+00							
	FOD	15/17	7.10E+00		0/17	NO	NO	NO	NO
Copper	Average	1.17E+02							
	Minimum	3.00E+01		2.00E+00 to 1.00E+02					
	Maximum	2.10E+02							
	FOD	53/53	2.10E+01		34/34	YES	YES	YES	YES
Lead	Average	8.60E+00							
	Minimum	3.80E+00		3.00E+01 to 1.00E+02					
	Maximum	1.10E+01							
	FOD	23/53	1.70E+01		0/34	NO	NO	NO	NO
Manganese	Average	1.57E+02							
	Minimum	2.40E+01		1.00E+02 to 4.00E+03					
	Maximum	6.50E+02							
	FOD	53/53	3.80E+02		2/34	NO	NO	NO	NO
Mercury	Average	5.65E-01							
	Minimum	1.80E-01							
	Maximum	1.00E+00							
	FOD	53/53	4.60E-01	NPV	17/34	YES	NO	ND	YES

TABLE B-1

CHEMICAL OF POTENTIAL CONCERN TIER 1 SCREENING CRITERIA FOR WASTE ROCK DATA

COPC or COPEC	Summary Statistic	Concentrations from all Waste Rock Sample Stations (mg/kg)	Mean Western U.S. Concentration[1] (mg/kg)	Established Range[1] (mg/kg)	Number of Samples that Exceed Mean Western U.S. Concentration/Number of Samples Analyzed	Maximum Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Greater Than Established Range (Yes/No)	Retain (Yes/No)
Molybdenum	Average	2.30E+01							
	Minimum	5.70E+00							
	Maximum	6.50E+01		2.00E-1 to 5.00E+00					
	FOD	53/53	8.50E-01		34/34	YES	YES	YES	YES
Nickel	Average	2.61E+02							
	Minimum	9.40E+01							
	Maximum	4.60E+02		1.00E-01 to 5.00E+03					
	FOD	53/53	1.50E+01		34/34	YES	YES	NO	YES
Selenium	Average	1.25E+02							
	Minimum	6.10E+00							
	Maximum	1.50E+03		3.00E-02 to 2.00E+00					
	FOD	53/53	2.30E-01		34/34	YES	YES	YES	YES
Silver	Average	6.40E+00							
	Minimum	5.30E-01		<1.00E-01 to					
	Maximum	1.30E+01							
	FOD	53/53	NPV	5.00E+00	NA	NA	NA	NA	YES
Thallium	Average	1.00E+00							
	Minimum	<2.00E+00							
	Maximum	<2.00E+00		6.00E-02 to 1.00E+01					
	FOD	0/44	9.10E+00		0/34	NO	NO	NO	NO
Uranium	Average	3.50E+01							
	Minimum	1.20E+01		2.70E+00 to					
	Maximum	6.30E+01							
	FOD	53/53	3.00E+00	1.20E+01	34/34	YES	YES	YES	YES

TABLE B-1

CHEMICAL OF POTENTIAL CONCERN TIER 1 SCREENING CRITERIA FOR WASTE ROCK DATA

COPC or COPEC	Summary Statistic	Concentrations from all Waste Rock Sample Stations (mg/kg)	Mean Western U.S. Concentration[1] (mg/kg)	Established Range[1] (mg/kg)	Number of Samples that Exceed Mean Western U.S. Concentration/Number of Samples Analyzed	Maximum Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Concentration Greater Than 2 Times Mean Western U.S. (Yes/No)	Mean Waste Rock Greater Than Established Range (Yes/No)	Retain (Yes/No)
Vanadium	Average	5.10E+02	7.00E+01	2.00E+01 to 5.00E+02	34/34	YES	YES	YES	YES
	Minimum	9.50E+01							
	Maximum	1.20E+03							
	FOD	53/53							
Zinc	Average	1.05E+03	5.50E+01	1.00E+01 to 3.00E+02	34/34	YES	YES	YES	YES
	Minimum	3.50E+02							
	Maximum	2.00E+03							
	FOD	53/53							

Notes:

COPC Chemical of potential concern
COPEC Chemical of potential ecological concern
FOD Frequency of detection
mg/kg Milligram per kilogram
NA Not applicable
NPV No published value

[1] Shacklette, H.T., and J.G. Boerngen. 1984.

TABLE B-2

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SEDIMENT DATA

(Page 1 of 4)

COPEC	Summary Statistic	ALL EVENTS SUMMARY		TIER 2 SCREENING	Ecological Benchmarks and Criteria for Sediment (mg/kg)	TIER 3 SCREENING	Retain as COPEC for Sediment (Yes/No)
		Impacted Sample Concentrations (mg/kg)	Background Sample Concentrations (mg/kg)	Maximum Impacted Concentration Greater Than 2 Times Background (Yes/No)		Maximum COPEC Concentration Greater Than Ecological Criteria for Sediment (Yes/No)	
Aluminum	Mean[6]	2.44E+04	1.49E+04	YES	2.55E+04[(1)]	YES	YES
	Minimum	1.14E+04	9.50E+03				
	Maximum	4.10E+04	1.90E+04				
	FOD	7/7	3/3				
Antimony	Mean[6]	7.50E-01	7.30E-01	YES	3.00E+00[(2)]	YES	YES
	Minimum	2.00E-02	2.00E-02				
	Maximum	3.50E+00	2.30E+00				
	FOD	2/19	1/12				
Arsenic	Mean[6]	5.62E+00	5.53E+00	YES	9.80E+00[(3)]	YES	YES
	Minimum	2.50E-01	1.10E+00				
	Maximum	1.60E+01	1.20E+01				
	FOD	18/19	12/12				
Beryllium	Mean[6]	9.00E-01	9.00E-01	NO	NPV	NA	NO
	Minimum	5.00E-01	3.90E-01				
	Maximum	1.40E+00	1.60E+00				
	FOD	19/19	12/12				
Boron	Mean[6]	9.21E+00	1.26E+01	YES	NPV	NA	YES
	Minimum	1.00E+00	1.00E+00				
	Maximum	2.90E+01	2.50E+01				
	FOD	11/19	10/12				
Cadmium	Mean[6]	4.42E+00	1.05E+00	YES	1.00E+00[(3)]	YES	YES
	Minimum	6.50E-01	1.00E-01				
	Maximum	1.40E+01	5.10E+00				
	FOD	19/19	8/12				

TABLE B-2

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SEDIMENT DATA

(Page 2 of 4)

COPEC	Summary Statistic	ALL EVENTS SUMMARY		TIER 2 SCREENING	Ecological Benchmarks and Criteria for Sediment (mg/kg)	TIER 3 SCREENING	Retain as COPEC for Sediment (Yes/No)
		Impacted Sample Concentrations (mg/kg)	Background Sample Concentrations (mg/kg)	Maximum Impacted Concentration Greater Than 2 Times Background (Yes/No)		Maximum COPEC Concentration Greater Than Ecological Criteria for Sediment (Yes/No)	
Chromium	Mean[6]	6.56E+01	3.95E+01	YES	3.73E+01[3,4]	YES	YES
	Minimum	1.60E+01	1.10E+01				
	Maximum	1.91E+02	1.00E+02				
	FOD	19/19	12/12				
Cobalt	Mean[6]	2.27E+00	NA	YES	NPV	NA	YES
	Minimum	1.70E+00	NA				
	Maximum	2.70E+00	NA				
	FOD	3/3	NA				
Copper	Mean[6]	1.49E+01	1.13E+01	YES	3.16E+01[3]	YES	YES
	Minimum	4.20E+00	3.20E+00				
	Maximum	4.40E+01	2.50E+01				
	FOD	19/19	12/12				
Mercury	Mean[6]	4.26E-02	1.99E-02	YES	1.8E-01[3]	NO	NO
	Minimum	1.00E-02	8.40E-03				
	Maximum	2.27E-01	3.40E-02				
	FOD	19/19	12/12				
Molybdenum	Mean[6]	1.96E+00	1.77E+00	YES	NPV	NA	YES
	Minimum	5.00E-01	5.00E-01				
	Maximum	5.00E+00	4.00E+00				
	FOD	4/17	2/12				
Nickel	Mean[6]	4.22E+01	1.91E+01	YES	4.86E+01[3]	YES	YES
	Minimum	1.10E+01	6.40E+00				
	Maximum	1.64E+02	4.40E+01				
	FOD	19/19	12/12				

TABLE B-2

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SEDIMENT DATA

COPEC	Summary Statistic	ALL EVENTS SUMMARY		TIER 2 SCREENING	Ecological Benchmarks and Criteria for Sediment (mg/kg)	TIER 3 SCREENING	Retain as COPEC for Sediment (Yes/No)
		Impacted Sample Concentrations (mg/kg)	Background Sample Concentrations (mg/kg)	Maximum Impacted Concentration Greater Than 2 Times Background (Yes/No)		Maximum COPEC Concentration Greater Than Ecological Criteria for Sediment (Yes/No)	
Selenium	Mean[6]	1.84E+01	1.22E+00	YES	4.00E+00[(5)]	YES	YES
	Minimum	1.10E+00	5.20E-01				
	Maximum	1.88E+02	2.60E+00				
	FOD	19/19	12/12				
Silver	Mean[6]	2.40E-01	9.00E-02	YES	4.50E+00[(2)]	NO	NO
	Minimum	1.00E-01	4.00E-02				
	Maximum	2.04E+00	1.00E-01				
	FOD	7/19	3/12				
Uranium	Mean[6]	8.67E+00	4.38E+00	YES	NPV	NA	YES
	Minimum	1.64E+00	5.90E-01				
	Maximum	2.00E+01	1.20E+01				
	FOD	17/17	12/12				
Vanadium	Mean[6]	5.43E+01	3.53E+01	YES	NPV	NA	YES
	Minimum	1.40E+01	1.40E+01				
	Maximum	1.33E+02	7.20E+01				
	FOD	19/19	12/12				
Zinc	Mean[6]	2.01E+02	8.42E+01	YES	1.23E02[(1)]	YES	YES
	Minimum	3.50E+01	3.80E+01				
	Maximum	8.66E+02	2.10E+02				
	FOD	19/19	12/12				

Notes:

COPEC Chemical of potential ecological concern
FOD Frequency of detection

TABLE B-2

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SEDIMENT DATA

Notes (continued):

mg/kg	Milligram per kilogram
NA	Not applicable
NDA	No data available
NPV	No published value

[1] Based on Threshold Effects Level concentration for Hyalella azteca bioassay as reported in Buchman 1999. Screening Quick Reference Tables. National Oceanic and Atmospheric Administration.

[2] Based on Upper Effects Threshold concentration from Microtox bioassays as reported in Buchman 1999.

[3] Based on Threshold Effect Concentration as reported in MacDonald, D.D., C.G. Ingersoll, and T. Berger. 2000. "Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems." *Archives of Environmental Contamination and Toxicology*. Volume 39. Pages 20 through 31

[4] Based on total Chromium

[5] Criteria taken from Skorupa, J. 1998. "Selenium." In: P.L. Martin and D.E. Larsen (editors). "Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment." National Irrigation Water Quality Program Information Report No. 3. Department of Interior. Pages 139 through 184. November.

[6] The mean values reported for each element were calculated using 1/2 the equipment detection limit (EDL) as a surrogate for below detection limit analytical results.

TABLE B-3

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SURFACE WATER DATA

COPC or COPEC	Summary Statistic	ALL EVENT SUMMARY		TIER 2 SCREENING CRITERIA	BENCHMARKS FOR SURFACE WATER		TIER 3 SCREENING CRITERIA			
							Human Health		Ecological Receptors	
		Impacted Sample Concentrations (mg/L)	Background Sample Concentrations (mg/L)	Maximum Impacted Concentration Greater Than 2 Times Mean Background (Yes/No)	Human Health Criteria For Tap Water[1] (mg/L)	Ecological Criteria For Surface Water Chronic Exposure (mg/L)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Surface Water (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Surface Water (Yes/No)
Aluminum	Mean[5]	1.94E+02	4.75E+02	YES	3.60E+04	8.70E+01[(2)]	NO	NO	YES	YES
	Minimum	4.50E+00	9.30E+00							
	Maximum	1.60E+03	8.10E+03							
	FOD	66/66	30/30							
Antimony	Mean[5]	1.20E+00	1.10E+00	NO	1.50E+01	3.00E+01[(2)]	NO	NO	NO	NO
	Minimum[3]	<2.00E-01	< 2.00E-01							
	Maximum[3]	<2.50E+00	< 2.50E+00							
	FOD	0/66	0/30							
Arsenic	Mean[5]	4.00E-01	3.00E-01	YES	5.00E-02	1.50E+02[(2)]	YES	YES	NO	NO
	Minimum	<5.00E-01	< 5.00E-01							
	Maximum	5.00E+00	1.50E+00							
	FOD	3/66	2/30							
Beryllium	Mean[5]	2.40E+00	2.30E+00	YES	7.30E+01	5.30E+00[(2)]	NO	NO	NO	NO
	Minimum	< 1.00E-01	< 1.0E-01							
	Maximum	5.00E+00	< 5.00E+00							
	FOD	3/66	0/30							
Boron	Mean[5]	7.19E+01	6.11E+01	YES	3.30E+03	NPV	NO	NO	NA	YES
	Minimum	1.00E+01	1.00E+01							
	Maximum	1.80E+02	1.20E+02							
	FOD	66/66	30/30							

TABLE B-3

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SURFACE WATER DATA

COPC or COPEC	Summary Statistic	ALL EVENT SUMMARY		TIER 2 SCREENING CRITERIA	BENCHMARKS FOR SURFACE WATER		TIER 3 SCREENING CRITERIA			
							Human Health		Ecological Receptors	
		Impacted Sample Concentrations (mg/L)	Background Sample Concentrations (mg/L)	Maximum Impacted Concentration Greater Than 2 Times Mean Background (Yes/No)	Human Health Criteria For Tap Water[1] (mg/L)	Ecological Criteria For Surface Water Chronic Exposure (mg/L)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Surface Water (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Surface Water (Yes/No)
Cadmium	Mean[5]	1.00E-01	1.00E-01	YES	1.80E+01	2.20E+00[(2)]	NO	NO	NO	NO
	Minimum	<1.00E-01	< 1.00E-01							
	Maximum	1.80E+00	6.50E-01							
	FOD	12/66	8/30							
Chromium	Mean[5]	4.00E-01	6.00E-01	YES	1.10E+02[(3)]	1.10E+01[(2,4)]	NO	NO	NO	NO
	Minimum	< 1.00E-01	< 1.00E-01							
	Maximum	4.60E+00	5.80E+00							
	FOD	18/66	5/30							
Cobalt	Mean[5]	5.07E+00	NA	NA	7.30E+02	2.30E+01	NO	NO	YES	YES
	Minimum	<2.5E+00	NA							
	Maximum	3.07E+01	NA							
	FOD	2/177	NA							
Copper	Mean[5]	6.00E-01	5.00E-01	YES	1.40E+03	9.00E+00[(2)]	NO	NO	NO	NO
	Minimum	<1.30E-01	< 1.30E-01							
	Maximum	5.80E+00	3.40E+00							
	FOD	34/66	11/30							
Mercury	Mean[5]	1.00E-01	1.00E-01	NO	NA	NA	NA	NO	NA	NO
	Minimum	< 2.00E-03	< 2.00E-04							
	Maximum	9.00E-03	5.00E-03							
	FOD	24/45	11/21							

TABLE B-3

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SURFACE WATER DATA

COPC or COPEC	Summary Statistic	ALL EVENT SUMMARY		TIER 2 SCREENING CRITERIA	BENCHMARKS FOR SURFACE WATER		TIER 3 SCREENING CRITERIA			
							Human Health		Ecological Receptors	
		Impacted Sample Concentrations (mg/L)	Background Sample Concentrations (mg/L)	Maximum Impacted Concentration Greater Than 2 Times Mean Background (Yes/No)	Human Health Criteria For Tap Water[1] (mg/L)	Ecological Criteria For Surface Water Chronic Exposure (mg/L)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Surface Water (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Surface Water (Yes/No)
Molybdenum	Mean[5]	1.40E+00	1.10E+00	YES	1.80E+02	NPV	NO	NO	NA	YES
	Minimum	< 1.00E-01	< 1.00E-01							
	Maximum	1.01E+01	< 2.50E+00							
	FOD	5/66	3/30							
Nickel	Mean[5]	1.60E+00	1.00E+00	YES	7.30E+02	5.20E+01[(2)]	NO	NO	NO	NO
	Minimum	< 1.30E-01	< 1.30E-01							
	Maximum	4.30E+01	4.00E+00							
	FOD	41/66	21/30							
Selenium	Mean[5]	2.34E+01	6.00E-01	YES	1.80E+02	5.00E+00[(2)]	YES	YES	YES	YES
	Minimum	< 1.00E+00	< 1.00E+00							
	Maximum	1.14E+03	1.60E+00							
	FOD	41/66	4/30							
Silver	Mean[5]	2.00E-01	1.00E-01	YES	1.80E+02	1.00E-01[(2)]	NO	NO	YES	YES
	Minimum	< 5.00E-02	< 5.00E-02							
	Maximum	1.10E+00	3.50E+00							
	FOD	8/66	2/30							
Uranium	Mean[5]	1.00E+00	6.00E-01	YES	7.30E+00	NPV	NO	NO	NA	YES
	Minimum	2.10E-01	3.00E-01							
	Maximum	5.40E+00	1.90E+00							
	FOD	66/66	30/30							

TABLE B-3

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SURFACE WATER DATA

(Page 4 of 5)

COPC or COPEC	Summary Statistic	ALL EVENT SUMMARY		TIER 2 SCREENING CRITERIA	BENCHMARKS FOR SURFACE WATER		TIER 3 SCREENING CRITERIA			
							Human Health		Ecological Receptors	
		Impacted Sample Concentrations (mg/L)	Background Sample Concentrations (mg/L)	Maximum Impacted Concentration Greater Than 2 Times Mean Background (Yes/No)	Human Health Criteria For Tap Water[1] (mg/L)	Ecological Criteria For Surface Water Chronic Exposure (mg/L)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Surface Water (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Surface Water (Yes/No)
Vanadium	Mean[5]	1.10E+00	1.10E+00	YES	2.60E+02	NPV	NO	NO	NA	YES
	Minimum	< 5.00E-02	< 5.00E-02							
	Maximum	6.20E+00	8.10E+00							
	FOD	46/66	16/30							
Zinc	Mean[5]	2.29E+01	1.64E+01	YES	1.10E+04	1.20E+02[(2)]	NO	NO	NO	NO
	Minimum	1.00E+01	< 1.00E+01							
	Maximum	1.10E+02	7.10E+01							
	FOD	45/66	17/30							

Notes:

µg/L Microgram per liter
COPEC Chemical of potential ecological concern
FOD Frequency of detection
MDL Minimum detection limit
NA No applicable
NPV No published value
PRG Preliminary remediation goal

1 Based on Region 9 U.S. Environmental Protection Agency Preliminary Remediation Goals for tap water.

2 Based on the Criteria Continuous Concentration as reported in Buchman 1999. Screening Quick Reference Tables. National Oceanic and Atmospheric Administration.

TABLE B-3

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SURFACE WATER DATA

Notes (continued):

[3] The data evaluated was a combination of four separate sampling events. The minimum detection limit (MDL) was not always the same for each sampling event; therefore, the minimum and maximum for analytes in which there were no detects were based on the lowest and highest of the MDLs, if they were different.

[4] Based on Chromium VI.

[5] The mean values reported for each element were calculated using 1/2 the equipment detection limit (EDL) as a surrogate for below detection limit analytical results.

Assumptions:

Average concentrations for COPCs/COPECs calculated using all samples collected. Concentrations below MDL used one-half MDL for mean calculations.

TABLE B-4

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SOIL DATA

(Page 1 of 4)

COPC or COPEC	Summary Statistic	ALL EVENTS SUMMARY		EDL Range (mg/kg)	TIER 2 SCREENING	BENCHMARKS FOR SOILS		TIER 3 SCREENING			
								Human Health		Ecological Receptors	
		Impacted Sample Concentrations (mg/kg)	Background Sample Concentrations (mg/kg)		Maximum Impacted Concentration Greater Than 2 Times Background (Yes/No)	Human Health Criteria for Residential Soil (mg/kg)(1)	Ecological Benchmark for Soils (mg/kg)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Soils (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Soils (Yes/No)
Aluminum	Mean[5]	2.42E+04	2.34E+04	NA	NO	NA	NA	NO	NO	NA	NO
	Minimum	7.87E+03	1.80E+04								
	Maximum	3.34E+04	2.96E+04								
	FOD	4/4	4/4								
Antimony	Mean[5]	2.80E+00	1.30E+00	0.38 – 1.6	YES	3.10E+01	3.50E+00(2)	NO	NO	YES	YES
	Minimum	2.00E-01	2.00E-01								
	Maximum	1.70E+01	5.60E+00								
	FOD	7/11	4/8								
Arsenic	Mean[5]	9.60E+00	6.60E+00	0.08 – 0.50	YES	4.00E-01	3.70E+01(3)	YES	YES	NO	NO
	Minimum	3.00E+00	5.20E+00								
	Maximum	2.90E+01	7.80E+00								
	FOD	11/11	8/8								
Beryllium	Mean[5]	1.40E+00	1.20E+00	0.02 – 0.08	NO	NA	NA	NA	NO	NA	NO
	Minimum	5.00E-01	8.00E-01								
	Maximum	1.70E+00	1.80E+00								
	FOD	11/11	8/8								
Boron	Mean[5]	1.59E+01	5.70E+00	2.00	YES	5.50E+03	5.00E-01(2)	NO	NO	YES	YES
	Minimum	1.00E+00	2.70E+00								
	Maximum	4.30E+01	2.40E+01								
	FOD	9/11	4/8								

TABLE B-4

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SOIL DATA

COPC or COPEC	Summary Statistic	ALL EVENTS SUMMARY		EDL Range (mg/kg)	TIER 2 SCREENING	BENCHMARKS FOR SOILS		TIER 3 SCREENING			
								Human Health	Ecological Receptors		
		Impacted Sample Concentrations (mg/kg)	Background Sample Concentrations (mg/kg)		Maximum Impacted Concentration Greater Than 2 Times Background (Yes/No)	Human Health Criteria for Residential Soil[1] (mg/kg)	Ecological Benchmark for Soils (mg/kg)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Soils (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Soils (Yes/No)
Cadmium	Mean[5]	7.70E+00	1.10E+00	0.02 – 0.2	YES	3.70E+01	2.90E+01(3)	YES	YES	YES	YES
	Minimum	1.00E-01	1.00E-01								
	Maximum	6.30E+01	2.70E+00								
	FOD	10/11	7/8								
Chromium	Mean[5]	1.44E+02	5.77E+01	0.08 – 0.18	YES	2.10E+02(4)	5.00E+00(3,4)	YES	YES	YES	YES
	Minimum	2.10E+01	3.50E+01								
	Maximum	9.70E+02	1.10E+02								
	FOD	11/11	8/8								
Cobalt	Mean[5]	7.08E+00	NA	NA	NA	9.00E+02	3.18E+01(3)	NO	NO	NO	NO
	Minimum	3.20E+00	NA								
	Maximum	1.90E+01	NA								
	FOD	24/25	NA								
Copper	Mean[5]	2.77E+01	1.74E+01	0.28 – 0.70	YES	2.90E+03	4.00E+01(2)	NO	NO	YES	YES
	Minimum	7.50E+00	1.10E+01								
	Maximum	1.20E+02	2.60E+01								
	FOD	11/11	8/8								
Mercury	Mean[5]	9.14E-02	2.92E-02	4.2	YES	2.30E-02	1.00E-04(2)	NO	NO	YES	YES
	Minimum	1.00E-04	1.40E-02								
	Maximum	6.20E-01	7.00E-02								
	FOD	11/11	8/8								
Molybdenum	Mean[5]	6.10E+00	1.90E+00	3.8	YES	3.90E+02	2.00E+00(2)	NO	NO	YES	YES
	Minimum	3.10E+01	< 3.80E+00								
	Maximum	3.10E+01	< 3.80E+00								
	FOD	1/7	0/4								

TABLE B-4

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SOIL DATA

COPC or COPEC	Summary Statistic	ALL EVENTS SUMMARY		EDL Range (mg/kg)	TIER 2 SCREENING	BENCHMARKS FOR SOILS		TIER 3 SCREENING			
								Human Health		Ecological Receptors	
		Impacted Sample Concentrations (mg/kg)	Background Sample Concentrations (mg/kg)		Maximum Impacted Concentration Greater Than 2 Times Background (Yes/No)	Human Health Criteria for Residential Soil[1] (mg/kg)	Ecological Benchmark for Soils (mg/kg)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Soils (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Soils (Yes/No)
Nickel	Mean[5]	5.60E+01	2.47E+01	0.02 – 0.5	YES	1.60E+03	3.05E+01[(3)]	NO	NO	YES	YES
	Minimum	1.37E+01	1.90E+01								
	Maximum	2.80E+02	3.70E+01								
	FOD	11/11	8/8								
Selenium	Mean[5]	1.64E+01	9.00E-01	0.04	YES	3.90E+02	8.00E-01[(3)]	NO	NO	YES	YES
	Minimum	9.00E-01	4.00E-01								
	Maximum	1.50E+02	1.40E+00								
	FOD	11/11	8/8								
Silver	Mean[5]	6.00E-01	1.00E-01	0.04 – 0.2	YES	3.90E+02	2.00E+00[(2)]	NO	NO	YES	YES
	Minimum	1.00E-01	1.00E-01								
	Maximum	5.20E+00	1.00E-01								
	FOD	5/11	4/8								
Uranium	Mean[5]	6.40E+00	6.60E+00	2	NO	NA	NA	NA	NO	NA	NO
	Minimum	1.00E+00	4.10E+00								
	Maximum	1.10E+01	9.30E+00								
	FOD	6/7	4/4								
Vanadium	Mean[5]	1.04E+02	5.49E+01	0.16 – 3.10	YES	5.50E+02	2.00E+00[(2)]	NO	NO	YES	YES
	Minimum	1.77E+01	4.23E+01								
	Maximum	5.00E+02	8.30E+01								
	FOD	8/8	8/8								

TABLE B-4

CHEMICAL OF POTENTIAL CONCERN TIER 2 AND 3 SCREENING CRITERIA FOR SOIL DATA

COPC or COPEC	Summary Statistic	ALL EVENTS SUMMARY		EDL Range (mg/kg)	TIER 2 SCREENING	BENCHMARKS FOR SOILS		TIER 3 SCREENING			
								Human Health		Ecological Receptors	
		Impacted Sample Concentrations (mg/kg)	Background Sample Concentrations (mg/kg)		Maximum Impacted Concentration Greater Than 2 Times Background (Yes/No)	Human Health Criteria for Residential Soil[1] (mg/kg)	Ecological Benchmark for Soils (mg/kg)	Maximum COPC Concentration Greater Than Human Health Criteria (Yes/No)	COPC Retained for Soils (Yes/No)	Maximum COPEC Concentration Greater Than Ecological Criteria (Yes/No)	COPEC Retained for Soils (Yes/No)
Zinc	Mean[5]	2.46E+02	1.06E+02	0.14 – 0.54	YES	2.30E+04	1.90E+02[(3)]	NO	NO	YES	YES
	Minimum	4.07E+01	6.70E+01								
	Maximum	1.40E+03	1.90E+02								
	FOD	11/11	8/8								

Notes:

COPC Chemical of potential concern
COPEC Chemical of potential ecological concern
EDL Equipment detection limit
EPA U.S. Environmental Protection Agency
FOD Frequency of detection
mg/kg Milligram per kilogram
NA Not applicable

1 Based on Region 9 U.S. Environmental Protection Agency (EPA) Preliminary Remediation Goals for residential soils.

2 Criteria taken from EPA, Region 4. 2001. "Recommended Ecological Screening Values (mg/kg) for Soil." Based on Friday, G.P. 1998. "Ecological Screening Values for Surface Water, Sediment, and Soil." Westinghouse Savannah River Company, Savannah River Technology Center. WSRC-TR-98-00110. Aiken, South Carolina.

3 Based on EPA. 2000. "Ecological Soil Screening Level Guidance, Draft."

4 Based on total Chromium.

5 The mean values reported for each element were calculated using 1/2 the equipment detection limit (EDL) as a surrogate for below detection limit analytical results.

TABLE B-5

CHEMICAL OF POTENTIAL CONCERN TIER 4 SCREENING CRITERIA FOR MINE POND DATA

(Page 1 of 1)

COPC or COPEC[1]	EDL (mg/L)	Average (mg/L)	Minimum (mg/L)	Maximum (mg/L)	Ecological Criteria for Surface Water Chronic Exposure[2] (mg/L)	TIER 4 SCREENING: Maximum Concentration Greater Than Ecological Criteria for Surface Water (Yes/No)
Aluminum	1.00E+00	1.31E+01	5.00E-01	2.00E+02	8.70E+01	YES
Antimony	2.50E+00	1.30E+00	1.30E+00	3.10E+00	3.00E+01	NO
Arsenic	5.00E-01	2.70E+00	3.00E-01	3.00E+01	1.50E+02	NO
Beryllium	5.00E+00	2.50E+00	2.50E+00	2.50E+00	5.30E+00	NO
Boron	2.50E+01	2.88E+01	1.25E+01	3.20E+02	NPV	NO
Cadmium	1.30E-01	2.48E+00	6.50E-02	5.00E+01	2.20E+00	YES
Chromium	5.00E-01	5.08E+00	2.50E-01	3.80E+01	7.40E+01	NO
Copper	1.30E-01	1.64E+00	4.90E-01	4.40E+00	9.00E+00	NO
Mercury	5.00E-01	2.50E-01	2.50E-01	2.50E-01	7.70E-01	NO
Molybdenum	2.50E+00	1.54E+01	1.25E+00	7.50E+01	NPV	YES
Nickel	1.30E-01	6.00E+01	6.60E-01	1,500	5.20E+01	YES
Selenium	1.00E+00	6.37E+01	5.00E-01	6.70E+02	5.00E+00	YES
Silver	2.50E-01	1.25E-01	1.25E-01	1.25E-01	1.20E-01	YES
Uranium	1.00E-01	4.60E+00	2.80E-01	5.90E+01	NPV	YES
Vanadium	2.50E-01	1.83E+01	1.25E-01	1.70E+02	NPV	YES
Zinc	1.00E+01	2.20E+02	5.00E+00	6,600	1.20E+02	YES

Notes:

µg/L	Microgram per liter
EDL	Equipment detection limit
COPC	Chemical of potential concern
COPEC	Chemical of potential ecological concern
NPV	No published value

[1] Only 2001 Montgomery Watson (MW) data used.

[2] Taken from Buchman, M.F. 1999. "NOAA Screening Quick References Tables." National Oceanic and Atmospheric Administration (NOAA) HAZMAT Report 99-1. Coastal Protection and Restoration Division. Seattle, Washington; and 1997 Federal Register 62: 42159 to 42208.

APPENDIX C

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION CALCULATIONS

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1.0 INTRODUCTION

Appendix C presents the equations, procedures, and assumptions used to calculate medium-specific exposure point concentrations (EPC) under Tiers 2 and 3 of the Area Wide Ecological Risk Assessment (AWERA) and the Area Wide Human Health Risk Assessment (AWHHRA) for the Southeast Idaho Phosphate Mining Resource Area (Resource Area). The EPCs are calculated based on analytical results from medium-specific samples collected throughout the Resource Area. Tier 2 EPCs were based primarily on analytical results from samples collected by Tetra Tech EM Inc. (TtEMI) and Montgomery Watson (MW) in Spring and Summer of 2001. Tier 3 EPCs were based on analytical results from samples of surface water and fish tissue collected by MW in 1998 and 1999. Appendix H presents analytical results for 2001 samples, while 1998 and 1999 analytical results are presented in MW (1999).

In general, the medium-specific EPCs were calculated as area-weighted average concentrations (AWAC) based on analytical results from samples collected from both potentially impacted and unimpacted portions of the Resource Area. This approach, in which analytical results were "weighted" based on the size or extent of the medium-specific unit sampled relative to the total medium-specific area over which the samples were averaged, is consistent with the fact that large portions of the Resource Area are apparently not impacted by mining activities. The area over which the analytical results were averaged is both medium-specific and dependent on the type of receptor assumed to be exposed. The areas of impacted and unimpacted media were based on the analytical data and calculated using existing geographic information system (GIS) overlays for the Resource Area. EPCs were calculated as mean AWACs across the entire Resource Area, individual watersheds, and individual riparian areas depending on the exposure scenario (e.g. receptor, exposure pathway combination). These AWACs were used as medium-specific EPCs for the AWERA and for the AWHHRA under central tendency exposure (CTE) conditions. However, the AWHHRA also evaluated receptor-specific exposures under reasonable maximum exposure (RME) conditions. Additional procedures used to calculate EPCs under RME conditions are also presented.

Consistent with the tiered approach used to prepare the AWHHRA, EPCs were calculated only for exposure pathways associated with total risks greater than 1E-06 and total hazard indexes (HI) greater than 1. Also, EPCs were only prepared for chemicals of potential concern (COPC) associated with total risks greater than 1E-07 and total HIs greater than 0.1. Therefore, for the purpose of completing Tiers 2 and 3 of the AWHHRA, EPCs were calculated only for arsenic, cadmium, chromium, and selenium and were not completed for media associated with the following exposure pathways: inhalation of

particulates, ingestion of aquatic and terrestrial plants, ingestion of tea brewed from terrestrial plants, and ingestion of homegrown produce.

Equations, procedures, and assumptions for calculating medium-specific EPCs are presented below for five categories of EPCs:

(1) Surface water, sediment, fish tissue, benthic inverts, and aquatic plants (AWERA only) – Section 2.0

(2) Riparian area soil (AWERA only) – Section 3.0

(3) Resource Area soil, plants, small mammals, and terrestrial invertebrate (all AWERA only) – Section 4.0

(4) Riparian area soil (AWHHRA only) – Section 5.0

(5) Beef and elk tissue (AWHHRA only) – Section 6.0

2.0 SURFACE WATER, SEDIMENT, FISH TISSUE, BENTHIC INVERTEBRATES, AND AQUATIC PLANTS

Section 2.1 presents the equations, procedures, and assumptions used to calculate AWACs for surface water, sediment, fish tissue, benthic invertebrates, and aquatic plants (AWERA only). Surface water and fish tissue AWACs were used as EPCs for both the AWERA and the AWHHRA. AWACs for the remaining media were used as AWACs for the AWERA and the AWHHRA (CTE case only). The discussion is organized by goal, general procedure, and assumptions. Section 2.2 presents the approach used to calculate RME EPCs based on AWACs.

It was postulated that the concentration of COPECs in surface water and fish tissue may be subject to temporal variation depending in large part on the annual amount of precipitation and the subsequent spring runoff. To evaluate this hypothesis, EPCs were calculated using the analytical results of surface water and fish tissue samples collected at different times.

Specifically, under Tier 2, AWACs were calculated based on analytical results from samples collected in 2001. Impacted reaches were defined as stream reaches in which the concentration of selenium exceeded the chronic ambient water quality criterion (AWQC) of 5 micrograms per liter (µg/L). For surface water, sediment, benthic invertebrates, and aquatic plants, 2001 analytical results were weighted based on impacted and unimpacted reaches established based on the maximum extent of stream segments documented as impacted using all available data. Therefore, for the purpose of the AWERA and the AWHHRA, 2001 analytical results were weighted by the relative presence of impacted and unimpacted

reaches as defined by both 2001 and 1998/1999 surface water analytical data (see Figure 8). For Tier 3, 1998/1999 analytical data was weighted based on 1998/1999 surface water data (for surface water EPCs) and based on both 2001 and 1998/1999 surface water data (for fish tissue EPCs).

2.1 AREA-WEIGHTED AVERAGE CONCENTRATION CALCULATIONS

This section presents the equation, procedures, and assumptions used to calculate surface water, sediment, fish tissue, and benthic invertebrate AWACs. These AWACs were used as EPCs in the AWERA and the AWHHRA (CTE case only).

Goal: Calculation of AWACs for an individual watershed with N reaches

$$\text{AWAC} = \sum_{j=1}^{N} \left(MCR_j\right) \times \left(AR_j \;/\; TSA\right) \qquad \text{(C-1)}$$

where

AWAC	=	Area-weighted average concentration (mg/kg)
AR	=	Area of reach (square feet [ft^2])
j	=	j^{th} stream reach
MCR	=	Mean concentration of reach (mg/kg)
N	=	Number of reaches in watershed
TSA	=	Total stream area (ft^2)

General Procedure

- Multiply the mean concentration for each reach by the area of the reach divided by the total area of all streams in the watershed (1st, 2nd, and 3rd order; all perennial)
- Sum the weighted means for all N reaches

Assumptions

- The mean concentration for each impacted reach is based on reach-specific analytical results.
- For impacted reaches with no analytical data, the mean concentration is equal to the mean concentration based on all impacted analytical data.
- All unimpacted reaches (including streams whose entire length within a watershed is unimpacted by mining activity) are considered a single composite reach – the mean concentration for this composite reach is calculated as the mean of available analytical data for unimpacted reaches.
- Nondetect results are assumed to be present at a concentration equal to one-half of the detection limit.

- The area of each reach was calculated as follows:
  - Calculate an average width for 1st, 2nd, and 3rd order streams based on stream-width information from total maximum daily load (TMDL) reports (TtEMI 2002b)
  - For impacted reaches calculate area as (length [ft] x average order-specific width [ft])
  - For composite unimpacted reach, calculated area as the sum of subreach-specific areas each calculated as (length of subreach [ft] x average order-specific width [ft])
  - Total stream area calculated as sum of reach-specific areas (ft^2)

The calculation tables for surface water, sediment, fish tissue, and benthic invertebrate tissue EPCs are presented in Tables C-1 through C-15.

2.2 REASONABLE MAXIMUM EXPOSURE POINT CONCENTRATION CALCULATIONS

This section presents the equation, procedures, and assumptions used to calculate surface water and fish tissue RME EPCs. These EPCs were used only in the AWHHRA.

Goal: Calculation of the 95 upper confidence limits (UCL_{95}) of the AWAC using the approach described in Section 11.12.2 in Gilbert (1987) for estimating confidence limits for regional means.

$$UCL_{95} = AWAC + t_{(1-\alpha,\, N-1)} \sqrt{S.E.}\ , \text{ and} \qquad \text{(C-2)}$$

$$S.E. = \frac{1}{N(N-1)} \sum_{j=1}^{N} \left(AWAC_j - AWAC \right)^2$$

where

UCL_{95}	=	95 Percent upper confidence level
α	=	Acceptable Type I error
N	=	Number of reaches
S.E.	=	Standard error of the weighted regional mean
t	=	Student's t statistic
AWAC	=	Area-weighted average concentration based on N reaches (= regional mean)
$AWAC_j$	=	Area-weighted average for the jth reach

General Procedures

- Calculate the standard error (equal to the standard deviation of the mean concentrations for individual reaches) of the regional mean concentration for N reaches. Note that this estimator does not use individual measurements within reaches, but only the estimated means for each reach.
- Calculate the UCL_{95} based on Equation C-2 (equation 11.21 in Gilbert [1987])

Assumptions

- An arithmetic mean is appropriate to represent the true average concentration of each chemical in each reach. In cases where only a single measurement is available, this measurement is used as a surrogate for the mean concentration.
- Possible spatial or serial correlations in the data can be ignored.
- The distribution of the means for all reaches follows a normal distribution. Note that this assumption applies to the distribution of means, rather than individual measurements within each reach.

The data used and the RME calculation results are presented in Tables 6-9, 6-10, 6-11, 6-12, 6-13, 6-14, 6-17, and 6-18 of the report.

3.0 RIPARIAN AREA-SPECIFIC SOIL, PLANT, SMALL MAMMAL, AND TERRESTRIAL INVERTEBRATE CONCENTRATIONS

This section presents the equations, procedures, and assumptions used to calculate AWACs for riparian area-specific soil, plants, small mammals, and terrestrial invertebrate concentrations. These AWACs were used as EPCs only in the AWERA.

Goal: Calculation of soil, plant, small mammal, and terrestrial invertebrate AWACs specific to riparian area for an individual watershed with N reaches.

$$\text{AWAC} = \sum_{j=1}^{N} MSC_j \times \left(LR_j \,/\, TSL\right) \qquad \text{(C-3)}$$

where

AWAC	=	Area-weighted average concentration (mg/kg)
j	=	j^{th} stream reach
LR	=	Length of reach (ft)
MSC	=	Mean soil concentration (mg/kg)
N	=	Number of reaches in the watershed
TSL	=	Total stream length (ft)

General Procedures

- Multiply the mean concentration for a reach by the length of the reach divided by the total length of all streams in the watershed (1st, 2nd, 3rd order; all perennial)
- Sum the weighted means for all N reaches

Assumptions

- Width of riparian area is constant (25 meters [82 ft]) for all riparian areas.
- Mean concentration for each impacted reach is based on reach-specific analytical results for each media.
- For impacted reaches with no analytical data, the mean concentration is equal to the mean concentration based on all impacted results for each media.
- All unimpacted reaches (including streams whose entire length within a watershed is unimpacted by mining activity) are considered a single composite reach – the mean concentration for this composite reach is calculated as the mean of available analytical data for unimpacted reaches.
- Nondetect results are assumed to be present at concentrations equal to one-half the detection limit.

The calculation tables for riparian area-specific soil, plant, small mammal, and terrestrial invertebrate EPCs are presented in Tables C-16 through C-27.

4.0 RESOURCE AREA SOIL, PLANT, SMALL MAMMAL, AND TERRESTRIAL INVERTEBRATE CONCENTRATIONS

This section presents the equations, procedures, and assumptions used to calculate Resource Area-wide soil, plant, small mammal, and terrestrial invertebrate concentrations. These AWACs were used as EPCs only in the AWERA.

Goal: Calculation of soil, plant, small mammal, and terrestrial invertebrate AWACs across the entire Resource Area

$$\text{AWAC} = \sum_{j=1}^{N} MCEA_j \text{ x } (Area\ of\ EA_j\ /\ TWSA) \qquad \text{(C-4)}$$

where

AWAC	=	Area-weighted average concentration (mg/kg)
EA	=	Exposure area (ft^2)
j	=	j^{th} exposure area
MCEA	=	Mean concentration in exposure area (mg/kg)
N	=	Number of exposure areas

TWSA = Total watershed soil area (ft^2)

General Procedures

- Multiply the mean concentration for an exposure area (EA) by the area of the EA divided by the total area of soil in the watershed
- Sum the weighted means for all N EAs

Assumptions

- EAs include (1) impacted riparian area, (2) waste rock piles, and (3) unimpacted soil in the Resource Area.
- Mean concentrations for impacted media are based on impacted riparian area- and waste rock pile-specific analytical data.
- Mean concentrations for remaining unimpacted media in Resource Area are based on analytical data for unimpacted media.
- Area of impacted riparian areas are calculated as (length (ft) x 82 ft).
- Area of waste rock piles obtained primarily from U.S. Geological Survey information.
- Area of total watershed area soil calculated as (total watershed area – total water body area).
- Area of unimpacted soil calculated as (total watershed soil area – area of impacted riparian areas + area of waste rock piles).

The calculation tables for overall area-specific soil, plant, small mammal, and terrestrial invertebrate EPCs are presented in Tables C-28 through C-39.

5.0 RIPARIAN AREA SOIL CONCENTRATIONS

Subsistence lifestyle receptors were assumed to be exposed to surface soil at a hypothetical residential property located adjacent to a Resource Area stream and containing a portion of riparian area. This section presents the equations, procedures, and assumptions used to calculate residential property-specific soil concentrations to which subsistence lifestyle receptors are assumed to be exposed. These AWACs were used as EPCs only in the AWHHRA.

Goal: Calculation of AWACs across the residential property of a subsistence lifestyle receptor

$$\text{AWAC} = \left(\sum_{j=1}^{N} MIC_j \text{ x } [AI_j / ARP]\right) + \left(\sum_{j=1}^{N} MUC_j \text{ x } [AURP_j / ARP]\right) \qquad \text{(C-5)}$$

where

AWAC	=	Area-weighted average concentration (mg/kg)
AI	=	Area impacted (ft^2)
ARP	=	Area of residential property (ft^2)
AURP	=	Area of unimpacted residential property (ft^2)
j	=	j^{th} stream reach
MIC	=	Mean impacted concentration (mg/kg)
MUC	=	Mean unimpacted concentration (mg/kg)
N	=	Number of residential properties

General Procedures

- Multiply the mean concentration for an impacted reach by the area of the impacted reach divided by the total area of the residential property
- Multiply the mean concentration for all unimpacted riparian soil by the area of unimpacted residential property, divided by the total area of residential property
- Sum the two weighed means

Assumptions

- Riparian area assumed to be 25 meters (82 ft) in width along all streams.
- Residential property defined as that portion of a subsistence lifestyle receptor's property immediately surrounding the home; assumed to be 0.5 acre (21,780 ft^2).
- Residential property assumed to be square (147.5 ft x 147.5 ft) and orientated parallel to stream beginning at the stream edge.
- Area of impacted reach calculated as (147.5 ft x 82 ft) = 12,095 ft^2
- Area of unimpacted residential property calculated as (147.5 ft x [147.5 – 82 ft]) = 9,666 ft^2

6.0 BEEF CATTLE AND ELK TISSUE

Members of all three receptor groups considered in the AWHHRA (recreational hunter/fishers, Native Americans, and subsistence lifestyle receptors) are assumed to be exposed to COPCs through ingestion of beef cattle and elk tissues. This section presents the equations, procedures, and assumptions used to calculate tissue concentrations to which members of all three receptor groups may be exposed. These concentrations were used as EPCs only in the AWHHRA.

Goal: Calculation of distribution-specific means and UCL_{95} values for COPCs in beef cattle and elk tissues

- For normal distributions, UCL_{95} values were calculated using the following equation:

$$UCL_{95} = \bar{x} + t_{(1-a,n-1)}\left(\frac{s}{\sqrt{n}}\right) \quad \text{(C-6)}$$

- For lognormal distributions, UCL_{95} values were calculated using the following equation:

$$UCL_{95} = e^{(\bar{x} + 0.5s^2 + sH/\sqrt{n-1})} \quad \text{(C-7)}$$

where

UCL_{95}	=	95 Percent upper confidence level
e	=	Constant (base of the natural log, equal to 2.718)
x	=	Mean concentration (mg/kg)
t	=	Student's t statistic
s	=	Standard deviation
n	=	Number of samples
H	=	H-statistic, from Gilbert (1987)

For the purpose of calculating EPCs, only analytical results associated with samples from beef cattle pastured on the Henry Mine pasture (n = 15) and elk identified as "after-the-fact-treatments" (n = 26) were used in Equations C-6 and C-7 (MW 1999).

General Procedures

- Test the distribution of each data set (e.g. normal, lognormal, or other)
- Calculate means (arithmetic or geometric) consistent with the determination of the appropriate distribution. [Note: if a data set was determined to have an "other" distribution, the greater of the arithmetic and geometric means was selected as the mean for that data set].
- Calculate UCL_{95} consistent with EPA (1992) using Equations C-6 and C-7. [Note: if a data set was determined to have an "other" distribution, the greater of the normal- or lognormal-based UCL_{95} was selected as the UCL_{95} for that data set].

All statistical calculations were performed using the MTCA *Stat* 3.0 statistical program developed by the Washington Department of Ecology (WDE) (WDE 2002).

Assumptions

- "After-the-fact-treatments" accurately represent elk that receptors hunting in the Resource Area will take.
- The greater of the mean and UCL_{95} values calculated for normal and lognormal distributions will conservatively represent the "true" mean and UCL_{95} values for distributions identified as "other" (e.g., neither normal or lognormal).

7.0 REFERENCES

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TABLES

TABLE C-1

HUMAN HEALTH RISK ASSESSMENT RIPARIAN SOIL CONCENTRATION CALCULATIONS

(Page 1 of 2)

ANALYTE	Background Mean Concentration[1] (mg/kg)	RA-1		RA-2		RA-3		RA-4	
		Sample SL-002 Concentration[1] (mg/kg)	RA-1 Area Weighted Soil Concentration[1] (mg/kg)	Sample SL-001 Concentration[1] (mg/kg)	RA-2 Area Weighted Soil Concentration[1] (mg/kg)	Sample SL-005 Concentration[1] (mg/kg)	RA-3 Area Weighted Soil Concentration[1] (mg/kg)	Sample SL-006 Concentration[1] (mg/kg)	RA-4 Area Weighted Soil Concentration[1] (mg/kg)
Antimony	1.83E+00	1.70E+01	8.40E+00	8.00E-01	1.17E+00	2.60E+00	1.98E+00	2.50E+00	1.93E+00
Arsenic	6.74E+00	2.90E+01	1.59E+01	8.90E+00	6.97E+00	8.30E+00	6.70E+00	7.70E+00	6.44E+00
Barium	2.08E+02	9.20E+01	1.33E+02	1.90E+02	1.77E+02	2.00E+02	1.82E+02	2.00E+02	1.82E+02
Beryllium	1.29E+00	1.70E+00	1.33E+00	1.50E+00	1.24E+00	1.40E+00	1.20E+00	1.40E+00	1.20E+00
Boron	7.14E+00	4.30E+01	2.24E+01	2.20E+01	1.30E+01	1.20E+01	8.53E+00	2.20E+01	1.30E+01
Cadmium	1.16E+00	6.30E+01	2.86E+01	4.40E+00	2.48E+00	4.30E+00	2.44E+00	7.90E-01	8.70E-01
Chromium	6.32E+01	9.10E+02	4.34E+02	7.50E+01	6.16E+01	9.60E+01	7.09E+01	5.10E+01	5.09E+01
Copper	1.82E+01	1.20E+02	6.17E+01	1.60E+01	1.53E+01	2.40E+01	1.88E+01	1.70E+01	1.57E+01
Lead	1.12E+01	7.50E-01	5.29E+00	1.20E+01	1.03E+01	1.60E+01	1.21E+01	4.80E+00	7.10E+00
Manganese	1.37E+03	2.70E+02	7.29E+02	1.40E+03	1.23E+03	6.90E+02	9.16E+02	1.50E+03	1.28E+03
Mercury	3.50E+01	6.20E+02	2.92E+02	3.10E+01	2.94E+01	7.10E+01	4.73E+01	3.00E+01	2.90E+01
Molybdenum	1.90E+00	3.10E+01	1.47E+01	1.90E+00	1.69E+00	1.90E+00	1.69E+00	1.90E+00	1.69E+00
Nickel	2.56E+01	2.80E+02	1.36E+02	3.40E+01	2.65E+01	4.60E+01	3.19E+01	2.50E+01	2.25E+01
Selenium	9.26E-01	1.50E+02	6.74E+01	2.40E+00	1.48E+00	6.60E+00	3.36E+00	9.90E-01	8.54E-01
Silver	9.25E-02	5.20E+00	2.36E+00	1.00E-01	8.58E-02	1.00E-01	8.58E-02	1.00E-01	8.58E-02
Thallium	7.05E-01	1.00E+00	7.60E-01	1.00E+00	7.60E-01	1.00E+00	7.60E-01	1.00E+00	7.60E-01
Uranium	8.37E+00	1.00E+00	4.17E+00	8.40E+00	7.47E+00	3.00E+00	5.06E+00	3.00E+00	5.06E+00
Vanadium	6.00E+01	5.00E+02	2.50E+02	7.20E+01	5.88E+01	5.90E+01	5.30E+01	5.90E+01	5.30E+01
Zinc	1.19E+02	1.40E+03	6.78E+02	1.40E+02	1.15E+02	1.10E+02	1.02E+02	1.00E+02	9.76E+01

TABLE C-1

HUMAN HEALTH RISK ASSESSMENT RIPARIAN SOIL CONCENTRATION CALCULATIONS

ANALYTE	RA-5		RA-6		RA-7		RA-8	
	Sample ST026 Concentration[1] (mg/kg)	RA-5 Area Weighted Soil Concentration[1] (mg/kg)	Sample ST076 Concentration[1] (mg/kg)	RA-6 Area Weighted Soil Concentration[1] (mg/kg)	Sample ST130 Concentration[1] (mg/kg)	RA-7 Area Weighted Soil Concentration[1] (mg/kg)	Sample ST227 Concentration[1] (mg/kg)	RA-8 Area Weighted Soil Concentration[1] (mg/kg)
Antimony	6.00E-01	1.08E+00	1.90E-01	9.00E-01	7.80E-01	1.16E+00	1.06E+00	1.29E+00
Arsenic	3.03E+00	4.35E+00	9.13E+00	7.07E+00	7.98E+00	6.56E+00	9.40E+00	7.19E+00
Barium	9.70E+01	1.36E+02	4.00E+02	2.71E+02	2.02E+02	1.82E+02	1.87E+02	1.76E+02
Beryllium	5.10E-01	8.02E-01	1.63E+00	1.30E+00	1.74E+00	1.35E+00	1.07E+00	1.05E+00
Boron	1.00E+00	3.62E+00	1.83E+01	1.14E+01	1.07E+01	7.97E+00	1.00E+00	3.62E+00
Cadmium	9.30E-01	9.33E-01	2.07E+00	1.44E+00	3.00E+00	1.86E+00	4.77E+00	2.65E+00
Chromium	2.10E+01	3.75E+01	4.80E+01	4.95E+01	6.70E+01	5.80E+01	9.20E+01	6.92E+01
Copper	7.50E+00	1.15E+01	1.77E+01	1.60E+01	2.66E+01	2.00E+01	2.87E+01	2.09E+01
Lead	4.97E+00	7.18E+00	2.47E+01	1.60E+01	1.70E+01	1.25E+01	1.43E+01	1.14E+01
Manganese	2.26E+02	7.09E+02	5.30E+02	8.45E+02	1.74E+03	1.39E+03	1.13E+03	1.11E+03
Mercury	5.00E-02	1.56E+01	3.77E+01	3.24E+01	4.24E+01	3.45E+01	7.70E+01	5.00E+01
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	1.37E+01	1.75E+01	3.17E+01	2.55E+01	7.40E+01	4.44E+01	4.53E+01	3.16E+01
Selenium	2.03E+00	1.32E+00	1.50E+00	1.08E+00	1.78E+00	1.21E+00	1.27E+01	6.08E+00
Silver	7.00E-02	7.24E-02	9.00E-02	8.13E-02	1.90E-02	4.96E-02	6.00E-01	3.09E-01
Thallium	1.90E-01	3.98E-01	6.00E-01	5.82E-01	2.30E-01	4.16E-01	3.00E-01	4.48E-01
Uranium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	1.77E+01	3.46E+01	5.17E+01	4.98E+01	6.62E+01	5.62E+01	9.17E+01	6.76E+01
Zinc	4.07E+01	7.11E+01	1.10E+02	1.02E+02	1.46E+02	1.18E+02	2.20E+02	1.51E+02

Notes:

mg/kg Milligram per kilogram
NA Data not available

1 All concentrations reported on a dry weight basis.

TABLE C-2

SALT WATERSHED SURFACE WATER EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration (mg/L)
	Sage Creek Areal Contribution	Sage Creek Concentration (mg/L)	Areal Contribution	Concentration (mg/L)	
Arsenic	0.002	2.50E-01	0.998	3.10E-01	3.10E-01
Cadmium	0.002	6.20E-02	0.993	1.21E-01	1.20E-01
Chromium	0.002	3.20E-01	0.993	3.90E-01	3.88E-01
Copper	0.002	1.83E-01	0.993	4.78E-01	4.75E-01
Nickel	0.002	6.89E-01	0.993	9.45E-01	9.39E-01
Selenium	0.002	4.00E+00	0.993	7.20E-01	7.23E-01
Vanadium	0.002	8.90E-01	0.993	9.13E-01	9.08E-01
Zinc	0.002	1.90E+01	0.993	1.88E+01	1.87E+01

Notes:

μ/L Microgram per liter

TABLE C-3

GEORGETOWN WATERSHED SURFACE WATER EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration (µg/L)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration (µg/L)	Areal Contribution	Concentration (µg/L)	
Arsenic	0.085	6.67E-01	0.915	2.50E-01	2.85E-01
Cadmium	0.085	6.50E-02	0.915	6.50E-02	6.50E-02
Chromium	0.085	3.47E-01	0.915	2.98E-01	3.02E-01
Copper	0.085	6.50E-02	0.915	1.32E-01	1.26E-01
Nickel	0.085	7.88E-01	0.915	1.11E+00	1.08E+00
Selenium	0.085	1.80E+00	0.915	1.10E+00	1.16E+00
Vanadium	0.085	8.90E-01	0.915	1.19E+00	1.17E+00
Zinc	0.085	1.13E+01	0.915	1.02E+01	1.03E+01

Notes:

µ/L Microgram per liter

TABLE C-4

BLACKFOOT WATERSHED FISH TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA								
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/kg)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/kg)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/kg)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/kg)	Spring Creek Area Contribution
Arsenic	0.252	1.13E-01	0.007	1.13E-01	0.002	1.05E-01	0.004	1.13E-01	0.001
Cadmium	0.252	4.98E-01	0.007	4.98E-01	0.002	1.50E+00	0.004	4.98E-01	0.001
Chromium	0.252	2.78E+00	0.007	2.78E+00	0.002	2.20E+00	0.004	2.78E+00	0.001
Copper	0.252	5.78E+00	0.007	5.78E+00	0.002	7.70E+00	0.004	5.78E+00	0.001
Nickel	0.252	8.60E-01	0.007	8.60E-01	0.002	7.30E-01	0.004	8.60E-01	0.001
Selenium	0.252	2.28E+01	0.007	2.28E+01	0.002	3.30E+01	0.004	2.28E+01	0.001
Vanadium	0.252	2.51E-01	0.007	2.51E-01	0.002	2.40E-01	0.004	2.51E-01	0.001
Zinc	0.252	1.06E+02	0.007	1.06E+02	0.002	8.79E+01	0.004	1.06E+02	0.001

ANALYTE	IMPACTED AREA			UNIMPACTED AREA		Area Weighted Concentration[1] (mg/kg)
	Spring Creek Concentration[1] (mg/kg)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/kg)	Areal Contribution	Concentration[1] (mg/kg)	
Arsenic	1.23E-01	0.005	1.13E-01	0.729	1.01E-01	1.04E-01
Cadmium	2.10E-01	0.005	4.98E-01	0.729	1.28E-01	2.29E-01
Chromium	3.35E+00	0.005	2.78E+00	0.729	1.60E+00	1.92E+00
Copper	5.70E+00	0.005	5.78E+00	0.729	3.70E+00	4.26E+00
Nickel	1.06E+00	0.005	8.60E-01	0.729	3.59E-01	4.95E-01
Selenium	2.32E+01	0.005	2.28E+01	0.729	8.30E+00	1.22E+01
Vanadium	2.73E-01	0.005	2.51E-01	0.729	2.25E-01	2.32E-01
Zinc	1.24E+02	0.005	1.06E+02	0.729	7.52E+01	8.36E+01

Notes:

mg/kg Milligram per kilogram

[1] All concentrations reported on a dry weight basis.

TABLE C-5

SALT WATERSHED FISH TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/kg)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/kg)	Areal Contribution	Concentration[1] (mg/kg)	
Arsenic	0.004	1.000E-01	0.996	1.01E-01	1.01E-01
Cadmium	0.004	7.000E-02	0.996	1.28E-01	1.27E-01
Chromium	0.004	2.200E+00	0.996	1.60E+00	1.60E+00
Copper	0.004	4.000E+00	0.996	3.70E+00	3.70E+00
Nickel	0.004	5.900E-01	0.996	3.59E-01	3.60E-01
Selenium	0.004	1.180E+01	0.996	8.30E+00	8.31E+00
Vanadium	0.004	2.200E-01	0.996	2.25E-01	2.25E-01
Zinc	0.004	8.950E+01	0.996	7.52E+01	7.52E+01

Notes:

mg/kg Milligram per kilogram

[1] All concentrations reported on a dry weight basis.

TABLE C-6

GEORGETOWN WATERSHED FISH TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/kg)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/kg)	Areal Contribution	Concentration[1] (mg/kg)	
Arsenic	0.085	1.13E-01	0.915	1.01E-01	1.02E-01
Cadmium	0.085	4.98E-01	0.915	1.28E-01	1.59E-01
Chromium	0.085	2.78E+00	0.915	1.60E+00	1.70E+00
Copper	0.085	5.78E+00	0.915	3.70E+00	3.88E+00
Nickel	0.085	8.60E-01	0.915	3.59E-01	4.01E-01
Selenium	0.085	2.28E+01	0.915	8.30E+00	9.53E+00
Vanadium	0.085	2.51E-01	0.915	2.25E-01	2.27E-01
Zinc	0.085	1.06E+02	0.915	7.52E+01	7.78E+01

Notes:

mg/kg Milligram per kilogram

[1] All concentrations reported on a dry weight basis.

TABLE C-7

BLACKFOOT WATERSHED SEDIMENT EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA										
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Goodheart Creek Areal Contribution	Goodheart Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Rasmussen Creek Areal Contribution
Arsenic	0.229	4.70E+00	0.007	5.07E+00	0.001	4.35E+00	0.002	1.60E+01	0.004	3.00E+00	0.003
Cadmium	0.229	7.80E-01	0.007	4.29E+00	0.001	7.95E+00	0.002	5.80E+00	0.004	1.40E+01	0.003
Chromium	0.229	2.77E+01	0.007	6.47E+01	0.001	1.13E+02	0.002	1.30E+02	0.004	4.70E+01	0.003
Copper	0.229	5.87E+00	0.007	1.48E+01	0.001	2.97E+01	0.002	1.40E+01	0.004	1.90E+01	0.003
Nickel	0.229	1.90E+01	0.007	4.47E+01	0.001	6.03E+01	0.002	9.90E+01	0.004	1.64E+02	0.003
Selenium	0.229	1.57E+00	0.007	2.26E+01	0.001	7.47E+01	0.002	5.80E+01	0.004	2.90E+01	0.003
Vanadium	0.229	1.93E+01	0.007	5.34E+01	0.001	1.00E+02	0.002	7.60E+01	0.004	5.57E+01	0.003
Zinc	0.229	3.90E+01	0.007	2.04E+02	0.001	3.15E+02	0.002	4.00E+02	0.004	8.66E+02	0.003

ANALYTE	IMPACTED AREA							UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Rasmussen Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	5.07E+00	0.001	2.15E+00	0.004	5.90E+00	0.091	4.29E+00	0.658	5.01E+00	4.89E+00
Cadmium	4.29E+00	0.001	1.37E+00	0.004	2.80E+00	0.091	4.18E+00	0.658	2.25E+00	2.17E+00
Chromium	6.47E+01	0.001	4.00E+01	0.004	9.90E+01	0.091	6.00E+01	0.658	4.77E+01	4.49E+01
Copper	1.48E+01	0.001	1.05E+01	0.004	2.00E+01	0.091	1.49E+01	0.658	1.30E+01	1.16E+01
Nickel	4.47E+01	0.001	1.92E+01	0.004	3.90E+01	0.091	4.09E+01	0.658	2.23E+01	2.42E+01
Selenium	2.26E+01	0.001	3.15E+00	0.004	3.80E+00	0.091	2.01E+01	0.658	1.48E+00	3.72E+00
Vanadium	5.34E+01	0.001	3.57E+01	0.004	6.10E+01	0.091	5.18E+01	0.658	3.91E+01	3.62E+01
Zinc	2.04E+02	0.001	7.10E+01	0.004	1.70E+02	0.091	1.90E+02	0.658	1.10E+02	1.06E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-8

SALT WATERSHED SEDIMENT EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.004	3.23E+00	0.091	4.29E+00	0.905	8.63E+00	8.22E+00
Cadmium	0.004	1.52E+00	0.091	4.18E+00	0.905	1.45E+00	1.70E+00
Chromium	0.004	3.83E+01	0.091	6.00E+01	0.905	5.05E+01	5.13E+01
Copper	0.004	9.10E+00	0.091	1.49E+01	0.905	1.17E+01	1.20E+01
Nickel	0.004	2.22E+01	0.091	4.09E+01	0.905	2.40E+01	2.55E+01
Selenium	0.004	3.00E+00	0.091	2.01E+01	0.905	1.70E+00	3.38E+00
Vanadium	0.004	3.56E+01	0.091	5.18E+01	0.905	4.37E+01	4.44E+01
Zinc	0.004	8.77E+01	0.091	1.90E+02	0.905	1.10E+02	1.17E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-9

GEORGETOWN WATERSHED SEDIMENT EXPOSURE POINT CONCENTRATION CALCULATIONS

Analyte	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.077	5.07E+00	0.091	4.29E+00	0.832	5.07E+00	5.00E+00
Cadmium	0.077	4.29E+00	0.091	4.18E+00	0.832	2.67E+00	2.93E+00
Chromium	0.077	6.47E+01	0.091	6.00E+01	0.832	2.40E+01	3.04E+01
Copper	0.077	1.48E+01	0.091	1.49E+01	0.832	6.50E+00	7.90E+00
Nickel	0.077	4.47E+01	0.091	4.09E+01	0.832	1.01E+01	1.56E+01
Selenium	0.077	2.26E+01	0.091	2.01E+01	0.832	1.29E+00	4.64E+00
Vanadium	0.077	5.34E+01	0.091	5.18E+01	0.832	3.20E+01	3.55E+01
Zinc	0.077	2.04E+02	0.091	1.90E+02	0.832	7.50E+01	9.53E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-10

BLACKFOOT WATERSHED BENTHIC INVERTEBRATE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA								
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution
Arsenic	0.229	6.92E-01	0.007	6.92E-01	0.001	9.50E-02	0.004	2.50E+00	0.001
Cadmium	0.229	1.82E+00	0.007	1.82E+00	0.001	1.10E+00	0.004	6.00E+00	0.001
Chromium	0.229	9.50E-01	0.007	9.50E-01	0.001	1.80E+00	0.004	6.00E-01	0.001
Copper	0.229	3.75E+00	0.007	3.75E+00	0.001	4.10E+00	0.004	7.10E+00	0.001
Nickel	0.229	1.51E+00	0.007	1.51E+00	0.001	9.40E-01	0.004	4.20E+00	0.001
Selenium	0.229	8.58E+00	0.007	8.58E+00	0.001	2.40E+00	0.004	2.95E+01	0.001
Vanadium	0.229	1.23E+00	0.007	1.23E+00	0.001	1.60E+00	0.004	1.80E+00	0.001
Zinc	0.229	5.66E+01	0.007	5.66E+01	0.001	5.15E+01	0.004	1.22E+02	0.001

ANALYTE	IMPACTED AREA					UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	1.40E-01	0.004	6.92E-01	0.091	6.92E-01	0.663	2.17E-01	3.83E-01
Cadmium	1.00E-01	0.004	1.82E+00	0.091	1.82E+00	0.663	1.40E-01	7.18E-01
Chromium	9.80E-01	0.004	9.50E-01	0.091	9.50E-01	0.663	1.91E-01	4.47E-01
Copper	1.80E+00	0.004	3.75E+00	0.091	3.75E+00	0.663	1.66E+00	2.37E+00
Nickel	6.00E-01	0.004	1.51E+00	0.091	1.51E+00	0.663	1.81E-01	6.36E-01
Selenium	1.20E+00	0.004	8.58E+00	0.091	8.58E+00	0.663	1.05E+00	3.65E+00
Vanadium	9.90E-01	0.004	1.23E+00	0.091	1.23E+00	0.663	3.82E-01	6.71E-01
Zinc	1.36E+01	0.004	5.66E+01	0.091	5.66E+01	0.663	2.51E+01	3.59E+01

Notes:

µg/g Microgram per gram

1 All concentrations reported on a wet weight basis.

TABLE C-11

SALT WATERSHED BENTHIC INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.004	3.50E-02	0.091	6.92E-01	0.905	2.17E-01	2.60E-01
Cadmium	0.004	7.00E-02	0.091	1.82E+00	0.905	1.40E-01	2.92E-01
Chromium	0.004	4.20E-01	0.091	9.50E-01	0.905	1.91E-01	2.61E-01
Copper	0.004	2.00E+00	0.091	3.75E+00	0.905	1.66E+00	1.85E+00
Nickel	0.004	2.80E-01	0.091	1.51E+00	0.905	1.81E-01	3.02E-01
Selenium	0.004	1.20E+00	0.091	8.58E+00	0.905	1.05E+00	1.73E+00
Vanadium	0.004	5.40E-01	0.091	1.23E+00	0.905	3.82E-01	4.60E-01
Zinc	0.004	3.91E+01	0.091	5.66E+01	0.905	2.51E+01	2.80E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a wet weight basis.

TABLE C-12

GEORGETOWN WATERSHED BENTHIC INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.077	6.92E-01	0.091	6.92E-01	0.832	2.17E-01	2.97E-01
Cadmium	0.077	1.82E+00	0.091	1.82E+00	0.832	1.40E-01	4.22E-01
Chromium	0.077	9.50E-01	0.091	9.50E-01	0.832	1.91E-01	3.19E-01
Copper	0.077	3.75E+00	0.091	3.75E+00	0.832	1.66E+00	2.01E+00
Nickel	0.077	1.51E+00	0.091	1.51E+00	0.832	1.81E-01	4.04E-01
Selenium	0.077	8.58E+00	0.091	8.58E+00	0.832	1.05E+00	2.31E+00
Vanadium	0.077	1.23E+00	0.091	1.23E+00	0.832	3.82E-01	5.25E-01
Zinc	0.077	5.66E+01	0.091	5.66E+01	0.832	2.51E+01	3.04E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a wet weight basis.

TABLE C-13

BLACKFOOT WATERSHED AQUATIC PLANT TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA								
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/kg)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution
Arsenic	0.229	1.61E+00	0.007	1.61E+00	0.001	1.21E+00	0.004	1.61E+00	0.001
Cadmium	0.229	2.15E+00	0.007	2.15E+00	0.001	5.79E+00	0.004	2.15E+00	0.001
Chromium	0.229	2.86E+01	0.007	2.86E+01	0.001	2.53E+01	0.004	2.86E+01	0.001
Copper	0.229	5.56E+00	0.007	5.56E+00	0.001	7.35E+00	0.004	5.56E+00	0.001
Nickel	0.229	1.39E+01	0.007	1.39E+01	0.001	1.34E+01	0.004	1.39E+01	0.001
Selenium	0.229	1.20E+01	0.007	1.20E+01	0.001	2.70E+01	0.004	1.20E+01	0.001
Vanadium	0.229	8.03E+00	0.007	8.03E+00	0.001	1.27E+01	0.004	8.03E+00	0.001
Zinc	0.229	6.79E+01	0.007	6.79E+01	0.001	1.15E+02	0.004	6.79E+01	0.001

ANALYTE	IMPACTED AREA					UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	4.05E+00	0.004	1.61E+00	0.091	1.61E+00	0.663	2.39E-01	7.04E-01
Cadmium	1.04E+00	0.004	2.15E+00	0.091	2.15E+00	0.663	1.65E-01	8.39E-01
Chromium	4.32E+01	0.004	2.86E+01	0.091	2.86E+01	0.663	1.03E+01	1.65E+01
Copper	5.60E+00	0.004	5.56E+00	0.091	5.56E+00	0.663	4.20E+00	4.66E+00
Nickel	2.01E+01	0.004	1.39E+01	0.091	1.39E+01	0.663	4.47E+00	7.65E+00
Selenium	7.25E+00	0.004	1.20E+01	0.091	1.20E+01	0.663	9.48E-01	4.70E+00
Vanadium	1.16E+01	0.004	8.03E+00	0.091	8.03E+00	0.663	1.10E+00	3.44E+00
Zinc	4.67E+01	0.004	6.79E+01	0.091	6.79E+01	0.663	4.07E+01	4.99E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-14

SALT WATERSHED AQUATIC PLANT TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.004	2.53E-01	0.091	1.61E+00	0.905	2.39E-01	3.64E-01
Cadmium	0.004	4.73E-01	0.091	2.15E+00	0.905	1.65E-01	3.47E-01
Chromium	0.004	2.10E+01	0.091	2.86E+01	0.905	1.03E+01	1.20E+01
Copper	0.004	4.33E+00	0.091	5.56E+00	0.905	4.20E+00	4.32E+00
Nickel	0.004	1.01E+01	0.091	1.39E+01	0.905	4.47E+00	5.35E+00
Selenium	0.004	5.23E+00	0.091	1.20E+01	0.905	9.48E-01	1.97E+00
Vanadium	0.004	2.58E+00	0.091	8.03E+00	0.905	1.10E+00	1.73E+00
Zinc	0.004	5.03E+01	0.091	6.79E+01	0.905	4.07E+01	4.32E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-15

GEORGETOWN WATERSHED AQUATIC PLANT TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.077	1.61E+00	0.091	1.61E+00	0.832	2.39E-01	4.69E-01
Cadmium	0.077	2.15E+00	0.091	2.15E+00	0.832	1.65E-01	4.99E-01
Chromium	0.077	2.86E+01	0.091	2.86E+01	0.832	1.03E+01	1.33E+01
Copper	0.077	5.56E+00	0.091	5.56E+00	0.832	4.20E+00	4.43E+00
Nickel	0.077	1.39E+01	0.091	1.39E+01	0.832	4.47E+00	6.05E+00
Selenium	0.077	1.20E+01	0.091	1.20E+01	0.832	9.48E-01	2.81E+00
Vanadium	0.077	8.03E+00	0.091	8.03E+00	0.832	1.10E+00	2.26E+00
Zinc	0.077	6.79E+01	0.091	6.79E+01	0.832	4.07E+01	4.53E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-16

BLACKFOOT WATERSHED RIPARIAN SOIL EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA									
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Goodheart Creek Areal Contribution	Goodheart Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)
Arsenic	0.057	6.36E+00	0.007	9.86E+00	0.006	8.47E+00	0.009	9.86E+00	0.006	9.86E+00
Cadmium	0.057	6.15E-01	0.007	8.86E+00	0.006	3.29E+00	0.009	8.86E+00	0.006	8.86E+00
Chromium	0.057	4.48E+01	0.007	1.63E+02	0.006	7.97E+01	0.009	1.63E+02	0.006	1.63E+02
Copper	0.057	1.38E+01	0.007	2.90E+01	0.006	2.32E+01	0.009	2.90E+01	0.006	2.90E+01
Nickel	0.057	1.99E+01	0.007	5.67E+01	0.006	3.88E+01	0.009	5.67E+01	0.006	5.67E+01
Selenium	0.057	1.21E+00	0.007	1.97E+01	0.006	6.76E+00	0.009	1.97E+01	0.006	1.97E+01
Vanadium	0.057	4.99E+01	0.007	1.13E+02	0.006	8.29E+01	0.009	1.13E+02	0.006	1.13E+02
Zinc	0.057	9.67E+01	0.007	2.72E+02	0.006	1.73E+02	0.009	2.72E+02	0.006	2.72E+02

ANALYTE	IMPACTED AREA						UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Rasmussen Creek Areal Contribution	Rasmussen Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.004	1.90E+01	0.002	9.86E+00	0.005	9.86E+00	0.905	7.01E+00	7.11E+00
Cadmium	0.004	3.37E+01	0.002	8.86E+00	0.005	8.86E+00	0.905	1.37E+00	1.68E+00
Chromium	0.004	5.23E+02	0.002	1.63E+02	0.005	1.63E+02	0.905	5.77E+01	6.19E+01
Copper	0.004	6.80E+01	0.002	2.90E+01	0.005	2.90E+01	0.905	1.83E+01	1.86E+01
Nickel	0.004	1.57E+02	0.002	5.67E+01	0.005	5.67E+01	0.905	3.03E+01	3.10E+01
Selenium	0.004	7.62E+01	0.002	1.97E+01	0.005	1.97E+01	0.905	1.01E+00	1.88E+00
Vanadium	0.004	2.86E+02	0.002	1.13E+02	0.005	1.13E+02	0.905	5.57E+01	5.81E+01
Zinc	0.004	7.70E+02	0.002	2.72E+02	0.005	2.72E+02	0.905	1.10E+02	1.17E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-17

SALT WATERSHED RIPARIAN SOIL EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYZE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.006	9.86E+00	0.994	7.01E+00	7.02E+00
Cadmium	0.006	8.86E+00	0.994	1.37E+00	1.42E+00
Chromium	0.006	1.63E+02	0.994	5.77E+01	5.83E+01
Copper	0.006	2.90E+01	0.994	1.83E+01	1.84E+01
Nickel	0.006	5.67E+01	0.994	3.03E+01	3.04E+01
Selenium	0.006	1.97E+01	0.994	1.01E+00	1.12E+00
Vanadium	0.006	1.13E+02	0.994	5.57E+01	5.60E+01
Zinc	0.006	2.72E+02	0.994	1.10E+02	1.11E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-18

GEORGETOWN WATERSHED RIPARIAN SOIL EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.076	9.86E+00	0.924	7.01E+00	7.23E+00
Cadmium	0.076	8.86E+00	0.924	1.37E+00	1.95E+00
Chromium	0.076	1.63E+02	0.924	5.77E+01	6.57E+01
Copper	0.076	2.90E+01	0.924	1.83E+01	1.92E+01
Nickel	0.076	5.67E+01	0.924	3.03E+01	3.23E+01
Selenium	0.076	1.97E+01	0.924	1.01E+00	2.44E+00
Vanadium	0.076	1.13E+02	0.924	5.57E+01	6.01E+01
Zinc	0.076	2.72E+02	0.924	1.10E+02	1.23E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-19

BLACKFOOT WATERSHED RIPARIAN VEGETATION EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA									
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Goodheart Creek Areal Contribution	Goodheart Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)
Arsenic	0.057	1.28E-01	0.007	1.94E-01	0.006	3.45E-01	0.009	1.94E-01	0.006	1.94E-01
Cadmium	0.057	9.03E-01	0.007	6.38E+00	0.006	1.42E+00	0.009	6.38E+00	0.006	6.38E+00
Chromium	0.057	1.97E+00	0.007	1.86E+00	0.006	9.73E-01	0.009	1.86E+00	0.006	1.86E+00
Copper	0.057	7.05E+00	0.007	8.28E+00	0.006	7.67E+00	0.009	8.28E+00	0.006	8.28E+00
Nickel	0.057	2.12E+00	0.007	2.74E+00	0.006	1.37E+00	0.009	2.74E+00	0.006	2.74E+00
Selenium	0.057	3.58E-01	0.007	4.72E+00	0.006	7.28E+00	0.009	4.72E+00	0.006	4.72E+00
Vanadium	0.057	2.00E+00	0.007	1.52E+00	0.006	5.51E-01	0.009	1.52E+00	0.006	1.52E+00
Zinc	0.057	6.68E+01	0.007	1.45E+02	0.006	7.03E+01	0.009	1.45E+02	0.006	1.45E+02

ANALYTE	IMPACTED AREA						UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Rasmussen Creek Areal Contribution	Rasmussen Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.004	1.00E-01	0.002	1.94E-01	0.005	1.94E-01	0.905	2.10E-01	2.05E-01
Cadmium	0.004	2.48E+01	0.002	6.38E+00	0.005	6.38E+00	0.905	5.46E-01	8.31E-01
Chromium	0.004	2.98E+00	0.002	1.86E+00	0.005	1.86E+00	0.905	1.67E+00	1.70E+00
Copper	0.004	1.17E+01	0.002	8.28E+00	0.005	8.28E+00	0.905	6.56E+00	6.66E+00
Nickel	0.004	6.05E+00	0.002	2.74E+00	0.005	2.74E+00	0.905	1.48E+00	1.57E+00
Selenium	0.004	9.60E+00	0.002	4.72E+00	0.005	4.72E+00	0.905	3.79E-01	5.75E-01
Vanadium	0.004	2.00E+00	0.002	1.52E+00	0.005	1.52E+00	0.905	9.78E-01	1.05E+00
Zinc	0.004	4.15E+02	0.002	1.45E+02	0.005	1.45E+02	0.905	4.02E+01	4.63E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-20

SALT WATERSHED RIPARIAN VEGETATION EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.006	1.94E-01	0.994	2.10E-01	2.10E-01
Cadmium	0.006	6.38E+00	0.994	5.46E-01	5.79E-01
Chromium	0.006	1.86E+00	0.994	1.67E+00	1.67E+00
Copper	0.006	8.28E+00	0.994	6.56E+00	6.57E+00
Nickel	0.006	2.74E+00	0.994	1.48E+00	1.49E+00
Selenium	0.006	4.72E+00	0.994	3.79E-01	4.04E-01
Vanadium	0.006	1.52E+00	0.994	9.78E-01	9.81E-01
Zinc	0.006	1.45E+02	0.994	4.02E+01	4.08E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-21

GEORGETOWN WATERSHED RIPARIAN VEGETATION EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.076	1.94E-01	0.924	2.10E-01	2.09E-01
Cadmium	0.076	6.38E+00	0.924	5.46E-01	9.91E-01
Chromium	0.076	1.86E+00	0.924	1.67E+00	1.69E+00
Copper	0.076	8.28E+00	0.924	6.56E+00	6.69E+00
Nickel	0.076	2.74E+00	0.924	1.48E+00	1.58E+00
Selenium	0.076	4.72E+00	0.924	3.79E-01	7.10E-01
Vanadium	0.076	1.52E+00	0.924	9.78E-01	1.02E+00
Zinc	0.076	1.45E+02	0.924	4.02E+01	4.82E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-22

BLACKFOOT WATERSHED RIPARIAN SMALL MAMMAL TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA								
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Areal Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution
Arsenic	0.057	4.70E+01	0.007	3.26E+01	0.006	8.67E+00	0.006	3.26E+01	0.002
Cadmium	0.057	3.44E+01	0.007	2.54E+01	0.006	1.05E+01	0.006	2.54E+01	0.002
Chromium	0.057	6.84E+02	0.007	7.36E+02	0.006	8.23E+02	0.006	7.36E+02	0.002
Copper	0.057	1.46E+03	0.007	1.23E+03	0.006	8.50E+02	0.006	1.23E+03	0.002
Nickel	0.057	3.26E+02	0.007	2.88E+02	0.006	2.24E+02	0.006	2.88E+02	0.002
Selenium	0.057	3.04E-01	0.007	3.99E-01	0.006	7.47E-01	0.006	3.99E-01	0.002
Vanadium	0.057	6.00E-02	0.007	6.38E-02	0.006	7.00E-02	0.006	6.38E-02	0.002
Zinc	0.057	1.64E+01	0.007	1.39E+01	0.006	9.63E+00	0.006	1.39E+01	0.002

ANALYTE	IMPACTED AREA			UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	3.26E+01	0.005	3.26E+01	0.918	1.78E+01	1.97E+01
Cadmium	2.54E+01	0.005	2.54E+01	0.918	2.72E+01	2.75E+01
Chromium	7.36E+02	0.005	7.36E+02	0.918	5.41E+02	5.54E+02
Copper	1.23E+03	0.005	1.23E+03	0.918	1.18E+03	1.19E+03
Nickel	2.88E+02	0.005	2.88E+02	0.918	1.51E+02	1.64E+02
Selenium	3.99E-01	0.005	3.99E-01	0.918	4.21E-01	4.16E-01
Vanadium	6.38E-02	0.005	6.38E-02	0.918	9.32E-02	9.06E-02
Zinc	1.39E+01	0.005	1.39E+01	0.918	1.56E+01	1.55E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-23

SALT WATERSHED RIPARIAN SMALL MAMMAL TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (µg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (µg/g)	Areal Contribution	Concentration[1] (µg/g)	
Arsenic	0.006	3.26E+01	0.994	1.78E+01	1.79E+01
Cadmium	0.006	2.54E+01	0.994	2.72E+01	2.72E+01
Chromium	0.006	7.36E+02	0.994	5.41E+02	5.42E+02
Copper	0.006	1.23E+03	0.994	1.18E+03	1.18E+03
Nickel	0.006	2.88E+02	0.994	1.51E+02	1.52E+02
Selenium	0.006	3.99E-01	0.994	4.21E-01	4.21E-01
Vanadium	0.006	6.38E-02	0.994	9.32E-02	9.30E-02
Zinc	0.006	1.39E+01	0.994	1.56E+01	1.56E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-24

GEORGETOWN WATERSHED RIPARIAN SMALL MAMMAL TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.076	3.26E+01	0.924	1.78E+01	1.90E+01
Cadmium	0.076	2.54E+01	0.924	2.72E+01	2.71E+01
Chromium	0.076	7.36E+02	0.924	5.41E+02	5.55E+02
Copper	0.076	1.23E+03	0.924	1.18E+03	1.18E+03
Nickel	0.076	2.88E+02	0.924	1.51E+02	1.62E+02
Selenium	0.076	3.99E-01	0.924	4.21E-01	4.19E-01
Vanadium	0.076	6.38E-02	0.924	9.32E-02	9.09E-02
Zinc	0.076	1.39E+01	0.924	1.56E+01	1.54E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-25

BLACKFOOT WATERSHED RIPARIAN TERRESTRIAL INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA								
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution
Arsenic	0.057	7.55E-01	0.007	9.38E-01	0.006	0.00E+00	0.006	9.38E-01	0.002
Cadmium	0.057	5.57E+00	0.007	1.71E+01	0.006	0.00E+00	0.006	1.71E+01	0.002
Chromium	0.057	5.17E+00	0.007	8.45E+00	0.006	0.00E+00	0.006	8.45E+00	0.002
Copper	0.057	7.90E+00	0.007	1.23E+01	0.006	0.00E+00	0.006	1.23E+01	0.002
Nickel	0.057	1.60E+00	0.007	2.45E+00	0.006	0.00E+00	0.006	2.45E+00	0.002
Selenium	0.057	2.04E+01	0.007	6.01E+01	0.006	9.97E+01	0.006	6.01E+01	0.002
Vanadium	0.057	5.37E+00	0.007	1.44E+01	0.006	2.35E+01	0.006	1.44E+01	0.002
Zinc	0.057	2.33E+02	0.007	2.57E+02	0.006	2.80E+02	0.006	2.57E+02	0.002

ANALYTE	IMPACTED AREA			UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	9.38E-01	0.005	9.38E-01	0.918	6.09E-01	6.20E-01
Cadmium	1.71E+01	0.005	1.71E+01	0.918	5.75E+00	5.92E+00
Chromium	8.45E+00	0.005	8.45E+00	0.918	6.94E+00	6.82E+00
Copper	1.23E+01	0.005	1.23E+01	0.918	1.47E+01	1.42E+01
Nickel	2.45E+00	0.005	2.45E+00	0.918	3.10E+00	2.98E+00
Selenium	6.01E+01	0.005	6.01E+01	0.918	1.92E+01	2.05E+01
Vanadium	1.44E+01	0.005	1.44E+01	0.918	1.51E+01	1.46E+01
Zinc	2.57E+02	0.005	2.57E+02	0.918	1.98E+02	2.02E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-26

SALT WATERSHED RIPARIAN TERRESTRIAL INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

ANALYTE	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.006	9.38E-01	0.994	6.09E-01	6.11E-01
Cadmium	0.006	1.71E+01	0.994	5.75E+00	5.81E+00
Chromium	0.006	8.45E+00	0.994	6.94E+00	6.95E+00
Copper	0.006	1.23E+01	0.994	1.47E+01	1.47E+01
Nickel	0.006	2.45E+00	0.994	3.10E+00	3.09E+00
Selenium	0.006	6.01E+01	0.994	1.92E+01	1.94E+01
Vanadium	0.006	1.44E+01	0.994	1.51E+01	1.51E+01
Zinc	0.006	2.57E+02	0.994	1.98E+02	1.99E+02

Notes:

μg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-27

GEORGETOWN WATERSHED RIPARIAN TERRESTRIAL INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

(Page 1 of 1)

Analyte	IMPACTED AREA		UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.076	9.38E-01	0.924	6.09E-01	6.34E-01
Cadmium	0.076	1.71E+01	0.924	5.75E+00	6.62E+00
Chromium	0.076	8.45E+00	0.924	6.94E+00	7.05E+00
Copper	0.076	1.23E+01	0.924	1.47E+01	1.45E+01
Nickel	0.076	2.45E+00	0.924	3.10E+00	3.05E+00
Selenium	0.076	6.01E+01	0.924	1.92E+01	2.23E+01
Vanadium	0.076	1.44E+01	0.924	1.51E+01	1.51E+01
Zinc	0.076	2.57E+02	0.924	1.98E+02	2.03E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-28

BLACKFOOT WATERSHED OVERALL SOIL EXPOSURE POINT CONCENTRATION CALCULATIONS

Analyte	IMPACTED AREA										
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Goodheart Creek Areal Contribution	Goodheart Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Rasmussen Creek Areal Contribution
Arsenic	0.003	6.36E+00	0.0004	9.86E+00	0.0003	8.47E+00	0.0004	9.86E+00	0.0003	9.86E+00	0.0002
Cadmium	0.003	6.15E-01	0.0004	8.86E+00	0.0003	3.29E+00	0.0004	8.86E+00	0.0003	8.86E+00	0.0002
Chromium	0.003	4.48E+01	0.0004	1.63E+02	0.0003	7.97E+01	0.0004	1.63E+02	0.0003	1.63E+02	0.0002
Copper	0.003	1.38E+01	0.0004	2.90E+01	0.0003	2.32E+01	0.0004	2.90E+01	0.0003	2.90E+01	0.0002
Nickel	0.003	1.99E+01	0.0004	5.67E+01	0.0003	3.88E+01	0.0004	5.67E+01	0.0003	5.67E+01	0.0002
Selenium	0.003	1.21E+00	0.0004	1.97E+01	0.0003	6.76E+00	0.0004	1.97E+01	0.0003	1.97E+01	0.0002
Vanadium	0.003	4.99E+01	0.0004	1.13E+02	0.0003	8.29E+01	0.0004	1.13E+02	0.0003	1.13E+02	0.0002
Zinc	0.003	9.67E+01	0.0004	2.72E+02	0.0003	1.73E+02	0.0004	2.72E+02	0.0003	2.72E+02	0.0002

Analyte	IMPACTED AREA							UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Rasmussen Creek Concentr ation[1] (mg/g)	Spring Creek Areal Contribution	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	1.90E+01	0.0001	9.86E+00	0.0002	9.86E+00	0.013	4.30E+01	0.983	7.27E+00	7.73E+00
Cadmium	3.37E+01	0.0001	8.86E+00	0.0002	8.86E+00	0.013	4.90E+01	0.983	2.05E+00	2.66E+00
Chromium	5.23E+02	0.0001	1.63E+02	0.0002	1.63E+02	0.013	8.86E+02	0.983	5.62E+01	6.69E+01
Copper	6.80E+01	0.0001	2.90E+01	0.0002	2.90E+01	0.013	1.17E+02	0.983	1.85E+01	1.98E+01
Nickel	1.57E+02	0.0001	5.67E+01	0.0002	5.67E+01	0.013	2.61E+02	0.983	2.91E+01	3.21E+01
Selenium	7.62E+01	0.0001	1.97E+01	0.0002	1.97E+01	0.013	1.25E+02	0.983	1.00E+00	2.62E+00
Vanadium	2.86E+02	0.0001	1.13E+02	0.0002	1.13E+02	0.013	5.10E+02	0.983	5.48E+01	6.07E+01
Zinc	7.70E+02	0.0001	2.72E+02	0.0002	2.72E+02	0.013	1.05E+03	0.983	1.38E+02	1.50E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-29

SALT WATERSHED OVERALL SOIL EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				IMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.0003	9.86E+00	0.001	4.30E+01	0.998	7.27E+00	7.32E+00
Cadmium	0.0003	8.86E+00	0.001	4.90E+01	0.998	2.05E+00	2.12E+00
Chromium	0.0003	1.63E+02	0.001	8.86E+02	0.998	5.62E+01	5.73E+01
Copper	0.0003	2.90E+01	0.001	1.17E+02	0.998	1.85E+01	1.86E+01
Nickel	0.0003	5.67E+01	0.001	2.61E+02	0.998	2.91E+01	2.94E+01
Selenium	0.0003	1.97E+01	0.001	1.25E+02	0.998	1.00E+00	1.16E+00
Vanadium	0.0003	1.13E+02	0.001	5.10E+02	0.998	5.48E+01	5.54E+01
Zinc	0.0003	2.72E+02	0.001	1.05E+03	0.998	1.38E+02	1.39E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-30

GEORGETOWN WATERSHED OVERALL SOIL EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Mines Area Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.003	9.86E+00	0.004	4.30E+01	0.993	7.27E+00	7.41E+00
Cadmium	0.003	8.86E+00	0.004	4.90E+01	0.993	2.05E+00	2.25E+00
Chromium	0.003	1.63E+02	0.004	8.86E+02	0.993	5.62E+01	5.96E+01
Copper	0.003	2.90E+01	0.004	1.17E+02	0.993	1.85E+01	1.89E+01
Nickel	0.003	5.67E+01	0.004	2.61E+02	0.993	2.91E+01	3.00E+01
Selenium	0.003	1.97E+01	0.004	1.25E+02	0.993	1.00E+00	1.52E+00
Vanadium	0.003	1.13E+02	0.004	5.10E+02	0.993	5.48E+01	5.67E+01
Zinc	0.003	2.72E+02	0.004	1.05E+03	0.993	1.38E+02	1.42E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-31

BLACKFOOT WATERSHED OVERALL TERRESTRIAL VEGETATION EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA										
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Goodheart Creek Areal Contribution	Goodheart Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Rasmussen Creek Areal Contribution
Arsenic	0.003	1.28E-01	0.0004	1.94E-01	0.0003	3.45E-01	0.0004	1.94E-01	0.0003	1.94E-01	0.0002
Cadmium	0.003	9.03E-01	0.0004	6.38E+00	0.0003	1.42E+00	0.0004	6.38E+00	0.0003	6.38E+00	0.0002
Chromium	0.003	1.97E+00	0.0004	1.86E+00	0.0003	9.73E-01	0.0004	1.86E+00	0.0003	1.86E+00	0.0002
Copper	0.003	7.05E+00	0.0004	8.28E+00	0.0003	7.67E+00	0.0004	8.28E+00	0.0003	8.28E+00	0.0002
Nickel	0.003	2.12E+00	0.0004	2.74E+00	0.0003	1.37E+00	0.0004	2.74E+00	0.0003	2.74E+00	0.0002
Selenium	0.003	3.58E-01	0.0004	4.72E+00	0.0003	7.28E+00	0.0004	4.72E+00	0.0003	4.72E+00	0.0002
Vanadium	0.003	2.00E+00	0.0004	1.52E+00	0.0003	5.51E-01	0.0004	1.52E+00	0.0003	1.52E+00	0.0002
Zinc	0.003	6.68E+01	0.0004	1.45E+02	0.0003	7.03E+01	0.0004	1.45E+02	0.0003	1.45E+02	0.0002

ANALYTE	IMPACTED AREA							UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Rasmussen Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	1.00E-01	0.0001	1.94E-01	0.0002	1.94E-01	0.013	4.31E-01	0.983	2.53E-01	2.55E-01
Cadmium	2.48E+01	0.0001	6.38E+00	0.0002	6.38E+00	0.013	1.34E+00	0.983	5.52E-01	5.77E-01
Chromium	2.98E+00	0.0001	1.86E+00	0.0002	1.86E+00	0.013	1.41E+00	0.983	1.61E+00	1.61E+00
Copper	1.17E+01	0.0001	8.28E+00	0.0002	8.28E+00	0.013	4.96E+00	0.983	6.20E+00	6.19E+00
Nickel	6.05E+00	0.0001	2.74E+00	0.0002	2.74E+00	0.013	3.19E+00	0.983	1.20E+00	1.23E+00
Selenium	9.60E+00	0.0001	4.72E+00	0.0002	4.72E+00	0.013	1.09E+01	0.983	3.25E-01	4.69E-01
Vanadium	2.00E+00	0.0001	1.52E+00	0.0002	1.52E+00	0.013	9.00E-01	0.983	7.60E-01	7.66E-01
Zinc	4.15E+02	0.0001	1.45E+02	0.0002	1.45E+02	0.013	6.22E+01	0.983	3.73E+01	3.80E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-32

SALT WATERSHED OVERALL TERRESTRIAL VEGETATION EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.0003	1.94E-01	0.001	4.31E-01	0.998	2.53E-01	2.53E-01
Cadmium	0.0003	6.38E+00	0.001	1.34E+00	0.998	5.52E-01	5.55E-01
Chromium	0.0003	1.86E+00	0.001	1.41E+00	0.998	1.61E+00	1.61E+00
Copper	0.0003	8.28E+00	0.001	4.96E+00	0.998	6.20E+00	6.19E+00
Nickel	0.0003	2.74E+00	0.001	3.19E+00	0.998	1.20E+00	1.20E+00
Selenium	0.0003	4.72E+00	0.001	1.09E+01	0.998	3.25E-01	3.40E-01
Vanadium	0.0003	1.52E+00	0.001	9.00E-01	0.998	7.60E-01	7.60E-01
Zinc	0.0003	1.45E+02	0.001	6.22E+01	0.998	3.73E+01	3.74E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-33

GEORGETOWN WATERSHED OVERALL TERRESTRIAL VEGETATION EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.003	1.94E-01	0.004	4.31E-01	0.993	2.53E-01	2.54E-01
Cadmium	0.003	6.38E+00	0.004	1.34E+00	0.993	5.52E-01	5.73E-01
Chromium	0.003	1.86E+00	0.004	1.41E+00	0.993	1.61E+00	1.61E+00
Copper	0.003	8.28E+00	0.004	4.96E+00	0.993	6.20E+00	6.20E+00
Nickel	0.003	2.74E+00	0.004	3.19E+00	0.993	1.20E+00	1.21E+00
Selenium	0.003	4.72E+00	0.004	1.09E+01	0.993	3.25E-01	3.77E-01
Vanadium	0.003	1.52E+00	0.004	9.00E-01	0.993	7.60E-01	7.63E-01
Zinc	0.003	1.45E+02	0.004	6.22E+01	0.993	3.73E+01	3.78E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-34

BLACKFOOT WATERSHED OVERALL SMALL MAMMAL TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA								
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution
Arsenic	0.003	4.70E+01	0.0004	3.26E+01	0.0003	8.67E+00	0.0003	3.26E+01	0.0001
Cadmium	0.003	3.44E+01	0.0004	2.54E+01	0.0003	1.05E+01	0.0003	2.54E+01	0.0001
Chromium	0.003	6.84E+02	0.0004	7.36E+02	0.0003	8.23E+02	0.0003	7.36E+02	0.0001
Copper	0.003	1.46E+03	0.0004	1.23E+03	0.0003	8.50E+02	0.0003	1.23E+03	0.0001
Nickel	0.003	3.26E+02	0.0004	2.88E+02	0.0003	2.24E+02	0.0003	2.88E+02	0.0001
Selenium	0.003	3.04E-01	0.0004	3.99E-01	0.0003	7.47E-01	0.0003	3.99E-01	0.0001
Vanadium	0.003	6.00E-02	0.0004	6.38E-02	0.0003	7.00E-02	0.0003	6.38E-02	0.0001
Zinc	0.003	1.64E+01	0.0004	1.39E+01	0.0003	9.63E+00	0.0003	1.39E+01	0.0001

ANALYTE	IMPACTED AREA					UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	3.26E+01	0.0002	3.26E+01	0.013	1.06E+02	0.983	2.10E+01	2.21E+01
Cadmium	2.54E+01	0.0002	2.54E+01	0.013	6.16E+01	0.983	1.30E+02	1.29E+02
Chromium	7.36E+02	0.0002	7.36E+02	0.013	6.23E+02	0.983	5.09E+02	5.11E+02
Copper	1.23E+03	0.0002	1.23E+03	0.013	1.37E+03	0.983	1.42E+03	1.42E+03
Nickel	2.88E+02	0.0002	2.88E+02	0.013	3.72E+02	0.983	1.68E+02	1.71E+02
Selenium	3.99E-01	0.0002	3.99E-01	0.013	2.97E+00	0.983	3.70E-01	4.03E-01
Vanadium	6.38E-02	0.0002	6.38E-02	0.013	9.75E-02	0.983	9.82E-02	9.80E-02
Zinc	1.39E+01	0.0002	1.39E+01	0.013	1.49E+01	0.983	2.16E+01	2.15E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-35

SALT WATERSHED OVERALL SMALL MAMMAL TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Sage Creek Areal Contribution	Sage Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Area Contribution	Concentration[1] (mg/g)	
Arsenic	0.0003	3.26E+01	0.001	1.06E+02	0.998	2.10E+01	2.11E+01
Cadmium	0.0003	2.54E+01	0.001	6.16E+01	0.998	1.30E+02	1.30E+02
Chromium	0.0003	7.36E+02	0.001	6.23E+02	0.998	5.09E+02	5.09E+02
Copper	0.0003	1.23E+03	0.001	1.37E+03	0.998	1.42E+03	1.42E+03
Nickel	0.0003	2.88E+02	0.001	3.72E+02	0.998	1.68E+02	1.68E+02
Selenium	0.0003	3.99E-01	0.001	2.97E+00	0.998	3.70E-01	3.74E-01
Vanadium	0.0003	6.38E-02	0.001	9.75E-02	0.998	9.82E-02	9.82E-02
Zinc	0.0003	1.39E+01	0.001	1.49E+01	0.998	2.16E+01	2.16E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-36

GEORGETOWN WATERSHED OVERALL SMALL MAMMAL TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.003	3.26E+01	0.004	1.06E+02	0.993	2.10E+01	2.13E+01
Cadmium	0.003	2.54E+01	0.004	6.16E+01	0.993	1.30E+02	1.29E+02
Chromium	0.003	7.36E+02	0.004	6.23E+02	0.993	5.09E+02	5.10E+02
Copper	0.003	1.23E+03	0.004	1.37E+03	0.993	1.42E+03	1.42E+03
Nickel	0.003	2.88E+02	0.004	3.72E+02	0.993	1.68E+02	1.69E+02
Selenium	0.003	3.99E-01	0.004	2.97E+00	0.993	3.70E-01	3.80E-01
Vanadium	0.003	6.38E-02	0.004	9.75E-02	0.993	9.82E-02	9.81E-02
Zinc	0.003	1.39E+01	0.004	1.49E+01	0.993	2.16E+01	2.15E+01

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-37

BLACKFOOT WATERSHED OVERALL TERRESTRIAL INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA								
	Blackfoot River Areal Contribution	Blackfoot River Concentration[1] (mg/g)	Dry Valley Creek Areal Contribution	Dry Valley Creek Concentration[1] (mg/g)	East Mill Creek Areal Contribution	East Mill Creek Concentration[1] (mg/g)	Maybe Creek Areal Contribution	Maybe Creek Concentration[1] (mg/g)	Spring Creek Areal Contribution
Arsenic	0.003	7.55E-01	0.0004	9.38E-01	0.0003	1.12E+00	0.0003	9.38E-01	0.0001
Cadmium	0.003	5.57E+00	0.0004	1.71E+01	0.0003	2.87E+01	0.0003	1.71E+01	0.0001
Chromium	0.003	5.17E+00	0.0004	8.45E+00	0.0003	1.17E+01	0.0003	8.45E+00	0.0001
Copper	0.003	7.90E+00	0.0004	1.23E+01	0.0003	1.67E+01	0.0003	1.23E+01	0.0001
Nickel	0.003	1.60E+00	0.0004	2.45E+00	0.0003	3.30E+00	0.0003	2.45E+00	0.0001
Selenium	0.003	2.04E+01	0.0004	6.01E+01	0.0003	9.97E+01	0.0003	6.01E+01	0.0001
Vanadium	0.003	5.37E+00	0.0004	1.44E+01	0.0003	2.35E+01	0.0003	1.44E+01	0.0001
Zinc	0.003	2.33E+02	0.0004	2.57E+02	0.0003	2.80E+02	0.0003	2.57E+02	0.0001

ANALYTE	IMPACTED AREA					IMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Spring Creek Concentration[1] (mg/g)	State Land Creek Areal Contribution	State Land Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	9.38E-01	0.0002	9.38E-01	0.013	5.85E-01	0.983	5.87E-01	5.87E-01
Cadmium	1.71E+01	0.0002	1.71E+01	0.013	4.43E+00	0.983	5.58E+00	5.59E+00
Chromium	8.45E+00	0.0002	8.45E+00	0.013	7.15E+00	0.983	7.08E+00	7.07E+00
Copper	1.23E+01	0.0002	1.23E+01	0.013	2.57E+01	0.983	1.55E+01	1.56E+01
Nickel	2.45E+00	0.0002	2.45E+00	0.013	5.72E+00	0.983	3.22E+00	3.25E+00
Selenium	6.01E+01	0.0002	6.01E+01	0.013	1.77E+01	0.983	1.19E+01	1.21E+01
Vanadium	1.44E+01	0.0002	1.44E+01	0.013	2.64E+00	0.983	1.44E+01	1.42E+01
Zinc	2.57E+02	0.0002	2.57E+02	0.013	2.30E+02	0.983	1.95E+02	1.95E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-38

SALT WATERSHED OVERALL TERRESTRIAL INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration (mg/g)[1]
	Sage Creek Areal Contribution	Sage Creek Concentration (mg/g)[1]	Mines Areal Contribution	Mines Concentration (mg/g)[1]	Areal Contribution	Concentration (mg/g)[1]	
Arsenic	0.0003	9.38E-01	0.001	5.8545E-01	0.998	5.87E-01	5.87E-01
Cadmium	0.0003	1.71E+01	0.001	4.4273E+00	0.998	5.58E+00	5.58E+00
Chromium	0.0003	8.45E+00	0.001	7.1545E+00	0.998	7.08E+00	7.08E+00
Copper	0.0003	1.23E+01	0.001	2.5727E+01	0.998	1.55E+01	1.55E+01
Nickel	0.0003	2.45E+00	0.001	5.7182E+00	0.998	3.22E+00	3.23E+00
Selenium	0.0003	6.01E+01	0.001	1.7700E+01	0.998	1.19E+01	1.20E+01
Vanadium	0.0003	1.44E+01	0.001	2.6391E+00	0.998	1.44E+01	1.44E+01
Zinc	0.0003	2.57E+02	0.001	2.3000E+02	0.998	1.95E+02	1.95E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-39

GEORGETOWN WATERSHED OVERALL TERRESTRIAL INVERTEBRATE TISSUE EXPOSURE POINT CONCENTRATION CALCULATIONS

ANALYTE	IMPACTED AREA				UNIMPACTED AREA		Area Weighted Concentration[1] (mg/g)
	Georgetown Creek Areal Contribution	Georgetown Creek Concentration[1] (mg/g)	Mines Areal Contribution	Mines Concentration[1] (mg/g)	Areal Contribution	Concentration[1] (mg/g)	
Arsenic	0.003	9.38E-01	0.004	5.85E-01	0.993	5.87E-01	5.88E-01
Cadmium	0.003	1.71E+01	0.004	4.43E+00	0.993	5.58E+00	5.61E+00
Chromium	0.003	8.45E+00	0.004	7.15E+00	0.993	7.08E+00	7.08E+00
Copper	0.003	1.23E+01	0.004	2.57E+01	0.993	1.55E+01	1.56E+01
Nickel	0.003	2.45E+00	0.004	5.72E+00	0.993	3.22E+00	3.23E+00
Selenium	0.003	6.01E+01	0.004	1.77E+01	0.993	1.19E+01	1.21E+01
Vanadium	0.003	1.44E+01	0.004	2.64E+00	0.993	1.44E+01	1.43E+01
Zinc	0.003	2.57E+02	0.004	2.30E+02	0.993	1.95E+02	1.95E+02

Notes:

µg/g Microgram per gram

[1] All concentrations reported on a dry weight basis.

TABLE C-40

HUMAN HEALTH RISK ASSESSMENT RIPARIAN SOIL CONCENTRATION CALCULATIONS

(Page 1 of 2)

ANALYTE	Background Mean Concentration[1] (mg/kg)	RA-1		RA-2		RA-3		RA-4	
		Sample SL-002 Concentration[1] (mg/kg)	RA-1 Area Weighted Soil Concentration[1] (mg/kg)	Sample SL-001 Concentration[1] (mg/kg)	RA-2 Area Weighted Soil Concentration[1] (mg/kg)	Sample SL-005 Concentration[1] (mg/kg)	RA-3 Area Weighted Soil Concentration[1] (mg/kg)	Sample SL-006 Concentration[1] (mg/kg)	RA-4 Area Weighted Soil Concentration[1] (mg/kg)
Antimony	1.83E+00	1.70E+01	8.40E+00	8.00E-01	1.17E+00	2.60E+00	1.98E+00	2.50E+00	1.93E+00
Arsenic	6.74E+00	2.90E+01	1.59E+01	8.90E+00	6.97E+00	8.30E+00	6.70E+00	7.70E+00	6.44E+00
Barium	2.08E+02	9.20E+01	1.33E+02	1.90E+02	1.77E+02	2.00E+02	1.82E+02	2.00E+02	1.82E+02
Beryllium	1.29E+00	1.70E+00	1.33E+00	1.50E+00	1.24E+00	1.40E+00	1.20E+00	1.40E+00	1.20E+00
Boron	7.14E+00	4.30E+01	2.24E+01	2.20E+01	1.30E+01	1.20E+01	8.53E+00	2.20E+01	1.30E+01
Cadmium	1.16E+00	6.30E+01	2.86E+01	4.40E+00	2.48E+00	4.30E+00	2.44E+00	7.90E-01	8.70E-01
Chromium	6.32E+01	9.10E+02	4.34E+02	7.50E+01	6.16E+01	9.60E+01	7.09E+01	5.10E+01	5.09E+01
Copper	1.82E+01	1.20E+02	6.17E+01	1.60E+01	1.53E+01	2.40E+01	1.88E+01	1.70E+01	1.57E+01
Lead	1.12E+01	7.50E-01	5.29E+00	1.20E+01	1.03E+01	1.60E+01	1.21E+01	4.80E+00	7.10E+00
Manganese	1.37E+03	2.70E+02	7.29E+02	1.40E+03	1.23E+03	6.90E+02	9.16E+02	1.50E+03	1.28E+03
Mercury	3.50E+01	6.20E+02	2.92E+02	3.10E+01	2.94E+01	7.10E+01	4.73E+01	3.00E+01	2.90E+01
Molybdenum	1.90E+00	3.10E+01	1.47E+01	1.90E+00	1.69E+00	1.90E+00	1.69E+00	1.90E+00	1.69E+00
Nickel	2.56E+01	2.80E+02	1.36E+02	3.40E+01	2.65E+01	4.60E+01	3.19E+01	2.50E+01	2.25E+01
Selenium	9.26E-01	1.50E+02	6.74E+01	2.40E+00	1.48E+00	6.60E+00	3.36E+00	9.90E-01	8.54E-01
Silver	9.25E-02	5.20E+00	2.36E+00	1.00E-01	8.58E-02	1.00E-01	8.58E-02	1.00E-01	8.58E-02
Thallium	7.05E-01	1.00E+00	7.60E-01	1.00E+00	7.60E-01	1.00E+00	7.60E-01	1.00E+00	7.60E-01
Uranium	8.37E+00	1.00E+00	4.17E+00	8.40E+00	7.47E+00	3.00E+00	5.06E+00	3.00E+00	5.06E+00
Vanadium	6.00E+01	5.00E+02	2.50E+02	7.20E+01	5.88E+01	5.90E+01	5.30E+01	5.90E+01	5.30E+01
Zinc	1.19E+02	1.40E+03	6.78E+02	1.40E+02	1.15E+02	1.10E+02	1.02E+02	1.00E+02	9.76E+01

TABLE C-40

HUMAN HEALTH RISK ASSESSMENT RIPARIAN SOIL CONCENTRATION CALCULATIONS

(Page 2 of 2)

ANALYTE	RA-5		RA-6		RA-7		RA-8	
	Sample ST026 Concentration[1] (mg/kg)	RA-5 Area Weighted Soil Concentration[1] (mg/kg)	Sample ST076 Concentration[1] (mg/kg)	RA-6 Area Weighted Soil Concentration[1] (mg/kg)	Sample ST130 Concentration[1] (mg/kg)	RA-7 Area Weighted Soil Concentration[1] (mg/kg)	Sample ST227 Concentration[1] (mg/kg)	RA-8 Area Weighted Soil Concentration[1] (mg/kg)
Antimony	6.00E-01	1.08E+00	1.90E-01	9.00E-01	7.80E-01	1.16E+00	1.06E+00	1.29E+00
Arsenic	3.03E+00	4.35E+00	9.13E+00	7.07E+00	7.98E+00	6.56E+00	9.40E+00	7.19E+00
Barium	9.70E+01	1.36E+02	4.00E+02	2.71E+02	2.02E+02	1.82E+02	1.87E+02	1.76E+02
Beryllium	5.10E-01	8.02E-01	1.63E+00	1.30E+00	1.74E+00	1.35E+00	1.07E+00	1.05E+00
Boron	1.00E+00	3.62E+00	1.83E+01	1.14E+01	1.07E+01	7.97E+00	1.00E+00	3.62E+00
Cadmium	9.30E-01	9.33E-01	2.07E+00	1.44E+00	3.00E+00	1.86E+00	4.77E+00	2.65E+00
Chromium	2.10E+01	3.75E+01	4.80E+01	4.95E+01	6.70E+01	5.80E+01	9.20E+01	6.92E+01
Copper	7.50E+00	1.15E+01	1.77E+01	1.60E+01	2.66E+01	2.00E+01	2.87E+01	2.09E+01
Lead	4.97E+00	7.18E+00	2.47E+01	1.60E+01	1.70E+01	1.25E+01	1.43E+01	1.14E+01
Manganese	2.26E+02	7.09E+02	5.30E+02	8.45E+02	1.74E+03	1.39E+03	1.13E+03	1.11E+03
Mercury	5.00E-02	1.56E+01	3.77E+01	3.24E+01	4.24E+01	3.45E+01	7.70E+01	5.00E+01
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	1.37E+01	1.75E+01	3.17E+01	2.55E+01	7.40E+01	4.44E+01	4.53E+01	3.16E+01
Selenium	2.03E+00	1.32E+00	1.50E+00	1.08E+00	1.78E+00	1.21E+00	1.27E+01	6.08E+00
Silver	7.00E-02	7.24E-02	9.00E-02	8.13E-02	1.90E-02	4.96E-02	6.00E-01	3.09E-01
Thallium	1.90E-01	3.98E-01	6.00E-01	5.82E-01	2.30E-01	4.16E-01	3.00E-01	4.48E-01
Uranium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	1.77E+01	3.46E+01	5.17E+01	4.98E+01	6.62E+01	5.62E+01	9.17E+01	6.76E+01
Zinc	4.07E+01	7.11E+01	1.10E+02	1.02E+02	1.46E+02	1.18E+02	2.20E+02	1.51E+02

Notes:

mg/kg Milligram per kilogram
NA Data not available

[1] All concentrations reported on a dry weight basis.

APPENDIX D

HUMAN HEALTH TOXICITY PROFILES

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ABBREVIATIONS AND ACRONYMS

µg/day	Microgram per day
µg/L	Microgram per liter
ATSDR	Agency for Toxic Substances and Disease Registry
AWHHRA	Area Wide Human Health Risk Assessment
CBD	Chronic beryllium disease
CCA	Chromated copper arsenate
COPC	Chemical of potential concern
EPA	U.S. Environmental Protection Agency
LOAEL	Lowest observed adverse effect level
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
mg/L	Milligram per liter
NCEA	National Center for Environmental Assessment
NLM	National Library of Medicine
NOAEL	No observed adverse effect level
PRG	Preliminary remediation goal
RfD	Oral reference dose
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine

1.0 TOXICITY PROFILES FOR CHEMICALS OF POTENTIAL CONCERN

This appendix presents short summaries of the toxicological effects of the chemicals of potential concern (COPC) for the Area Wide Human Health Risk Assessment (AWHHRA) of the Southeast Idaho Phosphate Mining Resource Area (Resource Area). These summaries include available information about use, occurrence, health effects, and toxicity values established by the U.S. Environmental Protection Agency (EPA).

EPA classifies compounds as to their carcinogenicity, based on weight-of-evidence as follows (EPA 1989):

- Group A - Human carcinogen (sufficient evidence of carcinogenicity in humans)
- Group B - Probable human carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans)
- Group C -Possible human carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data)
- Group D -Not classifiable as to human carcinogenicity (inadequate or no evidence)
- Group E -Evidence of noncarcinogenicity for humans (no evidence of carcinogenicity in adequate studies)

Information on typical concentrations of metals in soil is intended to give a general idea of naturally occurring concentrations in the U.S. Toxicity profiles for the COPCs are presented in the following sections in alphabetical order.

1.1 ALUMINUM

Use, Occurrence, and Health Effects

Aluminum, one of the most abundant metals in the earth's crust, is ubiquitous in air, soil, and water. Most soil contains approximately 3 to 10 percent aluminum. The major use of aluminum is as structural material in the construction, automotive, and aircraft industries. It is also used to manufacture aluminum products, fireworks, ceramics, paints, electrical goods, and abrasives. Some aluminum salts and compounds are used in antacids and other pharmaceutical preparations, and aluminum chlorohydrate is the active ingredient in many antiperspirants and deodorants. Aluminum is naturally present in a large

number of foods, with normal dietary intake ranging from 10 to 100 milligrams per day (mg/day) (Agency for Toxic Substances and Disease Registry [ATSDR] 1999a; Goyer 1991).

Experience with therapeutic and occupational exposures to aluminum indicates that low levels of aluminum are nontoxic. However, massive oral doses of aluminum cause gastrointestinal disturbances and may interfere with phosphate absorption leading to bone deformations. Inhalation of aluminum dust has been associated with lung fibrosis in occupational workers with histories of lengthy and heavy exposure.

Absorption of aluminum and aluminum compounds in humans following ingestion is low. Aluminum compounds can affect absorption of fluoride, calcium, and iron compounds in the gastrointestinal tract and alter intestinal function.

Toxicity Values

An oral reference dose (RfD) of 1 milligram per kilogram per day (mg/kg/day) was derived by the National Center for Environmental Assessment (NCEA), as presented in the Region 9 Preliminary Remediation Goal (PRG) document (EPA 2000). NCEA also provided an inhalation RfD of 0.0014 mg/kg/day (EPA 2000).

1.2 ANTIMONY

Use, Occurrence, and Health Effects

Antimony is widely distributed in the earth's crust, but generally at quite low concentrations, averaging 0.5 mg/kg. Commercial antimony is most commonly produced as a byproduct from sulfide ores of copper and other metals. Antimony has complex chemistry, with both trivalent and pentavalent oxidation states generating many organic and inorganic compounds. The primary uses of antimony are for fireproofing, especially plastics, and for alloying metals, especially hardening lead. Minor uses include antiparasitic drugs for humans and animals. Traces of antimony are found in most foods, giving a typical intake of 10 to 100 micrograms per day (µg/day) (ATSDR 1992d; Goyer, 1991; Carson and others, 1986).

Inhalation of antimony and its compounds produces irritation of the lung and other contacted tissues, especially the eyes and skin. Continued exposure leads to pneumoconiosis and other lung lesions, cardiac

toxicity (altered electrocardiograms), stomach pain, vomiting, diarrhea, and stomach ulcers. Ingestion produces generally similar effects, including vomiting and diarrhea, cardiac toxicity, joint and muscle pain, and anemia. Liver and kidney toxicity has been reported in animal studies.

Antimony is poorly absorbed, typically 1 to 10 percent depending on the chemical and physical form it is in. It is widely distributed in the body, primarily by reacting with sulfhydryl groups on proteins and other molecules. Antimony is not metabolized and is excreted in the urine and feces. Some is also excreted in the skin and hair as a result of protein binding.

Toxicity Values

An oral RfD of 0.0004 mg/kg/day was derived by EPA based on longevity and blood chemistry effects in one rat study (EPA 2002). The uncertainty factor is 1,000, and confidence is low, primarily due to the inadequacy of the available database. No inhalation RfD is available and no carcinogenicity assessment has been performed.

1.3 ARSENIC

Use, Occurrence, and Health Effects

Arsenic is present in soil at an average concentration of about 5 mg/kg and in water at an average concentration of 1 microgram per liter (µg/L). The main use of arsenic is in wood preservation products, especially chromated copper arsenate (CCA). However, CCA is being phased out for residential uses in the U.S. and will be eliminated by January 2004. Other uses of arsenic include insecticide, herbicide, algicide, and growth stimulant for plants and animals. Some arsenic formulations were used in the past for controlling rats and ants, but have been prohibited because of concerns about risks to human health during their production and application. Smaller quantities of arsenic are also used in the production of glass and nonferrous alloys and in the electronics industry. Although inorganic arsenic has been used as a poison for centuries, it is an essential nutrient in several animal species and is believed to be essential for humans. Typical human exposures to arsenic from background sources range from 20 to 70 µg/day, with food being the major source (ATSDR 2000a; Carson and others, 1986; Goyer 1991).

EPA classifies arsenic as a Group A human carcinogen. Numerous epidemiological studies have shown an increased incidence of skin and respiratory tract tumors in smelter workers exposed to arsenic fumes

and dusts. Ingestion of elevated levels of arsenic in drinking water has been associated with an increased incidence of skin cancer in several foreign populations. Some studies also report increased bladder, kidney, and liver cancers. One study showed a dose and time-dependent response curve, with skin cancer rates as high as 26 percent.

Noncancer effects of arsenic ingestion at levels greater than about 20 mg/kg/day include skin disorders, severe irritation of the gastrointestinal tract, anemia, nerve degeneration, and toxicity to the liver, kidney, and heart (ATSDR 2000a). Most reports of chronic toxicity have been in workers exposed to fumes and dusts, causing local irritation of the mucous membranes of the eyes and nose.

Arsenic is transported through the placenta, but teratogenicity and other reproductive effects have been reported in laboratory animals only after large doses that cause significant maternal toxicity (ATSDR 2000a).

Soluble arsenic compounds are almost completely absorbed from the gastrointestinal tract, whereas insoluble arsenic compounds are absorbed poorly, if at all. Organic arsenic compounds are less toxic than the organic compounds. Minimal dermal absorption has been observed. Within the body, arsenic is distributed rapidly to all tissues, with highest concentrations in the liver. It is detoxified in the liver by conversion to dimethylarsenic, which is excreted in the urine. In addition, some arsenic is incorporated in the hair and nails, which can indicate past exposures.

Toxicity Values

The EPA oral slope factor for arsenic is 1.5 $(mg/kg/day)^{-1}$ and is based on studies in a Taiwanese population who had ingested elevated levels of arsenic in drinking water over a lifetime (EPA 2002). Ingestion of arsenic has been associated with an increased incidence of skin cancer and increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder). A slope factor of 15 $(mg/kg/day)^{-1}$ is used for inhalation, based on occupational exposures of smelter workers at various locations in the U.S. (EPA 2002).

The oral RfD for arsenic is 0.0003 mg/kg/day (EPA 2002). This value was derived from the same studies used to derive the oral slope factor. The critical effects noted were keratosis, hyperpigmentation of the skin, and possible vascular effects. An uncertainty factor of 3 was used to account for intraspecies

variability and a lack of studies on reproductive toxicity. Confidence in the RfD is medium. No inhalation RfD is available.

1.4 BERYLLIUM

Use, Occurrence, and Health Effects

Beryllium is a very light metal, found in soil and rock at an average concentration of about 3 mg/kg. It is more concentrated in its ores (beryl and bertrandite) and in coal ash and some other mixtures. Beryllium's stiffness and light weight is useful in corrosion, resistance, and electrical and thermal conductivity. Beryllium is widely used in electronic and electrical devices, the aerospace and defense industries, and nuclear reactors. An important small-scale use is non-sparking tools produced from a beryllium-copper alloy. Traces of beryllium are ubiquitous, leading to human intake of 5 to 100 µg/day (ATSDR 2000b; EPA 1998c; Goyer 1991).

Inhalation of beryllium and its compounds leads to lung irritation. Repeated exposures produces allergic sensitization in many people, causing a long-lasting inflammation now called chronic beryllium disease (CBD) formerly called berylliosis. Ingestion leads to gastrointestinal ulcers and other inflammatory lesions. In some cases, chronic ingestion has led to rickets, but this is an indirect effect. Phosphate is precipitated in the intestine as beryllium salt, leading to very poor absorption and an inadequate supply for bone minerals.

EPA considers inhaled beryllium to be a Group B1 human carcinogen on the basis of limited human and animal data. There are no data on beryllium carcinogenicity by the oral route.

Beryllium and its compounds are poorly absorbed. They are not metabolized but, rather, excreted in the urine.

Toxicity Values

EPA has established an inhalation slope factor of 8.4 $(mg/kg/day)^{-1}$ for beryllium, based on lung tumors from occupational exposures (EPA 2002). No oral carcinogenicity data are available.

The oral RfD for beryllium is 0.002 mg/kg/day, based on gastrointestinal lesions from a dietary study in dogs. This value has an uncertainty factor of 300 and medium confidence. The inhalation RfD is 0.0000057 mg/kg/day, based on the production of CBD in exposed workers. The uncertainty factor for this value is 10 and confidence is medium, primarily due to uncertainties in the exposure monitoring in the study.

1.5 BORON

Use, Occurrence, and Health Effects

Boron is a widely distributed element comprising 10 to 25 mg/kg in soil. It is found in nature as borates (salts of boric acid, such as borax) and is made into other compounds, including boric acid, boron oxide (the anhydrous from of boric acid), boron hydrides, and some other exotic derivatives. The most used compound is the oxide, used in glasses, ceramics, enamels, and similar products. Other uses of boron compounds include soaps and detergents and plant foods. Boron is an essential nutrient for many plants. Estimated human dietary intake is 10 to 25 mg/day (ATSDR 1992a; Carson and others 1986).

Inhalation of borates produces irritation of the lung tissues. Ingestion causes nausea, vomiting, and diarrhea, liver and kidney damage, and central nervous system effects (congestion and edema of the brain, leading to tremors, seizures, and other symptoms). Continued ingestion leads to erythema (reddening) of the skin followed by exfoliation (peeling off). There are no data on carcinogenicity, but prolonged dosing does suppress reproductive activity (ATSDR 1992a).

Boron compounds are well absorbed from the gastrointestinal tract. There are no data on distribution within the body and metabolism is practically impossible. The compounds are rapidly excreted in the urine.

Toxicity Values

The oral RfD for boron and borates is 0.09 mg/kg/day, based on testicular atrophy in chronically dosed dogs (EPA 2002). The uncertainty factor is 100 and the confidence is medium. This has been converted to an inhalation RfD of 0.0057 mg/kg/day (EPA 2000).

1.6 CADMIUM

Use, Occurrence, and Health Effects

Cadmium in the environment is usually found as stable compounds of oxygen, chlorine, or sulfur. The concentration of cadmium in soil is typically 0.1 to 1 mg/kg. Cadmium metal is used in electroplating and nonferrous alloys and compounds used in batteries, plastic stabilizers, semiconductors, and as pigment in paints and plastics. The largest sources of cadmium released to the environment are the burning of fossil fuels, incineration of municipal wastes, and emissions from zinc, lead, and copper smelters. Environmental exposures most commonly result from leaching of cadmium from galvanized, copper, or plastic pipes into drinking water (ATSDR 1999b; Goyer 1991; Seiler and Sigel 1988).

Cadmium is classified by the EPA as a Group B1 probable human carcinogen on the basis of evidence from epidemiological and animal studies. Human occupational studies have shown an excess risk of lung cancer and prostate cancer. One study that exhibited a 2-fold excess risk of lung cancer is considered to supply limited evidence of human carcinogenicity. The results of the remaining occupational studies were compromised by the presence of other carcinogens or small sample sizes. Studies with rats have shown increases in lung tumors as a result of inhalation, increases in mammary tumors and tumors at multiple sites in males following intratracheal instillation, and increases in injection site tumors and distant site tumors resulting from intramuscular or subcutaneous administration. No available studies indicate that cadmium is carcinogenic by the oral route.

Although rarely seen, the principal acute toxic effect of cadmium following oral exposure is gastrointestinal distress. Immediate death may be caused by shock and dehydration. In individuals surviving these effects, death can result from renal and cardiopulmonary failure after a short latent period. Inhalation exposure may produce an acute pneumonitis and pulmonary edema. Several epidemics have resulted when cadmium leached from ceramic containers containing acidic media, such as fruit juices. Zinc and selenium can protect against cadmium toxicity through an unknown mechanism.

Information on the chronic toxicity of cadmium is available from two different study populations: workers exposed to cadmium fumes and dusts, and Japanese villagers who ingested cadmium-contaminated water and rice. Occupational exposures to cadmium are most often associated with the production of zinc or lead and in metal plating. Chronic occupational exposure to fumes results in cadmium-induced emphysema and kidney damage. Following ingestion of cadmium-contaminated

water, female Japanese villagers reported severe joint and muscle pains that progressed to mineral loss in bone with consequent multiple fractures.

Epidemiological and animal studies have revealed an association between cadmium and hypertension, but direct cause and effect have not been unequivocally established. Parenteral doses of cadmium have been shown to decrease testosterone levels and produce adverse effects on the testis and prostate of test animals. There are preliminary indications that the prostate may be a target organ in workers exposed to cadmium fumes. In addition, there is limited epidemiological evidence that inhalation of cadmium fumes causes an increase in tumors, especially in the lungs and prostate. From these results, cadmium is considered a Group B1 (probable human carcinogen) by inhalation.

Cadmium is well absorbed from the lungs (30 to 50 percent), but poorly absorbed from the gastrointestinal tract (1 to 10 percent). Absorption through the skin is also poor based on the results of limited studies that showed dermal absorption ranging from 0.1 to 1.0 percent for cadmium chloride in soil. Absorption depends on the solubility of the cadmium compound and whether it is ingested as food or drinking water. Typically, about 5 percent is absorbed from drinking water and 2.5 percent from food. However, various dietary factors such as calcium and iron deficiencies may alter absorption. Cadmium is concentrated mainly in the kidneys, but may also be found in the liver at elevated concentrations. Excretion, which occurs primarily through the urine, is exceedingly slow. Cadmium is retained in the body for long periods, with the biologic half-life estimated to be between 19 and 38 years.

Toxicity Values

No available studies indicate that cadmium is carcinogenic by oral exposure. The oral RfDs for cadmium are 0.0005 and 0.001 mg/kg/day for water and food, respectively (EPA 2002). The critical effect for cadmium toxicity is kidney damage, as measured by proteinuria in humans chronically exposed. The oral RfDs were calculated with a pharmacokinetics model, in which the input data were the highest concentration of cadmium in the human renal cortex not associated with significant proteinuria and the percent cadmium absorption from food and water. An uncertainty factor of 10 was used to account for intraspecies variability. The confidence in this RfD is high because of the vast quantity of human and animal data on cadmium toxicity.

The inhalation slope factor for cadmium is 6.3 $(mg/kg/day)^{-1}$, based on epidemiological studies (EPA 2002). No oral slope factor is available.

1.7 CHROMIUM

Use, Occurrence, and Health Effects

Chromium is a naturally occurring element present in soil at an average concentration of about 100 mg/kg. Chromium occurs in oxidation states ranging from Cr^{+2} to Cr^{+6}. Trivalent chromium (chromium III, chromic) and hexavalent chromium (chromium VI, chromate) are the predominant forms in the environment; trivalent chromium is the more common form, whereas hexavalent chromium results from man-made sources. Chromium is found in many foods, glass, paper products, organic chemicals, fertilizers, and sewage sludge. It is used mainly for manufacturing steel and other alloys, chrome plating, water treatment, and in paints. Trivalent chromium is an essential nutrient, with a recommended adult daily intake of 50 to 200µg/day (ATSDR 2000c; EPA 1998a; EPA 1998b).

The principal toxicological hazard of environmental chromium is associated with hexavalent chromium, which is classified by the EPA as a Group A human carcinogen following inhalation exposure. Epidemiological studies of workers in chromate facilities consistently show an association between lung cancer and exposure to chromium (presumably hexavalent chromium). Hexavalent chromium compounds were carcinogenic in animal assays producing the following tumor types: intramuscular injection site tumors in rats and mice, intrapleural implant site tumors in rats, intrabronchial implantation site tumors in rats, and subcutaneous injection site sarcomas in rats.

Examples of the more familiar forms of hexavalent chromium are the soluble salts, potassium dichromate, sodium dichromate, potassium chromate, and sodium chromate. In contrast to the toxicity of the hexavalent form, trivalent chromium is an essential nutrient. It is required for several biochemical reactions in carbohydrate metabolism and insulin production. Preliminary evidence indicates that hexavalent chromium is reduced *in vivo* to trivalent chromium.

Acute chromium toxicity, although seldom seen, is characterized by hemorrhage and fluid loss leading to hypovolemic shock. Chronic toxicity is most commonly reported after industrial exposure to chromate or to mixed chromate and chromic acid. In an industrial setting, the common routes of exposure are inhalation and dermal contact, with pathological effects developing at the site of exposure. Typical symptoms of chronic exposure are allergic contact dermatitis, skin ulcers, rhinitis, and nasal ulceration with nasal septum perforation. This latter condition is so typical of chromium exposure that the perforations are commonly referred to as “chrome holes.” Lung tumors are common in

chromate-exposed workers, particularly in those who smoke cigarettes. Although not as common, liver and kidney lesions have also been reported.

Chromium is a component of enzyme systems involved in the body's utilization of glucose, protein, and fat. Insufficient chromium intake leads to weight loss or decreased growth, improper function of the nervous system, and a diabetes-like condition.

The primary routes of chromium exposure are ingestion and inhalation. Limited data indicate that approximately 0.5 to 18 percent of a dose of trivalent chromium and 2 to 10 percent of a dose of hexavalent chromium are absorbed following oral exposure. Although qualitative data indicate that chromium is absorbed following inhalation and dermal exposure, quantitative data are not available.

Toxicity Values

Oral RfDs have been established for both trivalent chromium and hexavalent chromium. The RfD for trivalent chromium is 1.5 mg/kg/day (EPA 2002). This value is based on a chronic feeding study in rats. The only effects observed were reductions in the absolute weights of the liver and spleen. The confidence in the RfD is low because of the lack of detail in the study report, the absence of an observed effect level, and the lack of additional supporting data. An uncertainty factor of 100 and a modifying factor of 10 were used to account for interspecies variability, intraspecies variability, and extrapolation from a lowest observed adverse effect level (LOAEL) to a no observed adverse effect level (NOAEL) in the principal study. Because an insoluble salt of trivalent chromium (chromic oxide) was used in the study, the oral RfD is limited to insoluble salts of trivalent chromium.

For hexavalent chromium, the oral RfD is 0.003 mg/kg/day, based on the lack of observed toxic effects in an early drinking water study in rats (EPA 2002). The RfD has an uncertainty factor of 300 and a further modifying factor of 3 to reflect the low confidence in the quality of the study. The inhalation slope factor for hexavalent chromium is 290 $(mg/kg/day)^{-1}$, based on epidemiological studies from occupational exposures (EPA 2002).

1.8 COBALT

Use, Occurrence, and Health Effects

Cobalt is a relatively rare metal, usually present in copper ores. Its concentration in soil averages about 8 mg/kg. It is used in alloys because of its magnetic properties, resistance to corrosion, and ability to withstand high temperatures. In humans, cobalt is an essential nutrient, being an integral component of vitamin B12 (cyanocobalamin). Vitamin B12 is necessary for the production of red blood cells; pernicious anemia develops in the absence of adequate cobalt intake (ATSDR 1992b; Goyer 1991; Carson and others 1986).

Information on the toxicity of cobalt in humans is available from past administration of cobalt to children with sickle cell anemia (to stimulate red blood cell production) and from its brief use as an antifoam agent in beer. These uses were discontinued when the children developed goiter (enlargement of the thyroid gland) and when several heavy beer drinkers died from congestive heart failure. These experiences and data from animal studies allowed the National Academy of Sciences to conclude that, at daily doses greater than 1 mg/kg, cobalt may pose a health hazard to humans. Industrial exposures have resulted in respiratory dysfunction and skin sensitization similar to allergic contact dermatitis.

Although cobalt is well absorbed through both inhalation and ingestion, it does not accumulate in the human body, being easily excreted in the urine and feces. The largest total fraction of cobalt is found in the muscle, whereas, the highest concentrations are found in adipose tissue. Excretion occurs primarily in the urine.

Toxicity Values

The oral RfD for cobalt is 0.06 mg/kg/day. This value was derived by the NCEA, as presented in the Region 9 PRG document (EPA 2000).

1.9 COPPER

Use, Occurrence, and Health Effects

Copper is an abundant element present in different chemical forms in numerous ores. It is present in soil at an average concentration of about 30 mg/kg. Copper is used extensively in the manufacture of electrical equipment, alloys, coins, and chemical apparatus because it is malleable, ductile, and a good conductor of heat and electricity (ATSDR 1990; Goyer 1991; Scheinberg 1980; EPA 1984a; Seiler and Sigel 1988).

In humans, copper is an essential trace element that is necessary for the production of hemoglobin, for the maintenance of connective tissue, and for the proper functioning of many metabolic enzymes. A daily intake of 2 to 5 mg/day is considered essential. Copper deficiency results in defective hemoglobin synthesis, leading to anemia.

Copper is classified in Group D, not classifiable as to human carcinogenicity. No human data exist, and existing animal data are inadequate to make a determination of carcinogenicity.

At elevated levels, copper can produce toxic effects. Acute toxic effects include gastrointestinal irritation, vomiting, low blood pressure, jaundice, and coma. Cases of hemolytic anemia have also been seen. In individuals with a rare genetic syndrome known as Wilson's disease, copper is not metabolized correctly and accumulates in soft tissues. Lesions appear in the liver, brain, and eye, and individuals may have hemolytic anemia. With the exception of these individuals, chronic copper toxicity is practically unknown because of the body's homeostatic mechanisms that regulate the amount of copper in the body.

Infants and young children may be more susceptible than adults to the effects of copper because levels of copper in the liver are normally high in infants and because homeostatic mechanisms for controlling copper concentrations are not yet fully developed.

Approximately 50 percent of dietary copper is absorbed; the metal is also absorbed dermally. Following absorption, copper is concentrated in the liver, where it is bound in large part to metallothionein and in bone marrow. Excretion is through the bile into the feces.

Toxicity Values

EPA currently provides the drinking water standard of 1.3 milligram per liter (mg/L) for copper in place of an RfD because EPA's Drinking Water Criteria Document for copper concluded that toxicity data were inadequate for calculation of an RfD (EPA 2002). The Region 9 PRG Document adjusts this to the usual exposure units as 0.037 mg/kg/day (EPA 2000).

1.10 MERCURY

Use, Occurrence, and Health Effects

Mercury is a naturally occurring metal present in soil at very low concentrations of approximately 0.03 mg/kg. It is used in a number of products, including thermometers, batteries, fungicides, pesticides, paints, and pharmaceuticals. Mercury is also used as a catalyst in chloralkali plants and has been used in paper and pulp industries. Mercury is naturally present in foods, and the normal adult dietary intake is about 3.5µg/day (ATSDR 1999c; Stokinger 1981; Seiler and Sigel 1988; Goyer 1991).

Both inorganic and organic forms of mercury are toxic to humans and animals. In general, the organic forms are more toxic than the inorganic forms. In humans, the kidney and central nervous system are the main sites affected by mercury. Elemental mercury can cross the blood-brain barrier, where it produces neuropathies in both the central and peripheral nervous systems. The lesions are manifested as tremors in the extremities and neuropsychiatric disturbances such as irritability, insomnia, and emotional instability. Chronic intake of divalent mercury can result in kidney disease. In addition to systemic effects, dermal exposure to mercury can result in contact sensitization dermatitis.

EPA has classified mercury in Group C, a possible human carcinogen. Epidemiologic studies in humans failed to show a correlation between exposure to elemental mercury vapor and carcinogenicity. Possible or known concurrent exposures to other chemicals, including human carcinogens, as well as lifestyle factors, have confounded the results of the epidemologic studies. Findings from genotoxicity tests are severely limited and provide equivocal evidence that mercury adversely affects the number or structure of chromosomes in human somatic cells. However, some animal studies provide limited evidence of carcinogenicity.

Elemental mercury is well absorbed (80 to 100 percent) following inhalation exposure. Elemental mercury and inorganic mercury salts are generally poorly absorbed following ingestion: oral absorption is estimated to be about 0.1 percent for metallic mercury and 2 to 15 percent for inorganic mercury salts. Limited information indicates some absorption of elemental and inorganic mercury salts following dermal exposure. The pharmacokinetics of absorption, distribution, and excretion are highly dependent on the chemical state and valency of mercury. For example, divalent mercury and elemental mercury accumulate in the kidney, whereas only elemental mercury effectively crosses the blood-brain barrier.

Toxicity Values

The oral RfD for mercury and its inorganic compounds is 0.0003 mg/kg/day (EPA 2002). This is based on a rat feeding study using mercuric chloride and includes an uncertainty factor of 1000. There is high confidence in the RfD. The oral RfD for methylmercury is 0.0001 mg/kg/day (EPA 2002). This is based on developmental neurological abnormalities seen in infants whose mothers received methylmercury. The uncertainty factor is 10 and the confidence is medium, due to uncertainties in the dose data. No inhalation RfD is available for mercury compounds.

Elemental mercury has an inhalation RfD of 0.000086 mg/kg/day (EPA 2002). This was derived from human occupational exposure studies and has an uncertainty factor of 30. There is medium confidence in the RfD, primarily due to the lack of data on reproductive toxicity.

1.11 MOLYBDENUM

Use, Occurrence, and Toxic Effects

Molybdenum is widely distributed in the earth's crust as various oxide and sulfide compounds with an average concentration about 2 mg/kg. It exists in many oxidation states. The main use of molybdenum is as the hexavalent oxide in high-grade steel alloys. Other uses for molybdenum compounds include lubricants (especially molybdenum disulfide), pigments (especially molybdate compounds), and catalysts. Molybdenum is present in many foodstuffs so the average intake is 0.1 to 0.5 mg/day (National Library of Medicine [NLM] 2002; Carson and others 1986; Goyer 1991).

The primary short-term effect of exposure to molybdenum compounds is irritation at the site of contact. Continued exposure leads to pneumoconiosis (after inhalation) and loss of appetite, weight loss, and

listlessness (after ingestion). Ingestion also produces effects in other organs, causing anemia, infertility, bone and joint deformities, and a gout-like disease. There are no data on carcinogenicity.

Common molybdenum compounds are well absorbed from the gastro-intestinal tract but not from the lung. The absorbed molybdenum is widely distributed, with some accumulations in the liver and long bones (if they are still being ossified). The main route of excretion is in the urine. Molybdenum is an essential mineral in plants (especially for nitrogen fixation) and animals. Human deficiencies have not been observed, due to the ubiquitous distribution of the element. Determination of the minimum necessary intake and of toxic levels is complicated by the mutual antagonism between molybdenum and copper. For example, toxicity has been observed in cattle grazing on land with high molybdenum and very low copper concentrations, but not with high concentrations of both.

Toxicity Values

EPA has established an oral RfD of 0.005 mg/kg/day for molybdenum. This was derived from the minimal signs of gout seen in people in a part of Armenia with high molybdenum and low copper concentrations. The uncertainty factor is 30 and confidence is medium, due to limited data in the study used for the derivation. No inhalation RfD is available, in part due to the relatively low inhalation toxicity of molybdenum that results from the poor absorption from the lung.

1.12 NICKEL

Use, Occurrence, and Health Effects

Nickel and its compounds are widely distributed in the environment at an average concentration in soil of 40 mg/kg. Industrial applications for nickel include electroplating, various steels and alloys, ceramics, and nickel-cadmium batteries. Small amounts of nickel are essential for normal growth and reproduction in some species and may be essential for humans. Nickel is a natural component of food, and normal dietary intake is about 170 µg/day (ATSDR 1997; Seiler and Sigel, 1988; Goyer 1991).

EPA does not classify nickel or soluble nickel compounds as carcinogens. Nickel subsulfide and nickel refinery dust are classified by the EPA as Group A human carcinogens; this classification is based on several studies from different countries that show an association of lung and nasal cancer with exposure to nickel refinery dust. Tumors have also been produced in rats exposed to nickel subsulfide via inhalation.

Nickel has not been shown to produce significant acute toxicity. Contact dermatitis and allergic sensitization in humans are the most common toxicological effects observed and typically result from wearing nickel-containing jewelry. Dermal effects can also be produced following ingestion.

Nickel is absorbed poorly from the gastrointestinal tract. Upon reaching the systemic circulation, it concentrates in the kidneys and liver. The major route of excretion is through the urine. The particular form of nickel greatly influences its bioavailability, and thus, its systemic toxicity. For example, a 40-fold difference in absorption from the gastrointestinal tract between water soluble and insoluble forms of nickel has been demonstrated in some studies.

Toxicity Values

EPA has derived slope factors only for "nickel refinery dust" and nickel subsulfide. The oral RfD for nickel (as soluble nickel salts) is 0.02 mg/kg/day (EPA 2002). This value is based on a study in which decreased body and organ weights were observed in rats fed nickel sulfate hexahydrate at varying levels for 2 years. An uncertainty factor of 300 was used to account for interspecies variability, intraspecies variability, and because data from reproductive studies are inconclusive. Confidence in the RfD is medium. An inhalation RfD for nickel is not available from the EPA.

1.13 SELENIUM

Use, Occurrence, and Health Effects

Selenium is a naturally occurring element widely distributed at low levels in nature. Typical concentrations of selenium in soil are 0.1 to 2.0 mg/kg; however, concentrations may be much higher, depending on the parent rock from which the soil was derived. Selenium is often found to be concentrated as a by-product of copper refining at mining sites. Selenium and its compounds are used in the electronics, glass, and rubber industries; in fungicides and insecticides; in some dandruff shampoos as selenium sulfide (note: selenium sulfide unlikely to be encountered in nature; furthermore, selenium sulfide [along with all forms of absorbed selenium] will be metabolized in the human body to selenite, selenate, or another similar form of selenium); in pigments; and in photographic and xerographic processes. Significant contributors to atmospheric selenium levels are the mining of uranium, lead, zinc, and phosphate; copper smelting; and combustion of seleniferous coal. Ordinary intakes of selenium are 0.07 to 0.15 mg/day, depending on diet (ATSDR 1996; EPA 1984b; Seiler and Sigel 1988; Goyer 1991).

Selenium is considered an essential nutrient in humans. It is a component of the enzyme glutathione peroxidase, which protects membrane lipids and possibly other cellular components from damage by oxidants and free radicals. About 50 to 100 µg/day is required in the human diet. Selenium deficiencies have been shown to result in degenerative muscle disease and retarded growth in experimental animals and cardiomyopathy (Keshan disease) in humans.

Toxicity from selenium has been observed in human populations living in seleniferous areas where the soil content of selenium is high, contributing to high selenium concentrations in foods. Chronic ingestion of high levels can result in discolored and decayed teeth, skin eruptions, gastrointestinal distress, lassitude, and hair and nail loss. Chronic inhalation exposure may cause gastrointestinal disorders, liver and spleen damage, anemia, mucosal irritation, and lower back pain. Acute poisoning symptoms, as seen in industrial exposures, include nervousness, drowsiness, and convulsions.

Selenium and most of its compounds are classified in Group D, not classifiable as to human carcinogenicity; in fact, several studies suggest that normal amounts of dietary selenium may protect against cancer. However, ingested selenium sulfide has been shown to be carcinogenic in animals, and warrants a B2 (probable human carcinogen) classification. Findings from laboratory experiments indicate that selenium may be embryotoxic and teratogenic.

Absorption is dependent on the chemical form of selenium, but limited data indicate that both elemental selenium and selenious acid are absorbed through inhalation. Insoluble elemental selenium is probably not absorbed from the gastrointestinal tract; estimates of the absorption of selenium compounds range from 44 to 100 percent. There appears to be a homeostatic mechanism for maintaining a certain level of selenium in the body. Selenium is preferentially deposited in the kidneys and liver and is primarily excreted in the urine. When excretory capabilities are exceeded, toxicity can develop.

Toxicity Values

The oral RfD for selenium is 0.005 mg/kg/day (EPA 2002). This value was calculated from a comparative study of Chinese populations living in areas with low, medium, and high environmental concentrations of selenium. The subjects were evaluated for clinical and biochemical signs of selenium intoxication, and were shown to have the critical effect of clinical selenosis. An uncertainty factor of 3 was used to account for intraspecies variability. Confidence in the RfD is high, because of two studies

that corroborate one another's NOAEL. An inhalation RfD is not available from the EPA. No slope factors are available for selenium sulfide.

1.14 URANIUM

Use, Occurrence, and Health Effects

This profile is concerned with only the chemical effects of natural and depleted uranium. The radiation effects, including carcinogenicity, which are the predominant effects of enriched uranium, are not included.

Uranium is an extremely dense metal found throughout the earth's crust at typical concentrations of 1 to 4 mg/kg. Basic rocks and soils derived from them are in the lower part of that range and acidic rocks and their soils in the high end. Even higher concentrations are found in coal ash, Florida phosphate deposits, the rocks feeding the mineral springs of Saratoga, New York, and other locations. The primary use of uranium is as fuel for reactors. Depleted uranium is also used as counterweights in aircraft and in military armor and anti-armor ammunition. Some uranium compounds are used in glasses, ceramics, and pigments. Typical human intakes are 1 to 5 µg/day (ATSDR 1999d; NLM 2002; U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 1999; Goyer 1991).

Inhalation of uranium or its compounds produces no observed toxic effects from the uranium. However, toxicity can be produced from simultaneously inhaled material, such as silicon and cigarette smoke, and from compounds formed from the uranium compounds, such as the hydrofluoric acid formed when uranium hexafluoride dissolves in water.

The toxicity of uranium compounds after ingestion is tied directly to the water solubility of the compounds. The more soluble ones, including most hexavalent (uranyl) compounds, are poorly absorbed, only 1 to 5 percent. Even smaller fractions of the less soluble compounds are absorbed. Once absorbed, uranium is deposited in the bones (especially tetravalent uranium) and the kidneys (especially hexavalent uranium). The accumulation in the renal tubular epithelium leads to localized necrosis and impaired kidney function. This nephrotoxicity is the only significant adverse effect of uranium. Absorbed uranium is excreted slowly, especially the fraction that is precipitated in the mineral matrix of the bone.

Toxicity Values

EPA has provided an oral RfD of 0.003 mg/kg/day for uranium. This is applicable only to the soluble salts and would be extremely conservative for less soluble salts such as uranium dioxide. The RfD is derived from nephrotoxicity seen in a 30-day rabbit study and has an uncertainty factor of 1,000. Confidence is medium due to the few animals used in the study. No inhalation RfD is available and carcinogenicity is related to radioactivity, not the chemical reactions of uranium.

1.15 VANADIUM

Use, Occurrence, and Health Effects

Vanadium is widely distributed in the earth's crust, primarily as pentavalent compounds (vanadates). The average concentration is about 150 mg/kg, but higher concentrations are found in some phosphates (including those in the Idaho-Montana area), coal ash, and some crude oils (especially those from Venezuela). The primary use of vanadium is as an alloying agent in steels, often at concentrations less than 0.1 percent. Other uses of vanadium compounds include catalysts, ceramics, electronics, and chemical reagents. Human intake is about 2 mg/day (ATSDR 1992c; NLM 2002; Carson and others, 1986).

Inhalation exposures to vanadium and its compounds produce lung and eye irritation. Ingestion leads to interferences with a number of enzymes, especially those involved with the metabolism of sulfur-containing amino acids. These interferences are probably the cause of the mild kidney effects and other organ effects sometimes reported. Vanadium compounds have been associated with decreased cystine levels in fingernails and hair. There is no evidence of any carcinogenic effects of vanadium compounds.

Vanadium compounds are poorly absorbed. Studies report some accumulation in the lungs (after inhalation) and in the bones, kidneys, and liver (after ingestion). There is some interconversion between the tetravalent (vanadyl) and pentavalent (vanadate) oxidation states. The pentavalent state seems to be somewhat more toxic, but this oxidation-reduction metabolism minimizes the differences between the states. Vanadium is excreted in the urine fairly rapidly.

Toxicity Values

EPA has issued an oral RfD of 0.009 mg/kg/day for vanadium pentoxide (EPA 2002). The basis for the RfD is decreased hair cystine in chronically dosed rats. The uncertainty factor is 100 and confidence is low because of the minimal information presented in the study and the scantiness of the database. No inhalation RfD is available.

1.16 ZINC

Use, Occurrence, and Health Effects

Zinc is an abundant element present in soil at an average concentration of about 50 mg/kg. As a component of galvanized steel, it is used extensively in the machining, building, and automotive industries. Zinc compounds are also used during the production of plastics, appliances, paints, linoleum, rubber, paper, glass, fertilizers, insecticides, batteries, and as wood preservatives (ATSDR 1994; Stokinger 1981; Seiler and Sigel 1988; Goyer 1991).

Zinc is an essential trace element involved in enzyme functions, protein synthesis, and carbohydrate metabolism. The average daily intake of zinc is 12 to 15 mg/kg/day, mostly from food. In general, zinc deficiencies are of greater health significance than overexposure to zinc. Over 70 enzymes require zinc as a cofactor, and deficiency results in a wide spectrum of clinical effects.

EPA has classified zinc in Group D, not classifiable as to human carcinogenicity. Studies conducted with mice, rats, and chickens either showed no carcinogenic response or were deemed inadequate for determining carcinogenicity by EPA.

Zinc toxicity is observed at high dose levels. Toxic effects in rats given zinc in excess of 0.25 percent in the diet included growth retardation, anemia, and defective mineralization of the bone; the anemia may result from zinc-induced copper deficiencies. No zinc toxicity has been observed at dietary levels below 0.25 percent. Studies with animals and humans indicate that metabolic changes may occur as a result of the interaction of zinc and other metals in the diet. Metal fume fever is the most common zinc-related industrial disease and is associated with inhalation of zinc oxide fumes. The major symptom is fever and chills with recovery in 24 to 48 hours in severe cases. There is no evidence that adverse effects exist after recovery. Contact with zinc chloride can cause skin and eye irritation.

In humans, approximately 20 to 50 percent of ingested zinc is absorbed, and absorption from the gastrointestinal tract is controlled by homeostatic mechanisms. Following absorption, zinc is distributed to the muscle, liver, kidney, pancreas, eyes, and male reproductive organs. Elimination is primarily in the feces, but significant amounts may also be excreted in sweat.

Toxicity Values

The oral RfD for zinc is 0.3 mg/kg/day (EPA 2002). This value is based on studies of humans administered zinc; the critical effect was a decrease in erythrocyte superoxide dismutase concentration. Long-term ingestion of elevated levels of zinc interferes with copper absorption, leading to anemia. An uncertainty factor of 3 was used to account for a minimal LOAEL from a moderate-duration study of the most sensitive humans, and consideration that zinc is an essential dietary nutrient. Confidence in the RfD is medium, as the studies were well-conducted, but only a few numbers of humans were tested. No inhalation RfD is available.

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APPENDIX E

HUMAN HEALTH TIER-SPECIFIC EXPOSURE, RISK, AND HAZARD CALCULATIONS

TABLE E-1

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INHALATION OF PARTICULATES

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfDi	Slope Factor (Sfi)	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD			ADULT	CHILD	ADULT	CHILD	TOTAL
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1					
Antimony	2.30E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	5.28E-11	1.85E-10	2.26E-11	1.58E-11	NA	NA	--	--	--	--	--
Arsenic	7.70E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.77E-10	6.18E-10	7.57E-11	5.30E-11	NA	1.50E+01	--	--	1.1E-09	8.0E-10	1.9E-09
Beryllium	2.10E+00	2.29E-12	8.03E-12	9.83E-13	6.88E-13	4.82E-12	1.69E-11	2.07E-12	1.45E-12	5.71E-06	8.40E+00	8.4E-07	3.0E-06	1.7E-11	1.2E-11	2.9E-11
Boron	7.60E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.74E-10	6.10E-10	7.47E-11	5.23E-11	5.71E-03	NA	3.1E-08	1.1E-07	--	--	--
Cadmium	1.20E+02	2.29E-12	8.03E-12	9.83E-13	6.88E-13	2.75E-10	9.64E-10	1.18E-10	8.26E-11	NA	6.30E+00	--	--	7.4E-10	5.2E-10	1.3E-09
Chromium	1.50E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	3.44E-09	1.20E-08	1.48E-09	1.03E-09	2.86E-05	2.90E+02	1.2E-04	4.2E-04	4.3E-07	3.0E-07	7.3E-07
Copper	2.10E+02	2.29E-12	8.03E-12	9.83E-13	6.88E-13	4.82E-10	1.69E-09	2.07E-10	1.45E-10	NA	NA	--	--	--	--	--
Molybdenum	6.50E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.49E-10	5.22E-10	6.39E-11	4.47E-11	NA	NA	--	--	--	--	--
Nickel	4.60E+02	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.06E-09	3.69E-09	4.52E-10	3.17E-10	NA	1.70E+00	--	--	7.7E-10	5.4E-10	1.3E-09
Selenium	1.50E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	3.44E-09	1.20E-08	1.48E-09	1.03E-09	NA	NA	--	--	--	--	--
Silver	1.30E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	2.98E-11	1.04E-10	1.28E-11	8.95E-12	NA	NA	--	--	--	--	--
Uranium	6.30E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.45E-10	5.06E-10	6.20E-11	4.34E-11	NA	NA	--	--	--	--	--
Vanadium	1.20E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	2.75E-09	9.64E-09	1.18E-09	8.26E-10	NA	NA	--	--	--	--	--
Zinc	2.00E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	4.59E-09	1.61E-08	1.97E-09	1.38E-09	NA	NA	--	--	--	--	--
Exposure Pathway/Receptor Totals												1.2E-04	4.2E-04	4.3E-07	3.0E-07	7.3E-07

Notes:

--	Information is not available
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Not available
LADD	Lifetime average daily dose
RfDi	Reference dose inhalation
Sfi	Slope factor inhalation

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-2

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.10E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.71E-07	5.10E-07	7.33E-08	4.37E-08	5.00E-04	NA	3.4E-04	1.0E-03	--	--	--
Chromium	4.60E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.54E-06	7.56E-06	1.09E-06	6.48E-07	1.50E+00	NA	1.7E-06	5.0E-06	--	--	--
Selenium	1.14E+00	5.52E-04	1.64E-03	2.37E-04	1.41E-04	6.29E-04	1.87E-03	2.70E-04	1.61E-04	5.00E-03	NA	1.3E-01	3.7E-01	--	--	--
Exposure Pathway/Receptor Totals												1.3E-01	3.8E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-3

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF ELK AND OTHER WILD GAME - SKELETAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfDi	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	2.78E-01	6.96E-07	1.02E-06	2.98E-07	8.70E-08	1.93E-07	2.82E-07	8.29E-08	2.42E-08	5.00E-04	NA	3.9E-04	5.6E-04	--	--	--
Selenium	9.20E-01	6.96E-07	1.02E-06	2.98E-07	8.70E-08	6.40E-07	9.34E-07	2.74E-07	8.00E-08	5.00E-03	NA	1.3E-04	1.9E-04	--	--	--
Exposure Pathway/Receptor Totals												5.2E-04	7.5E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-4

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF ELK AND OTHER WILD GAME - OFFAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.70E+00	6.96E-08	1.02E-07	2.98E-08	8.70E-09	1.18E-07	1.73E-07	5.07E-08	1.48E-08	5.00E-04	NA	2.4E-04	3.5E-04	--	--	--
Selenium	1.30E+01	6.96E-08	1.02E-07	2.98E-08	8.70E-09	9.05E-07	1.32E-06	3.88E-07	1.13E-07	5.00E-03	NA	1.8E-04	2.6E-04	--	--	--
Exposure Pathway/Receptor Totals												4.2E-04	6.1E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-5

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	1.30E+00	3.86E-04	7.13E-04	1.66E-04	6.11E-05	5.02E-04	9.27E-04	2.15E-04	7.94E-05	5.00E-03	NA	1.0E-01	1.9E-01	--	--	--
Exposure Pathway/Receptor Totals												1.0E-01	1.9E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-6

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.60E-01	3.93E-05	7.07E-05	1.68E-05	6.06E-06	2.20E-05	3.96E-05	9.42E-06	3.39E-06	5.00E-04	NA	4.4E-02	7.9E-02	--	--	--
Selenium	9.10E-01	3.93E-05	7.07E-05	1.68E-05	6.06E-06	3.57E-05	6.43E-05	1.53E-05	5.51E-06	5.00E-03	NA	7.1E-03	1.3E-02	--	--	--
Exposure Pathway/Receptor Totals												5.1E-02	9.2E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-7

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.53E-01	5.36E-04	9.00E-04	2.30E-04	7.71E-05	1.89E-04	3.18E-04	8.10E-05	2.72E-05	5.00E-04	NA	3.8E-01	6.4E-01	--	--	--
Chromium	8.46E+00	5.36E-04	9.00E-04	2.30E-04	7.71E-05	4.53E-03	7.61E-03	1.94E-03	6.53E-04	1.50E+00	NA	3.0E-03	5.1E-03	--	--	--
Selenium	7.76E+00	5.36E-04	9.00E-04	2.30E-04	7.71E-05	4.16E-03	6.98E-03	1.78E-03	5.99E-04	5.00E-03	NA	8.3E-01	1.4E+00	--	--	--
Exposure Pathway/Receptor Totals												1.2E+00	2.0E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
LADD	Lifetime average daily dose
NA	Information not available
RfD	Reference dose

[1] ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-8

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF WATER CRESS

		ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD								
	EPC	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	RfD	Slope Factor	Hazard Index		Cancer Risk		
Chemical of Potential Concern	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Aluminum	4.50E+03	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.20E-03	1.20E-03	5.16E-04	1.03E-04	1.00E+00	NA	1.2E-03	1.2E-03	--	--	--
Antimony	1.00E+00	2.68E-07	2.68E-07	1.15E-07	2.29E-08	2.68E-07	2.68E-07	1.15E-07	2.29E-08	4.00E-04	NA	6.7E-04	6.7E-04	--	--	--
Arsenic	2.20E+00	2.68E-07	2.68E-07	1.15E-07	2.29E-08	5.89E-07	5.89E-07	2.52E-07	5.04E-08	3.00E-04	1.50E+00	2.0E-03	2.0E-03	3.8E-07	7.6E-08	4.5E-07
Cadmium	1.15E+01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	3.08E-06	3.08E-06	1.32E-06	2.64E-07	5.00E-04	NA	6.2E-03	6.2E-03	--	--	--
Chromium	4.52E+01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.21E-05	1.21E-05	5.18E-06	1.04E-06	1.50E+00	NA	8.1E-06	8.1E-06	--	--	--
Cobalt	2.40E+00	2.68E-07	2.68E-07	1.15E-07	2.29E-08	6.42E-07	6.42E-07	2.75E-07	5.50E-08	6.00E-02	NA	1.1E-05	1.1E-05	--	--	--
Copper	1.14E+01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	3.05E-06	3.05E-06	1.31E-06	2.61E-07	3.70E-02	NA	8.2E-05	8.2E-05	--	--	--
Nickel	2.39E+01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	6.39E-06	6.39E-06	2.74E-06	5.48E-07	2.00E-02	NA	3.2E-04	3.2E-04	--	--	--
Selenium	3.94E+01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.05E-05	1.05E-05	4.52E-06	9.03E-07	5.00E-03	NA	2.1E-03	2.1E-03	--	--	--
Vanadium	2.44E+01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	6.53E-06	6.53E-06	2.80E-06	5.59E-07	9.00E-03	NA	7.3E-04	7.3E-04	--	--	--
Zinc	1.62E+02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	4.33E-05	4.33E-05	1.86E-05	3.71E-06	3.00E-01	NA	1.4E-04	1.4E-04	--	--	--
Exposure Pathway/Receptor Totals												1.3E-02	1.3E-02	3.8E-07	7.6E-08	4.5E-07

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-9

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF WILD ONION

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Aluminum	2.28E+00	2.68E-07	2.68E-07	1.15E-07	2.29E-08	6.09E-07	6.09E-07	2.61E-07	5.22E-08	1.00E+00	NA	6.1E-07	6.1E-07	--	--	--
Arsenic	3.38E-03	2.68E-07	2.68E-07	1.15E-07	2.29E-08	9.05E-10	9.05E-10	3.88E-10	7.76E-11	3.00E-04	1.50E+00	3.0E-06	3.0E-06	5.8E-10	1.2E-10	7.0E-10
Cadmium	4.37E+00	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.17E-06	1.17E-06	5.01E-07	1.00E-07	5.00E-04	NA	2.3E-03	2.3E-03	--	--	--
Chromium	3.24E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	8.67E-09	8.67E-09	3.71E-09	7.43E-10	1.50E+00	NA	5.8E-09	5.8E-09	--	--	--
Cobalt	5.04E-03	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.35E-09	1.35E-09	5.78E-10	1.16E-10	6.00E-02	NA	2.2E-08	2.2E-08	--	--	--
Nickel	7.48E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	2.00E-08	2.00E-08	8.58E-09	1.72E-09	2.00E-02	NA	1.0E-06	1.0E-06	--	--	--
Selenium	4.32E-01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.16E-07	1.16E-07	4.95E-08	9.91E-09	5.00E-03	NA	2.3E-05	2.3E-05	--	--	--
Uranium	2.02E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	5.39E-09	5.39E-09	2.31E-09	4.62E-10	3.00E-03	NA	1.8E-06	1.8E-06	--	--	--
Vanadium	1.29E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	3.45E-09	3.45E-09	1.48E-09	2.96E-10	9.00E-03	NA	3.8E-07	3.8E-07	--	--	--
Zinc	9.48E+02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	2.54E-04	2.54E-04	1.09E-04	2.17E-05	3.00E-01	NA	8.5E-04	8.5E-04	--	--	--
Exposure Pathway/Receptor Totals												3.2E-03	3.2E-03	5.8E-10	1.2E-10	7.0E-10

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-10

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF WILD CARROT

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Aluminum	2.28E+00	2.68E-07	2.68E-07	1.15E-07	2.29E-08	6.09E-07	6.09E-07	2.61E-07	5.22E-08	1.00E+00	NA	6.1E-07	6.1E-07	--	--	--
Arsenic	3.38E-03	2.68E-07	2.68E-07	1.15E-07	2.29E-08	9.05E-10	9.05E-10	3.88E-10	7.76E-11	3.00E-04	1.50E+00	3.0E-06	3.0E-06	5.8E-10	1.2E-10	7.0E-10
Cadmium	4.37E+00	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.17E-06	1.17E-06	5.01E-07	1.00E-07	5.00E-04	NA	2.3E-03	2.3E-03	--	--	--
Chromium	3.24E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	8.67E-09	8.67E-09	3.71E-09	7.43E-10	1.50E+00	NA	5.8E-09	5.8E-09	--	--	--
Cobalt	5.04E-03	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.35E-09	1.35E-09	5.78E-10	1.16E-10	6.00E-02	NA	2.2E-08	2.2E-08	--	--	--
Nickel	7.48E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	2.00E-08	2.00E-08	8.58E-09	1.72E-09	2.00E-02	NA	1.0E-06	1.0E-06	--	--	--
Selenium	4.32E-01	2.68E-07	2.68E-07	1.15E-07	2.29E-08	1.16E-07	1.16E-07	4.95E-08	9.91E-09	5.00E-03	NA	2.3E-05	2.3E-05	--	--	--
Uranium	2.02E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	5.39E-09	5.39E-09	2.31E-09	4.62E-10	3.00E-03	NA	1.8E-06	1.8E-06	--	--	--
Vanadium	1.29E-02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	3.45E-09	3.45E-09	1.48E-09	2.96E-10	9.00E-03	NA	3.8E-07	3.8E-07	--	--	--
Zinc	9.48E+02	2.68E-07	2.68E-07	1.15E-07	2.29E-08	2.54E-04	2.54E-04	1.09E-04	2.17E-05	3.00E-01	NA	8.5E-04	8.5E-04	--	--	--
Exposure Pathway/Receptor Totals												3.2E-03	3.2E-03	5.8E-10	1.2E-10	7.0E-10

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-11

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC AND TERRESTRIAL PLANTS

	Ingestion of Watercress					Ingestion of Wild Onion					Ingestion of Wild Carrot					Ingestion of Aquatic and Terrestrial Plants - Total				
	Hazard Index		Cancer Risk			Hazard Index		Cancer Risk			Hazard Index		Cancer Risk			Hazard Index		Cancer Risk		
Chemical of Potential Concern	**ADULT**	**CHILD**	**ADULT**	**CHILD**	**TOTAL**	**ADULT**	**CHILD**	**ADULT**	**CHILD**	**TOTAL**	**ADULT**	**CHILD**	**ADULT**	**CHILD**	**TOTAL**	**ADULT**	**CHILD**	**ADULT**	**CHILD**	**TOTAL**
Aluminum	1.2E-03	1.2E-03	--	--	--	6.1E-07	6.1E-07	--	--	--	6.1E-07	6.1E-07	--	--	--	1.2E-03	1.2E-03	--	--	--
Antimony	6.7E-04	6.7E-04	--	--	--	0.0E+00	0.0E+00	--	--	--	0.0E+00	0.0E+00	--	--	--	6.7E-04	6.7E-04	--	--	--
Arsenic	2.0E-03	2.0E-03	3.8E-07	7.6E-08	4.5E-07	3.0E-06	3.0E-06	5.8E-10	1.2E-10	7.0E-10	3.0E-06	3.0E-06	5.8E-10	1.2E-10	7.0E-10	2.0E-03	2.0E-03	3.8E-07	7.6E-08	4.6E-07
Cadmium	6.2E-03	6.2E-03	--	--	--	2.3E-03	2.3E-03	--	--	--	2.3E-03	2.3E-03	--	--	--	1.1E-02	1.1E-02	--	--	--
Chromium	8.1E-06	8.1E-06	--	--	--	5.8E-09	5.8E-09	--	--	--	5.8E-09	5.8E-09	--	--	--	8.1E-06	8.1E-06	--	--	--
Cobalt	1.1E-05	1.1E-05	--	--	--	2.2E-08	2.2E-08	--	--	--	2.2E-08	2.2E-08	--	--	--	1.1E-05	1.1E-05	--	--	--
Copper	8.2E-05	8.2E-05	--	--	--	0.0E+00	0.0E+00	--	--	--	0.0E+00	0.0E+00	--	--	--	8.2E-05	8.2E-05	--	--	--
Nickel	3.2E-04	3.2E-04	--	--	--	1.0E-06	1.0E-06	--	--	--	1.0E-06	1.0E-06	--	--	--	3.2E-04	3.2E-04	--	--	--
Selenium	2.1E-03	2.1E-03	--	--	--	2.3E-05	2.3E-05	--	--	--	2.3E-05	2.3E-05	--	--	--	2.2E-03	2.2E-03	--	--	--
Uranium	0.0E+00	0.0E+00	--	--	--	1.8E-06	1.8E-06	--	--	--	1.8E-06	1.8E-06	--	--	--	3.6E-06	3.6E-06	--	--	--
Vanadium	7.3E-04	7.3E-04	--	--	--	3.8E-07	3.8E-07	--	--	--	3.8E-07	3.8E-07	--	--	--	7.3E-04	7.3E-04	--	--	--
Zinc	1.4E-04	1.4E-04	--	--	--	8.5E-04	8.5E-04	--	--	--	8.5E-04	8.5E-04	--	--	--	1.8E-03	1.8E-03	--	--	--
Exposure Pathway/Receptor Totals	1.3E-02	1.3E-02	3.8E-07	7.6E-08	4.5E-07	3.2E-03	3.2E-03	5.8E-10	1.2E-10	7.0E-10	3.2E-03	3.2E-03	5.8E-10	1.2E-10	7.0E-10	2.0E-02	2.0E-02	3.8E-07	7.6E-08	4.6E-07

Note:

-- Information is not available.

TABLE E-12

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF TEA

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Aluminum	9.82E-02	1.03E-03	5.67E-04	4.41E-04	4.86E-05	1.01E-04	5.57E-05	4.33E-05	4.77E-06	1.00E+00	NA	1.0E-04	5.6E-05	--	--	--
Arsenic	4.20E-04	1.03E-03	5.67E-04	4.41E-04	4.86E-05	4.32E-07	2.38E-07	1.85E-07	2.04E-08	3.00E-04	1.50E+00	1.4E-03	7.9E-04	2.8E-07	3.1E-08	3.1E-07
Cadmium	4.15E-01	1.03E-03	5.67E-04	4.41E-04	4.86E-05	4.27E-04	2.35E-04	1.83E-04	2.02E-05	5.00E-04	NA	8.5E-01	4.7E-01	--	--	--
Chromium	1.00E-03	1.03E-03	5.67E-04	4.41E-04	4.86E-05	1.03E-06	5.69E-07	4.43E-07	4.88E-08	1.50E+00	NA	6.9E-07	3.8E-07	--	--	--
Cobalt	1.79E-04	1.03E-03	5.67E-04	4.41E-04	4.86E-05	1.84E-07	1.01E-07	7.87E-08	8.67E-09	6.00E-02	NA	3.1E-06	1.7E-06	--	--	--
Nickel	6.82E-03	1.03E-03	5.67E-04	4.41E-04	4.86E-05	7.02E-06	3.87E-06	3.01E-06	3.31E-07	2.00E-02	NA	3.5E-04	1.9E-04	--	--	--
Selenium	7.14E-03	1.03E-03	5.67E-04	4.41E-04	4.86E-05	7.35E-06	4.05E-06	3.15E-06	3.47E-07	5.00E-03	NA	1.5E-03	8.1E-04	--	--	--
Vanadium	4.09E-04	1.03E-03	5.67E-04	4.41E-04	4.86E-05	4.21E-07	2.32E-07	1.80E-07	1.99E-08	9.00E-03	NA	4.7E-05	2.6E-05	--	--	--
Zinc	4.90E+00	1.03E-03	5.67E-04	4.41E-04	4.86E-05	5.04E-03	2.78E-03	2.16E-03	2.38E-04	3.00E-01	NA	1.7E-02	9.3E-03	--	--	--
Exposure Pathway/Receptor Totals												8.7E-01	4.8E-01	2.8E-07	3.1E-08	3.1E-07

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-13

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
ADULT TOTAL HAZARD AND RISK

ADULT TOTAL HAZARD

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of water cress	Ingestion of wild onion	Ingestion of wild carrot	Total injestion of terrestrial and aquatic vegetation	Ingestion of tea	TOTAL
Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	6.1E-07	6.1E-07	1.2E-03	1.0E-04	1.3E-03
Antimony	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.7E-04	0.0E+00	0.0E+00	6.7E-04	0.0E+00	6.7E-04
Arsenic	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-03	3.0E-06	3.0E-06	2.0E-03	1.4E-03	3.4E-03
Beryllium	8.4E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	0.0E+00	2.6E-07
Boron	3.1E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	0.0E+00	9.5E-09
Cadmium	--	3.4E-04	3.9E-04	2.4E-04	0.0E+00	4.4E-02	3.8E-01	6.2E-03	2.3E-03	2.3E-03	1.1E-02	8.5E-01	1.3E+00
Chromium	1.2E-04	1.7E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-03	8.1E-06	5.8E-09	5.8E-09	8.1E-06	6.9E-07	3.1E-03
Cobalt	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-05	2.2E-08	2.2E-08	1.1E-05	3.1E-06	1.4E-05
Copper	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.2E-05	0.0E+00	0.0E+00	8.2E-05	0.0E+00	8.2E-05
Nickel	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E-04	1.0E-06	1.0E-06	3.2E-04	3.5E-04	6.7E-04
Selenium	--	1.3E-01	1.3E-04	1.8E-04	1.0E-01	7.1E-03	8.3E-01	2.1E-03	2.3E-05	2.3E-05	2.2E-03	1.5E-03	1.1E+00
Uranium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-06	1.8E-06	3.6E-06	0.0E+00	3.6E-06
Vanadium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-04	3.8E-07	3.8E-07	7.3E-04	4.7E-05	7.7E-04
Zinc	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-04	8.5E-04	8.5E-04	1.8E-03	1.7E-02	1.9E-02
Exposure Pathway/Receptor Totals	1.2E-04	1.3E-01	5.2E-04	4.2E-04	1.0E-01	5.1E-02	1.2E+00	1.3E-02	3.2E-03	3.2E-03	2.0E-02	8.7E-01	2.4E+00

ADULT TOTAL RISK

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of water cress	Ingestion of wild onion	Ingestion of wild carrot	Total injestion of terrestrial and aquatic vegetation	Ingestion of tea	TOTAL
Arsenic	1.1E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.8E-07	5.8E-10	5.8E-10	3.8E-07	2.8E-07	6.6E-07
Beryllium	1.7E-11	--	--	--	--	--	--	--	--	--	--	--	1.7E-11
Cadmium	7.4E-10	--	--	--	--	--	--	--	--	--	--	--	7.4E-10
Chromium	4.3E-07	--	--	--	--	--	--	--	--	--	--	--	4.3E-07
Nickel	7.7E-10	--	--	--	--	--	--	--	--	--	--	--	7.7E-10
Exposure Pathway/ Receptor Totals	4.3E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.8E-07	5.8E-10	5.8E-10	3.8E-07	2.8E-07	1.1E-06

Note:

-- Information not available.

TABLE E-14

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
CHILD TOTAL HAZARD AND RISK

(Page 1 of 1)

CHILD TOTAL HAZARD

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of water cress	Ingestion of wild onion	Ingestion of wild carrot	Total injestion of terrestrial and aquatic vegetation	Ingestion of tea	TOTAL
Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	6.1E-07	6.1E-07	1.2E-03	5.6E-05	1.3E-03
Antimony	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.7E-04	0.0E+00	0.0E+00	6.7E-04	0.0E+00	6.7E-04
Arsenic	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-03	3.0E-06	3.0E-06	2.0E-03	7.9E-04	2.8E-03
Beryllium	3.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	0.0E+00	3.0E-06
Boron	1.1E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	0.0E+00	1.1E-07
Cadmium	--	1.0E-03	5.6E-04	3.5E-04	0.0E+00	7.9E-02	6.4E-01	6.2E-03	2.3E-03	2.3E-03	1.1E-02	4.7E-01	1.2E+00
Chromium	4.2E-04	5.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E-03	8.1E-06	5.8E-09	5.8E-09	8.1E-06	3.8E-07	5.5E-03
Cobalt	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-05	2.2E-08	2.2E-08	1.1E-05	1.7E-06	1.2E-05
Copper	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.2E-05	0.0E+00	0.0E+00	8.2E-05	0.0E+00	8.2E-05
Nickel	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E-04	1.0E-06	1.0E-06	3.2E-04	1.9E-04	5.2E-04
Selenium	--	3.7E-01	1.9E-04	2.6E-04	1.9E-01	1.3E-02	1.4E+00	2.1E-03	2.3E-05	2.3E-05	2.2E-03	8.1E-04	2.0E+00
Uranium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-06	1.8E-06	3.6E-06	0.0E+00	3.6E-06
Vanadium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-04	3.8E-07	3.8E-07	7.3E-04	2.6E-05	7.5E-04
Zinc	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-04	8.5E-04	8.5E-04	1.8E-03	9.3E-03	1.1E-02
Exposure Pathway/Receptor Totals	4.2E-04	3.8E-01	7.5E-04	6.1E-04	1.9E-01	9.2E-02	2.0E+00	1.3E-02	3.2E-03	3.2E-03	2.0E-02	4.8E-01	3.2E+00

CHILD TOTAL RISK

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of water cress	Ingestion of wild onion	Ingestion of wild carrot	Total ingestion of terrestrial and aquatic vegetation	Ingestion of tea	TOTAL
Arsenic	8.0E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.6E-08	1.2E-10	1.2E-10	7.6E-08	3.1E-08	1.1E-07
Beryllium	1.2E-11	--	--	--	--	--	--	--	--	--	--	--	1.2E-11
Cadmium	5.2E-10	--	--	--	--	--	--	--	--	--	--	--	5.2E-10
Chromium	3.0E-07	--	--	--	--	--	--	--	--	--	--	--	3.0E-07
Nickel	5.4E-10	--	--	--	--	--	--	--	--	--	--	--	5.4E-10
Exposure Pathway/Receptor Totals	3.0E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.6E-08	1.2E-10	1.2E-10	7.6E-08	3.1E-08	4.1E-07

Note:

-- Information is not available.

TABLE E-15

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
RISK GRAND TOTAL

Chemical of Potential Concern	RISK GRAND TOTAL											
	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of water cress	Ingestion of wild onion	Ingestion of wild carrot	Ingestion of tea	TOTAL
Arsenic	1.9E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E-07	7.0E-10	7.0E-10	3.1E-07	7.7E-07
Beryllium	2.9E-11	--	--	--	--	--	--	--	--	--	--	2.9E-11
Cadmium	1.3E-09	--	--	--	--	--	--	--	--	--	--	1.3E-09
Chromium	7.3E-07	--	--	--	--	--	--	--	--	--	--	7.3E-07
Nickel	1.3E-09	--	--	--	--	--	--	--	--	--	--	1.3E-09
Exposure Pathway/Receptor Totals	7.3E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E-07	7.0E-10	7.0E-10	3.1E-07	1.5E-06

Note:

-- Information is not available.

TABLE E-16

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INHALATION OF PARTICULATES

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfDi	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Antimony	2.30E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	5.28E-11	1.85E-10	2.26E-11	1.58E-11	NA	NA	--	--	--	--	--
Arsenic	7.70E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.77E-10	6.18E-10	7.57E-11	5.30E-11	NA	1.50E+01	--	--	1.1E-09	8.0E-10	1.9E-09
Beryllium	2.10E+00	2.29E-12	8.03E-12	9.83E-13	6.88E-13	4.82E-12	1.69E-11	2.07E-12	1.45E-12	5.71E-06	8.40E+00	8.4E-07	3.0E-06	1.7E-11	1.2E-11	2.9E-11
Boron	7.60E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.74E-10	6.10E-10	7.47E-11	5.23E-11	5.71E-03	NA	3.1E-08	1.1E-07	--	--	--
Cadmium	1.20E+02	2.29E-12	8.03E-12	9.83E-13	6.88E-13	2.75E-10	9.64E-10	1.18E-10	8.26E-11	NA	6.30E+00	--	--	7.4E-10	5.2E-10	1.3E-09
Chromium	1.50E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	3.44E-09	1.20E-08	1.48E-09	1.03E-09	2.86E-05	2.90E+02	1.2E-04	4.2E-04	4.3E-07	3.0E-07	7.3E-07
Copper	2.10E+02	2.29E-12	8.03E-12	9.83E-13	6.88E-13	4.82E-10	1.69E-09	2.07E-10	1.45E-10	NA	NA	--	--	--	--	--
Molybdenum	6.50E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.49E-10	5.22E-10	6.39E-11	4.47E-11	NA	NA	--	--	--	--	--
Nickel	4.60E+02	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.06E-09	3.69E-09	4.52E-10	3.17E-10	NA	1.70E+00	--	--	7.7E-10	5.4E-10	1.3E-09
Selenium	1.50E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	3.44E-09	1.20E-08	1.48E-09	1.03E-09	NA	NA	--	--	--	--	--
Silver	7.76E+00	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.78E-11	6.23E-11	7.63E-12	5.34E-12	NA	NA	--	--	--	--	--
Uranium	6.30E+01	2.29E-12	8.03E-12	9.83E-13	6.88E-13	1.45E-10	5.06E-10	6.20E-11	4.34E-11	NA	NA	--	--	--	--	--
Vanadium	1.20E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	2.75E-09	9.64E-09	1.18E-09	8.26E-10	NA	NA	--	--	--	--	--
Zinc	2.00E+03	2.29E-12	8.03E-12	9.83E-13	6.88E-13	4.59E-09	1.61E-08	1.97E-09	1.38E-09	NA	NA	--	--	--	--	--
Exposure Pathway/Receptor Totals												1.2E-04	4.2E-04	4.3E-07	3.0E-07	7.3E-07

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfDi	Reference dose inhalation

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-17

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.10E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.71E-07	5.10E-07	7.33E-08	4.37E-08	5.00E-04	NA	3.4E-04	1.0E-03	--	--	--
Chromium	4.60E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.54E-06	7.56E-06	1.09E-06	6.48E-07	1.50E+00	NA	1.7E-06	5.0E-06	--	--	--
Selenium	1.14E+00	5.52E-04	1.64E-03	2.37E-04	1.41E-04	6.29E-04	1.87E-03	2.70E-04	1.61E-04	5.00E-03	NA	1.3E-01	3.7E-01	--	--	--
Exposure Pathway/Receptor Totals												1.3E-01	3.8E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-18

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF ELK & WILD GAME - SKELETAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	2.78E-01	7.54E-06	1.10E-05	3.23E-06	9.40E-07	2.10E-06	3.05E-06	8.98E-07	2.61E-07	5.00E-04	NA	4.2E-03	6.1E-03	--	--	--
Selenium	9.20E-01	7.54E-06	1.10E-05	3.23E-06	9.40E-07	6.94E-06	1.01E-05	2.97E-06	8.64E-07	5.00E-03	NA	1.4E-03	2.0E-03	--	--	--
Exposure Pathway/Receptor Totals												5.6E-03	8.1E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-19

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF ELK & WILD GAME - OFFAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.70E+00	2.90E-07	1.16E-06	1.24E-07	9.94E-08	4.93E-07	1.97E-06	2.11E-07	1.69E-07	5.00E-04	NA	9.9E-04	3.9E-03	--	--	--
Selenium	1.30E+01	2.90E-07	1.16E-06	1.24E-07	9.94E-08	3.77E-06	1.51E-05	1.62E-06	1.29E-06	5.00E-03	NA	7.5E-04	3.0E-03	--	--	--
Exposure Pathway/Receptor Totals												1.7E-03	7.0E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-20

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	1.30E+00	3.14E-04	5.86E-04	1.35E-04	5.02E-05	4.08E-04	7.61E-04	1.75E-04	6.53E-05	5.00E-03	NA	8.2E-02	1.5E-01	--	--	--
Exposure Pathway/Receptor Totals												8.2E-02	1.5E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-21

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.60E-01	1.40E-05	6.59E-05	5.99E-06	5.65E-06	7.82E-06	3.69E-05	3.35E-06	3.17E-06	5.00E-04	NA	1.6E-02	7.4E-02	--	--	--
Selenium	9.10E-01	1.40E-05	6.59E-05	5.99E-06	5.65E-06	1.27E-05	6.00E-05	5.45E-06	5.14E-06	5.00E-03	NA	2.5E-03	1.2E-02	--	--	--
Exposure Pathway/Receptor Totals												1.8E-02	8.6E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-22

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.53E-01	3.57E-04	6.00E-04	1.53E-04	5.14E-05	1.26E-04	2.12E-04	5.40E-05	1.82E-05	5.00E-04	NA	2.5E-01	4.2E-01	--	--	--
Chromium	8.46E+00	3.57E-04	6.00E-04	1.53E-04	5.14E-05	3.02E-03	5.08E-03	1.29E-03	4.35E-04	1.50E+00	NA	2.0E-03	3.4E-03	--	--	--
Selenium	7.76E+00	3.57E-04	6.00E-04	1.53E-04	5.14E-05	2.77E-03	4.66E-03	1.19E-03	3.99E-04	5.00E-03	NA	5.5E-01	9.3E-01	--	--	--
Exposure Pathway/Receptor Totals												8.1E-01	1.4E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-23

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
ADULT TOTAL HAZARD AND RISK

ADULT TOTAL HAZARD								
Chemical of Potential Concern	**Inhalation of particulates**	**Ingestion of surface water**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life**	**TOTAL**
Beryllium	8.4E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.4E-07
Boron	3.1E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E-08
Cadmium	--	3.4E-04	4.2E-03	9.9E-04	0.0E+00	1.6E-02	2.5E-01	2.7E-01
Chromium	1.2E-04	1.7E-06	0.0E+00	6.8E-08	0.0E+00	0.0E+00	2.0E-03	2.1E-03
Selenium	--	1.3E-01	1.4E-03	7.5E-04	8.2E-02	2.5E-03	5.5E-01	7.7E-01
Exposure Pathway/Receptor Totals	1.2E-04	1.3E-01	5.6E-03	1.7E-03	8.2E-02	1.8E-02	8.1E-01	1.0E+00

ADULT TOTAL RISK								
Chemical of Potential Concern	**Inhalation of particulates**	**Ingestion of surface water**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life**	**TOTAL**
Arsenic	1.1E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-09
Beryllium	1.7E-11	--	--	--	--	--	--	1.7E-11
Cadmium	7.4E-10	--	--	--	--	--	--	7.4E-10
Chromium	4.3E-07	--	--	--	--	--	--	4.3E-07
Nickel	7.7E-10	--	--	--	--	--	--	7.7E-10
Exposure Pathway/Receptor Totals	4.3E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-07

Note:

-- Information not available.

TABLE E-24

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
CHILD TOTAL HAZARD AND RISK

CHILD TOTAL HAZARD

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	TOTAL
Beryllium	3.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-06
Boron	1.1E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-07
Cadmium	--	1.0E-03	6.1E-03	3.9E-03	0.0E+00	7.4E-02	4.2E-01	5.1E-01
Chromium	4.2E-04	5.0E-06	0.0E+00	2.7E-07	0.0E+00	0.0E+00	3.4E-03	3.8E-03
Selenium	--	3.7E-01	2.0E-03	3.0E-03	1.5E-01	1.2E-02	9.3E-01	1.5E+00
Exposure Pathway/Receptor Totals	4.2E-04	3.8E-01	8.1E-03	7.0E-03	1.5E-01	8.6E-02	1.4E+00	2.0E+00

CHILD TOTAL RISK

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	TOTAL
Antimony	--	--	--	--	--	--	--	--
Arsenic	8.0E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.0E-10
Beryllium	1.2E-11	--	--	--	--	--	--	1.2E-11
Cadmium	5.2E-10	--	--	--	--	--	--	5.2E-10
Chromium	3.0E-07	--	--	--	--	--	--	3.0E-07
Nickel	5.4E-10	--	--	--	--	--	--	5.4E-10
Exposure Pathway/Receptor Totals	3.0E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-07

Note:

-- Information not available.

TABLE E-25

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
RISK GRAND TOTAL

RISK GRAND TOTAL								
Chemical of Potential Concern	**Inhalation of particulates**	**Ingestion of surface water**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life**	**TOTAL**
Arsenic	1.9E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-09
Beryllium	2.9E-11	--	--	--	--	--	--	2.9E-11
Cadmium	1.3E-09	--	--	--	--	--	--	1.3E-09
Chromium	7.3E-07	--	--	--	--	--	--	7.3E-07
Nickel	1.3E-09	--	--	--	--	--	--	1.3E-09
Exposure Pathway/Receptor Totals	7.3E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-07

Note:

-- Information is not available.

TABLE E-26

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INHALATION OF PARTICULATES

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfDi	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Antimony	2.30E+01	6.50E-12	2.28E-11	2.79E-12	1.95E-12	1.50E-10	5.23E-10	6.41E-11	4.49E-11	NA	NA	--	--	--	--	--
Arsenic	7.70E+01	6.50E-12	2.28E-11	2.79E-12	1.95E-12	5.01E-10	1.75E-09	2.15E-10	1.50E-10	NA	1.50E+01	--	--	3.2E-09	3.2E-09	6.4E-09
Beryllium	2.10E+00	6.50E-12	2.28E-11	2.79E-12	1.95E-12	1.37E-11	4.78E-11	5.85E-12	4.10E-12	5.71E-06	8.40E+00	2.4E-06	8.4E-06	4.9E-11	4.9E-11	9.8E-11
Boron	7.60E+01	6.50E-12	2.28E-11	2.79E-12	1.95E-12	4.94E-10	1.73E-09	2.12E-10	1.48E-10	5.71E-03	NA	8.7E-08	3.0E-07	--	--	--
Cadmium	1.20E+02	6.50E-12	2.28E-11	2.79E-12	1.95E-12	7.80E-10	2.73E-09	3.34E-10	2.34E-10	NA	6.30E+00	--	--	2.1E-09	2.1E-09	4.2E-09
Chromium	1.50E+03	6.50E-12	2.28E-11	2.79E-12	1.95E-12	9.75E-09	3.41E-08	4.18E-09	2.93E-09	2.86E-05	2.90E+02	3.4E-04	1.2E-03	1.2E-06	1.2E-06	2.4E-06
Copper	2.10E+02	6.50E-12	2.28E-11	2.79E-12	1.95E-12	1.37E-09	4.78E-09	5.85E-10	4.10E-10	NA	NA	--	--	--	--	--
Molybdenum	6.50E+01	6.50E-12	2.28E-11	2.79E-12	1.95E-12	4.23E-10	1.48E-09	1.81E-10	1.27E-10	NA	NA	--	--	--	--	--
Nickel	4.60E+02	6.50E-12	2.28E-11	2.79E-12	1.95E-12	2.99E-09	1.05E-08	1.28E-09	8.97E-10	NA	1.70E+00	--	--	2.2E-09	2.2E-09	4.4E-09
Selenium	1.50E+03	6.50E-12	2.28E-11	2.79E-12	1.95E-12	9.75E-09	3.41E-08	4.18E-09	2.93E-09	NA	NA	--	--	--	--	--
Silver	1.30E+01	6.50E-12	2.28E-11	2.79E-12	1.95E-12	8.45E-11	2.96E-10	3.62E-11	2.54E-11	NA	NA	--	--	--	--	--
Uranium	6.30E+01	6.50E-12	2.28E-11	2.79E-12	1.95E-12	4.10E-10	1.43E-09	1.76E-10	1.23E-10	NA	NA	--	--	--	--	--
Vanadium	1.20E+03	6.50E-12	2.28E-11	2.79E-12	1.95E-12	7.80E-09	2.73E-08	3.34E-09	2.34E-09	NA	NA	--	--	--	--	--
Zinc	2.00E+03	6.50E-12	2.28E-11	2.79E-12	1.95E-12	1.30E-08	4.55E-08	5.57E-09	3.90E-09	NA	NA	--	--	--	--	--
Exposure Pathway/Receptor Totals												3.4E-04	1.2E-03	1.2E-06	1.2E-06	2.4E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfDi	Reference dose inhalation

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-27

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.10E-04	1.56E-03	4.66E-03	6.70E-04	3.99E-04	4.85E-07	1.44E-06	2.08E-07	1.24E-07	5.00E-04	NA	9.7E-04	2.9E-03	--	--	--
Chromium	4.60E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	7.19E-06	2.14E-05	3.08E-06	1.84E-06	1.50E+00	NA	4.8E-06	1.4E-05	--	--	--
Selenium	1.14E+00	1.56E-03	4.66E-03	6.70E-04	3.99E-04	1.78E-03	5.31E-03	7.64E-04	4.55E-04	5.00E-03	NA	3.6E-01	1.1E+00	--	--	--
Exposure Pathway/Receptor Totals												3.6E-01	1.1E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-28

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF ELK AND WILDGAME - SKELETAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	2.78E-01	9.28E-05	2.41E-04	3.98E-05	2.06E-05	2.58E-05	6.69E-05	1.11E-05	5.74E-06	5.00E-04	NA	5.2E-02	1.3E-01	--	--	--
Selenium	9.20E-01	9.28E-05	2.41E-04	3.98E-05	2.06E-05	8.54E-05	2.21E-04	3.66E-05	1.90E-05	5.00E-03	NA	1.7E-02	4.4E-02	--	--	--
Exposure Pathway/Receptor Totals												6.9E-02	1.8E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-29

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF ELK AND WILDGAME - OFFAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.70E+00	2.90E-07	1.16E-06	1.24E-07	9.94E-08	4.93E-07	1.97E-06	2.11E-07	1.69E-07	5.00E-04	NA	9.9E-04	3.9E-03	--	--	--
Selenium	1.30E+01	2.90E-07	1.16E-06	1.24E-07	9.94E-08	3.77E-06	1.51E-05	1.62E-06	1.29E-06	5.00E-03	NA	7.5E-04	3.0E-03	--	--	--
Exposure Pathway/Receptor Totals												1.7E-03	7.0E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-30

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	1.30E+00	3.17E-04	5.86E-04	1.36E-04	5.02E-05	4.12E-04	7.61E-04	1.77E-04	6.53E-05	5.00E-03	NA	8.2E-02	1.5E-01	--	--	--
Exposure Pathway/Receptor Totals												8.2E-02	1.5E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-31

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.60E-01	1.40E-05	6.59E-05	5.99E-06	5.65E-06	7.82E-06	3.69E-05	3.35E-06	3.17E-06	5.00E-04	NA	1.6E-02	7.4E-02	--	--	--
Selenium	9.10E-01	1.40E-05	6.59E-05	5.99E-06	5.65E-06	1.27E-05	6.00E-05	5.45E-06	5.14E-06	5.00E-03	NA	2.5E-03	1.2E-02	--	--	--
Exposure Pathway/Receptor Totals												1.8E-02	8.6E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-32

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.53E-01	2.43E-03	4.08E-03	1.04E-03	3.50E-04	8.57E-04	1.44E-03	3.67E-04	1.23E-04	5.00E-04	NA	1.7E+00	2.9E+00	--	--	--
Chromium	8.46E+00	2.43E-03	4.08E-03	1.04E-03	3.50E-04	2.05E-02	3.45E-02	8.81E-03	2.96E-03	1.50E+00	NA	1.4E-02	2.3E-02	--	--	--
Selenium	7.76E+00	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.88E-02	3.17E-02	8.08E-03	2.71E-03	5.00E-03	NA	3.8E+00	6.3E+00	--	--	--
Exposure Pathway/Receptor Totals												5.5E+00	9.2E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-33

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	2.90E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	3.97E-05	3.71E-04	1.70E-05	3.18E-05	3.00E-04	1.50E+00	1.3E-01	1.2E+00	2.6E-05	4.8E-05	7.3E-05
Cadmium	6.30E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	8.63E-05	8.05E-04	3.70E-05	6.90E-05	5.00E-04	NA	1.7E-01	1.6E+00	--	--	--
Chromium	9.70E+02	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.33E-03	1.24E-02	5.69E-04	1.06E-03	1.50E+00	NA	8.9E-04	8.3E-03	--	--	--
Selenium	1.50E+02	1.37E-06	1.28E-05	5.87E-07	1.10E-06	2.05E-04	1.92E-03	8.81E-05	1.64E-04	5.00E-03	NA	4.1E-02	3.8E-01	--	--	--
Exposure Pathway/Receptor Totals												3.5E-01	3.3E+00	2.6E-05	4.8E-05	7.3E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-34

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF TERRESTRIAL PLANTS/HOMEGROWN PRODUCE - ABOVEGROUND

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Aluminum	1.48E+00	8.70E-07	1.12E-06	3.73E-07	9.60E-08	1.28E-06	1.65E-06	5.50E-07	1.42E-07	1.00E+00	NA	1.3E-06	1.7E-06	--	--	--
Arsenic	2.98E-03	8.70E-07	1.12E-06	3.73E-07	9.60E-08	2.59E-09	3.33E-09	1.11E-09	2.86E-10	3.00E-04	1.50E+00	8.6E-06	1.1E-05	1.7E-09	4.3E-10	2.1E-09
Cadmium	5.75E+00	8.70E-07	1.12E-06	3.73E-07	9.60E-08	5.00E-06	6.44E-06	2.14E-06	5.52E-07	5.00E-04	NA	1.0E-02	1.3E-02	--	--	--
Chromium	2.64E-02	8.70E-07	1.12E-06	3.73E-07	9.60E-08	2.29E-08	2.95E-08	9.83E-09	2.53E-09	1.50E+00	NA	1.5E-08	2.0E-08	--	--	--
Cobalt	3.11E-03	8.70E-07	1.12E-06	3.73E-07	9.60E-08	2.71E-09	3.49E-09	1.16E-09	2.99E-10	6.00E-02	NA	4.5E-08	5.8E-08	--	--	--
Nickel	8.01E-02	8.70E-07	1.12E-06	3.73E-07	9.60E-08	6.97E-08	8.97E-08	2.99E-08	7.69E-09	2.00E-02	NA	3.5E-06	4.5E-06	--	--	--
Selenium	3.51E-01	8.70E-07	1.12E-06	3.73E-07	9.60E-08	3.05E-07	3.93E-07	1.31E-07	3.37E-08	5.00E-03	NA	6.1E-05	7.9E-05	--	--	--
Uranium	1.47E-02	8.70E-07	1.12E-06	3.73E-07	9.60E-08	1.28E-08	1.64E-08	5.46E-09	1.41E-09	3.00E-03	NA	4.3E-06	5.5E-06	--	--	--
Vanadium	9.96E-03	8.70E-07	1.12E-06	3.73E-07	9.60E-08	8.67E-09	1.12E-08	3.71E-09	9.56E-10	9.00E-03	NA	9.6E-07	1.2E-06	--	--	--
Zinc	5.69E+01	8.70E-07	1.12E-06	3.73E-07	9.60E-08	4.95E-05	6.37E-05	2.12E-05	5.46E-06	3.00E-01	NA	1.6E-04	2.1E-04	--	--	--
Exposure Pathway/Receptor Totals												1.0E-02	1.3E-02	1.7E-09	4.3E-10	2.1E-09

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-35

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF TERRESTRIAL PLANTS/HOMEGROWN PRODUCE - BELOW GROUND

Chemical of Potential Concern	EPC (mg/kg)	ADD Exposure Factor[1] ADULT (mg/kg/day)	ADD Exposure Factor[1] CHILD (mg/kg/day)	LADD Exposure Factor[1] ADULT (mg/kg/day)	LADD Exposure Factor[1] CHILD (mg/kg/day)	ADD ADULT (mg/kg/day)	ADD CHILD (mg/kg/day)	LADD ADULT (mg/kg/day)	LADD CHILD (mg/kg/day)	RfD (mg/kg/day)	Slope Factor (mg/kg/day)-1	Hazard Index ADULT	Hazard Index CHILD	Cancer Risk ADULT	Cancer Risk CHILD	Cancer Risk TOTAL
Aluminum	6.44E-01	1.40E-07	2.20E-07	6.00E-08	1.89E-08	9.01E-08	1.42E-07	3.86E-08	1.21E-08	1.00E+00	NA	9.0E-08	1.4E-07	--	--	--
Arsenic	3.76E-03	1.40E-07	2.20E-07	6.00E-08	1.89E-08	5.26E-10	8.27E-10	2.26E-10	7.09E-11	3.00E-04	1.50E+00	1.8E-06	2.8E-06	3.4E-10	1.1E-10	4.4E-10
Cadmium	2.94E+00	1.40E-07	2.20E-07	6.00E-08	1.89E-08	4.12E-07	6.48E-07	1.77E-07	5.55E-08	5.00E-04	NA	8.2E-04	1.3E-03	--	--	--
Chromium	2.43E-02	1.40E-07	2.20E-07	6.00E-08	1.89E-08	3.40E-09	5.35E-09	1.46E-09	4.58E-10	1.50E+00	NA	2.3E-09	3.6E-09	--	--	--
Cobalt	2.52E-03	1.40E-07	2.20E-07	6.00E-08	1.89E-08	3.53E-10	5.54E-10	1.51E-10	4.75E-11	6.00E-02	NA	5.9E-09	9.2E-09	--	--	--
Nickel	6.88E-02	1.40E-07	2.20E-07	6.00E-08	1.89E-08	9.63E-09	1.51E-08	4.13E-09	1.30E-09	2.00E-02	NA	4.8E-07	7.6E-07	--	--	--
Selenium	3.96E-01	1.40E-07	2.20E-07	6.00E-08	1.89E-08	5.54E-08	8.71E-08	2.38E-08	7.47E-09	5.00E-03	NA	1.1E-05	1.7E-05	--	--	--
Uranium	1.28E-02	1.40E-07	2.20E-07	6.00E-08	1.89E-08	1.79E-09	2.82E-09	7.68E-10	2.41E-10	3.00E-03	NA	6.0E-07	9.4E-07	--	--	--
Vanadium	9.00E-03	1.40E-07	2.20E-07	6.00E-08	1.89E-08	1.26E-09	1.98E-09	5.40E-10	1.70E-10	9.00E-03	NA	1.4E-07	2.2E-07	--	--	--
Zinc	3.48E+01	1.40E-07	2.20E-07	6.00E-08	1.89E-08	4.87E-06	7.65E-06	2.09E-06	6.55E-07	3.00E-01	NA	1.6E-05	2.5E-05	--	--	--
Exposure Pathway/Receptor Totals												8.5E-04	1.3E-03	3.4E-10	1.1E-10	4.4E-10

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-36

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF TERRESTRIAL PLANTS/HOMEGROWN PRODUCE - TOTAL

	Ingestion of Homegrown Produce - Aboveground					Ingestion of Homegrown Produce - Belowground					Ingestion of Homegrown Produce - Total				
	Hazard Index		Cancer Risk			Hazard Index		Cancer Risk			Hazard Index		Cancer Risk		
Chemical of Potential Concern	**ADULT**	**CHILD**	**ADULT**	**CHILD**	**TOTAL**	**ADULT**	**CHILD**	**ADULT**	**CHILD**	**TOTAL**	**ADULT**	**CHILD**	**ADULT**	**CHILD**	**TOTAL**
Aluminum	1.28E-06	1.65E-06	--	--	--	9.01E-08	1.42E-07	--	--	--	1.37E-06	1.79E-06	--	--	--
Arsenic	8.6E-06	1.1E-05	1.7E-09	4.3E-10	2.1E-09	1.8E-06	2.8E-06	3.4E-10	1.1E-10	4.4E-10	1.0E-05	1.4E-05	2.0E-09	5.3E-10	2.5E-09
Cadmium	1.0E-02	1.3E-02	--	--	--	8.2E-04	1.3E-03	--	--	--	1.1E-02	1.4E-02	--	--	--
Chromium	1.5E-08	2.0E-08	--	--	--	2.3E-09	3.6E-09	--	--	--	1.8E-08	2.3E-08	--	--	--
Cobalt	4.5E-08	5.8E-08	--	--	--	5.9E-09	9.2E-09	--	--	--	5.1E-08	6.7E-08	--	--	--
Nickel	3.5E-06	4.5E-06	--	--	--	4.8E-07	7.6E-07	--	--	--	4.0E-06	5.2E-06	--	--	--
Selenium	6.1E-05	7.9E-05	--	--	--	1.1E-05	1.7E-05	--	--	--	7.2E-05	9.6E-05	--	--	--
Uranium	4.3E-06	5.5E-06	--	--	--	6.0E-07	9.4E-07	--	--	--	4.8E-06	6.4E-06	--	--	--
Vanadium	9.6E-07	1.2E-06	--	--	--	1.4E-07	2.2E-07	--	--	--	1.1E-06	1.5E-06	--	--	--
Zinc	1.6E-04	2.1E-04	--	--	--	1.6E-05	2.5E-05	--	--	--	1.8E-04	2.4E-04	--	--	--
Exposure Pathway/Receptor Totals	1.0E-02	1.3E-02	1.7E-09	4.3E-10	2.1E-09	8.5E-04	1.3E-03	3.4E-10	1.1E-10	4.4E-10	1.1E-02	1.5E-02	2.0E-09	5.3E-10	2.5E-09

Note:

-- Information is not available.

TABLE E-37

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
ADULT TOTAL HAZARD AND RISK

ADULT TOTAL HAZARD

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of surface soil	Ingestion of aboveground produce	Ingestion of belowground produce	TOTAL
Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E-06	9.0E-08	1.4E-06
Arsenic	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E-01	8.6E-06	1.8E-06	1.3E-01
Beryllium	2.4E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.4E-06
Boron	8.7E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.7E-08
Cadmium	--	9.7E-04	5.2E-02	9.9E-04	0.0E+00	1.6E-02	1.7E+00	1.7E-01	1.0E-02	8.2E-04	2.0E+00
Chromium	3.4E-04	4.8E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-02	8.9E-04	1.5E-08	2.3E-09	1.5E-02
Cobalt	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E-08	5.9E-09	5.1E-08
Nickel	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.5E-06	4.8E-07	4.0E-06
Selenium	--	3.6E-01	1.7E-02	7.5E-04	8.2E-02	2.5E-03	3.8E+00	4.1E-02	6.1E-05	1.1E-05	4.3E+00
Uranium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-06	6.0E-07	4.8E-06
Vanadium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.6E-07	1.4E-07	1.1E-06
Zinc	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E-04	1.6E-05	1.8E-04
Exposure Pathway/Receptor Totals	3.4E-04	3.6E-01	6.9E-02	1.7E-03	8.2E-02	1.8E-02	5.5E+00	3.5E-01	1.0E-02	8.5E-04	6.4E+00

ADULT TOTAL RISK

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of surface soil	Ingestion of aboveground produce	Ingestion of belowground produce	TOTAL
Arsenic	3.2E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E-05	1.7E-09	3.4E-10	2.6E-05
Beryllium	4.9E-11	--	--	--	--	--	--	--	--	--	4.9E-11
Cadmium	2.1E-09	--	--	--	--	--	--	--	--	--	2.1E-09
Chromium	1.2E-06	--	--	--	--	--	--	--	--	--	1.2E-06
Nickel	2.2E-09	--	--	--	--	--	--	--	--	--	2.2E-09
Exposure Pathway/Receptor Totals	1.2E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E-05	1.7E-09	3.4E-10	2.7E-05

Note:

-- Information is not available.

TABLE E-38

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
CHILD TOTAL HAZARD AND RISK

CHILD TOTAL HAZARD

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of surface soil	Ingestion of aboveground produce	Ingestion of belowground produce	TOTAL
Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E-06	1.4E-07	1.8E-06
Arsenic	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E+00	1.1E-05	2.8E-06	1.2E+00
Beryllium	8.4E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.4E-06
Boron	3.0E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-07
Cadmium	--	2.9E-03	1.3E-01	3.9E-03	0.0E+00	7.4E-02	2.9E+00	1.6E+00	1.3E-02	1.3E-03	4.7E+00
Chromium	1.2E-03	1.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-02	8.3E-03	2.0E-08	3.6E-09	3.2E-02
Cobalt	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.8E-08	9.2E-09	6.7E-08
Nickel	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E-06	7.6E-07	5.2E-06
Selenium	--	1.1E+00	4.4E-02	3.0E-03	1.5E-01	1.2E-02	6.3E+00	3.8E-01	7.9E-05	1.7E-05	8.0E+00
Uranium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-06	9.4E-07	6.4E-06
Vanadium	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-06	2.2E-07	1.5E-06
Zinc	--	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E-04	2.5E-05	2.4E-04
Exposure Pathway/Receptor Totals	1.2E-03	1.1E+00	1.8E-01	7.0E-03	1.5E-01	8.6E-02	9.2E+00	3.2E+00	1.3E-02	1.3E-03	1.4E+01

CHILD TOTAL RISK

Chemical of Potential Concern	Inhalation of particulates	Ingestion of surface water	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life	Ingestion of surface soil	Ingestion of aboveground produce	Ingestion of belowground produce	TOTAL
Arsenic	3.2E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.8E-05	4.3E-10	1.1E-10	4.8E-05
Beryllium	4.9E-11	--	--	--	--	--	--	--	--	--	4.9E-11
Cadmium	2.1E-09	--	--	--	--	--	--	--	--	--	2.1E-09
Chromium	1.2E-06	--	--	--	--	--	--	--	--	--	1.2E-06
Nickel	2.2E-09	--	--	--	--	--	--	--	--	--	2.2E-09
Exposure Pathway/Receptor Totals	1.2E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.8E-05	4.3E-10	1.1E-10	4.9E-05

Note:

-- Information is not available.

TABLE E-39

TIER 1 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
RISK GRAND TOTAL

RISK GRAND TOTAL											
Chemical of Potential Concern	**Inhalation of particulates**	**Ingestion of surface water**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life**	**Ingestion of surface soil**	**Ingestion of aboveground produce**	**Ingestion of belowground produce**	**TOTAL**
Arsenic	6.4E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-05	2.1E-09	4.4E-10	7.3E-05
Beryllium	9.8E-11	--	--	--	--	--	--	--	--	--	9.8E-11
Cadmium	4.2E-09	--	--	--	--	--	--	--	--	--	4.2E-09
Chromium	2.4E-06	--	--	--	--	--	--	--	--	--	2.4E-06
Nickel	4.4E-09	--	--	--	--	--	--	--	--	--	4.4E-09
Exposure Pathway/Receptor Totals	2.4E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-05	2.1E-09	4.4E-10	7.6E-05

Note:

-- Information is not available.

TABLE E-40

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.99E-08	4.87E-08	2.55E-09	4.17E-09	5.00E-04	NA	4.0E-05	9.7E-05	--	--	--
Chromium	5.00E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	8.28E-08	2.03E-07	1.06E-08	1.74E-08	1.50E+00	NA	5.5E-08	1.4E-07	--	--	--
Selenium	5.77E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	9.55E-07	2.34E-06	1.23E-07	2.01E-07	3.00E-01	NA	3.2E-06	7.8E-06	--	--	--
Exposure Pathway/Receptor Totals												4.3E-05	1.1E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-41

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.99E-08	4.87E-08	2.55E-09	4.17E-09	5.00E-04	NA	4.0E-05	9.7E-05	--	--	--
Chromium	3.90E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	6.46E-08	1.58E-07	8.30E-09	1.36E-08	1.50E+00	NA	4.3E-08	1.1E-07	--	--	--
Selenium	7.30E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.21E-07	2.96E-07	1.55E-08	2.54E-08	5.00E-03	NA	2.4E-05	5.9E-05	--	--	--
Exposure Pathway/Receptor Totals												6.4E-05	1.6E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-42

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	6.00E-05	1.66E-04	4.05E-04	2.13E-05	3.48E-05	9.93E-09	2.43E-08	1.28E-09	2.09E-09	5.00E-04	NA	2.0E-05	4.9E-05	--	--	--
Chromium	3.00E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	4.97E-08	1.22E-07	6.39E-09	1.04E-08	1.50E+00	NA	3.3E-08	8.1E-08	--	--	--
Selenium	1.16E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.92E-07	4.70E-07	2.47E-08	4.03E-08	5.00E-03	NA	3.8E-05	9.4E-05	--	--	--
Exposure Pathway/Receptor Totals												5.8E-05	1.4E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-43

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF ELK AND WILD GAME - SKELETAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.10E-01	2.90E-07	4.64E-07	3.73E-08	3.98E-08	3.19E-08	5.10E-08	4.10E-09	4.37E-09	5.00E-04	NA	6.4E-05	1.0E-04	--	--	--
Selenium	3.80E-01	2.90E-07	4.64E-07	3.73E-08	3.98E-08	1.10E-07	1.76E-07	1.42E-08	1.51E-08	5.00E-03	NA	2.2E-05	3.5E-05	--	--	--
Exposure Pathway/Receptor Totals												8.6E-05	1.4E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-44

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF ELK AND WILD GAME - OFFAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	4.40E-01	2.90E-08	4.64E-08	3.73E-09	3.98E-09	1.28E-08	2.04E-08	1.64E-09	1.75E-09	5.00E-04	NA	2.6E-05	4.1E-05	--	--	--
Selenium	3.80E+00	2.90E-08	4.64E-08	3.73E-09	3.98E-09	1.10E-07	1.76E-07	1.42E-08	1.51E-08	5.00E-03	NA	2.2E-05	3.5E-05	--	--	--
Exposure Pathway/Receptor Totals												4.8E-05	7.6E-05	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-45

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	7.40E-01	4.44E-05	8.21E-05	5.70E-06	7.04E-06	3.28E-05	6.08E-05	4.22E-06	5.21E-06	5.00E-03	NA	6.6E-03	1.2E-02	--	--	--
Exposure Pathway/Receptor Totals												6.6E-03	1.2E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-46

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	6.90E-01	4.44E-06	8.16E-06	5.70E-07	1.97E-06	3.06E-06	5.63E-06	3.94E-07	1.36E-06	5.00E-03	NA	6.1E-04	1.1E-03	--	--	--
Exposure Pathway/Receptor Totals												6.1E-04	1.1E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-47

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.41E-02	1.71E-04	2.87E-04	2.20E-05	2.46E-05	9.27E-06	1.55E-05	1.19E-06	1.33E-06	5.00E-04	NA	1.9E-02	3.1E-02	--	--	--
Chromium	4.50E-01	1.71E-04	2.87E-04	2.20E-05	2.46E-05	7.71E-05	1.29E-04	9.92E-06	1.11E-05	1.50E+00	NA	5.1E-05	8.6E-05	--	--	--
Selenium	2.88E+00	1.71E-04	2.87E-04	2.20E-05	2.46E-05	4.94E-04	8.26E-04	6.35E-05	7.08E-05	5.00E-03	NA	9.9E-02	1.7E-01	--	--	--
Exposure Pathway/Receptor Totals												1.2E-01	2.0E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-48

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.06E-02	1.71E-04	2.87E-04	2.20E-05	2.46E-05	5.25E-06	8.77E-06	6.74E-07	7.52E-07	5.00E-04	NA	1.0E-02	1.8E-02	--	--	--
Chromium	3.80E-01	1.71E-04	2.87E-04	2.20E-05	2.46E-05	6.51E-05	1.09E-04	8.38E-06	9.34E-06	1.50E+00	NA	4.3E-05	7.3E-05	--	--	--
Selenium	1.95E+00	1.71E-04	2.87E-04	2.20E-05	2.46E-05	3.34E-04	5.59E-04	4.30E-05	4.79E-05	5.00E-03	NA	6.7E-02	1.1E-01	--	--	--
Exposure Pathway/Receptor Totals												7.7E-02	1.3E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-49

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.76E-02	1.71E-04	2.87E-04	2.20E-05	2.46E-05	6.45E-06	1.08E-05	8.29E-07	9.24E-07	5.00E-04	NA	1.3E-02	2.2E-02	--	--	--
Chromium	4.00E-01	1.71E-04	2.87E-04	2.20E-05	2.46E-05	6.86E-05	1.15E-04	8.82E-06	9.83E-06	1.50E+00	NA	4.6E-05	7.6E-05	--	--	--
Selenium	2.24E+00	1.71E-04	2.87E-04	2.20E-05	2.46E-05	3.84E-04	6.42E-04	4.94E-05	5.50E-05	5.00E-03	NA	7.7E-02	1.3E-01	--	--	--
Exposure Pathway/Receptor Totals												9.0E-02	1.5E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-50

TIER 2 HAZARD AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
ADULT TOTAL HAZARD AND RISK
CENTRAL TENDENCY EXPOSURE

ADULT TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Cadmium	4.0E-05	4.0E-05	2.0E-05	6.4E-05	2.6E-05	0.0E+00	0.0E+00	1.9E-02	1.0E-02	1.3E-02	1.9E-02	1.1E-02	1.3E-02
Chromium	5.5E-08	4.3E-08	3.3E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E-05	4.3E-05	4.6E-05	5.1E-05	4.3E-05	4.6E-05
Selenium	1.9E-04	2.4E-05	3.8E-05	2.2E-05	2.2E-05	6.6E-03	6.1E-04	9.9E-02	6.7E-02	7.7E-02	1.1E-01	7.4E-02	8.4E-02
Exposure Pathway/Receptor Totals	2.3E-04	6.4E-05	5.8E-05	8.6E-05	4.8E-05	6.6E-03	6.1E-04	1.2E-01	7.7E-02	9.0E-02	1.2E-01	8.5E-02	9.7E-02

ADULT TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	--	--	--	--	--	--	--	--	--	--			--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-51

TIER 2 HAZARD AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
CHILD TOTAL HAZARD AND RISK
CENTRAL TENDENCY EXPOSURE

CHILD TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Cadmium	9.7E-05	9.7E-05	4.9E-05	1.0E-04	4.1E-05	0.0E+00	0.0E+00	3.1E-02	1.8E-02	2.2E-02	3.1E-02	1.8E-02	2.2E-02
Chromium	1.4E-07	1.1E-07	8.1E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-05	7.3E-05	7.6E-05	8.7E-05	7.3E-05	7.7E-05
Selenium	4.7E-04	5.9E-05	9.4E-05	3.5E-05	3.5E-05	1.2E-02	1.1E-03	1.7E-01	1.1E-01	1.3E-01	1.8E-01	1.3E-01	1.4E-01
Exposure Pathway/Receptor Totals	5.7E-04	1.6E-04	1.4E-04	1.4E-04	7.6E-05	1.2E-02	1.1E-03	2.0E-01	1.3E-01	1.5E-01	2.1E-01	1.4E-01	1.6E-01

CHILD TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-52

TIER 2 HAZARD AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
RISK GRAND TOTAL
CENTRAL TENDENCY EXPOSURE

RISK GRAND TOTAL													
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of aquatic life - Salt Watershed**	**Ingestion of aquatic life - Georgetown Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Arsenic	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-53

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	2.70E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.49E-07	4.44E-07	6.39E-08	3.80E-08	5.00E-04	NA	3.0E-04	8.9E-04	--	--	--
Chromium	1.07E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	5.90E-07	1.76E-06	2.53E-07	1.51E-07	1.50E+00	NA	3.9E-07	1.2E-06	--	--	--
Selenium	1.20E-02	5.52E-04	1.64E-03	2.37E-04	1.41E-04	6.62E-06	1.97E-05	2.84E-06	1.69E-06	5.00E-03	NA	1.3E-03	3.9E-03	--	--	--
Exposure Pathway/Receptor Totals												1.6E-03	4.8E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-54

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	6.62E-08	1.97E-07	2.84E-08	1.69E-08	5.00E-04	NA	1.3E-04	3.9E-04	--	--	--
Chromium	3.90E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.15E-07	6.41E-07	9.22E-08	5.50E-08	1.50E+00	NA	1.4E-07	4.3E-07	--	--	--
Selenium	3.93E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.17E-06	6.46E-06	9.29E-07	5.54E-07	5.00E-03	NA	4.3E-04	1.3E-03	--	--	--
Exposure Pathway/Receptor Totals												5.7E-04	1.7E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-55

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	6.00E-05	5.52E-04	1.64E-03	2.37E-04	1.41E-04	3.31E-08	9.86E-08	1.42E-08	8.45E-09	5.00E-04	NA	6.6E-05	2.0E-04	--	--	--
Chromium	3.50E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.93E-07	5.75E-07	8.28E-08	4.93E-08	1.50E+00	NA	1.3E-07	3.8E-07	--	--	--
Selenium	1.80E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	9.93E-07	2.96E-06	4.26E-07	2.54E-07	5.00E-03	NA	2.0E-04	5.9E-04	--	--	--
Exposure Pathway/Receptor Totals												2.7E-04	7.9E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-56

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF ELK AND WILD GAME - SKELETAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.30E-01	6.96E-07	1.02E-06	2.98E-07	8.70E-08	9.05E-08	1.32E-07	3.88E-08	1.13E-08	5.00E-04	NA	1.8E-04	2.6E-04	--	--	--
Selenium	4.50E-01	6.96E-07	1.02E-06	2.98E-07	8.70E-08	3.13E-07	4.57E-07	1.34E-07	3.92E-08	5.00E-03	NA	6.3E-05	9.1E-05	--	--	--
Exposure Pathway/Receptor Totals												2.4E-04	3.6E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-57

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF ELK AND WILD GAME - OFFAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.10E-01	6.96E-08	1.02E-07	2.98E-08	8.70E-09	3.55E-08	5.18E-08	1.52E-08	4.44E-09	5.00E-04	NA	7.1E-05	1.0E-04	--	--	--
Selenium	4.86E+00	6.96E-08	1.02E-07	2.98E-08	8.70E-09	3.38E-07	4.93E-07	1.45E-07	4.23E-08	5.00E-03	NA	6.8E-05	9.9E-05	--	--	--
Exposure Pathway/Receptor Totals												1.4E-04	2.0E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-58

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	8.70E-01	3.86E-04	7.13E-04	1.66E-04	6.11E-05	3.36E-04	6.20E-04	1.44E-04	5.32E-05	5.00E-03	NA	6.7E-02	1.2E-01	--	--	--
Exposure Pathway/Receptor Totals												6.7E-02	1.2E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-59

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	7.70E-01	3.93E-05	7.07E-05	1.68E-05	6.06E-06	3.02E-05	5.44E-05	1.30E-05	4.66E-06	5.00E-03	NA	6.0E-03	1.1E-02	--	--	--
Exposure Pathway/Receptor Totals												6.0E-03	1.1E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-60

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	7.29E-02	5.36E-04	9.00E-04	2.30E-04	7.71E-05	3.91E-05	6.56E-05	1.67E-05	5.62E-06	5.00E-04	NA	7.8E-02	1.3E-01	--	--	--
Chromium	6.90E-01	5.36E-04	9.00E-04	2.30E-04	7.71E-05	3.70E-04	6.21E-04	1.58E-04	5.32E-05	1.50E+00	NA	2.5E-04	4.1E-04	--	--	--
Selenium	4.12E+00	5.36E-04	9.00E-04	2.30E-04	7.71E-05	2.21E-03	3.71E-03	9.46E-04	3.18E-04	5.00E-03	NA	4.4E-01	7.4E-01	--	--	--
Exposure Pathway/Receptor Totals												5.2E-01	8.7E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-61

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.06E-02	5.36E-04	9.00E-04	2.30E-04	7.71E-05	1.64E-05	2.75E-05	7.03E-06	2.36E-06	5.00E-04	NA	3.3E-02	5.5E-02	--	--	--
Chromium	5.20E-01	5.36E-04	9.00E-04	2.30E-04	7.71E-05	2.79E-04	4.68E-04	1.19E-04	4.01E-05	1.50E+00	NA	1.9E-04	3.1E-04	--	--	--
Selenium	2.77E+00	5.36E-04	9.00E-04	2.30E-04	7.71E-05	1.48E-03	2.49E-03	6.36E-04	2.14E-04	5.00E-03	NA	3.0E-01	5.0E-01	--	--	--
Exposure Pathway/Receptor Totals												3.3E-01	5.5E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-62

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-01	5.36E-04	9.00E-04	2.30E-04	7.71E-05	6.43E-05	1.08E-04	2.76E-05	9.26E-06	5.00E-04	NA	1.3E-01	2.2E-01	--	--	--
Chromium	6.50E-01	5.36E-04	9.00E-04	2.30E-04	7.71E-05	3.48E-04	5.85E-04	1.49E-04	5.01E-05	1.50E+00	NA	2.3E-04	3.9E-04	--	--	--
Selenium	5.35E+00	5.36E-04	9.00E-04	2.30E-04	7.71E-05	2.87E-03	4.82E-03	1.23E-03	4.13E-04	5.00E-03	NA	5.7E-01	9.6E-01	--	--	--
Exposure Pathway/Receptor Totals												7.0E-01	1.2E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-63

TIER 2 HAZARD AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
ADULT TOTAL HAZARD AND RISK
REASONABLE MAXIMUM EXPOSURE

ADULT TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Cadmium	3.0E-04	1.3E-04	6.6E-05	1.8E-04	7.1E-05	0.0E+00	0.0E+00	7.8E-02	3.3E-02	1.3E-01	7.9E-02	3.3E-02	1.3E-01
Chromium	3.9E-07	1.4E-07	1.3E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-04	1.9E-04	2.3E-04	2.5E-04	1.9E-04	2.3E-04
Selenium	1.3E-03	4.3E-04	2.0E-04	6.3E-05	6.8E-05	6.7E-02	6.0E-03	4.4E-01	3.0E-01	5.7E-01	5.2E-01	3.7E-01	6.5E-01
Exposure Pathway/Receptor Totals	1.6E-03	5.7E-04	2.7E-04	2.4E-04	1.4E-04	6.7E-02	6.0E-03	5.2E-01	3.3E-01	7.0E-01	6.0E-01	4.0E-01	7.8E-01

ADULT TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-64

TIER 2 HAZARD AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
CHILD TOTAL HAZARD AND RISK
REASONABLE MAXIMUM EXPOSURE

CHILD TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Cadmium	8.9E-04	3.9E-04	2.0E-04	2.6E-04	1.0E-04	0.0E+00	0.0E+00	1.3E-01	5.5E-02	2.2E-01	1.3E-01	5.6E-02	2.2E-01
Chromium	1.2E-06	4.3E-07	3.8E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.1E-04	3.1E-04	3.9E-04	4.2E-04	3.1E-04	3.9E-04
Selenium	3.9E-03	1.3E-03	5.9E-04	9.1E-05	9.9E-05	1.2E-01	1.1E-02	7.4E-01	5.0E-01	9.6E-01	8.8E-01	6.3E-01	1.1E+00
Exposure Pathway/Receptor Totals	4.8E-03	1.7E-03	7.9E-04	3.6E-04	2.0E-04	1.2E-01	1.1E-02	8.7E-01	5.5E-01	1.2E+00	1.0E+00	6.9E-01	1.3E+00

CHILD TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-65

TIER 2 HAZARD AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
RISK GRAND TOTAL
REASONABLE MAXIMUM EXPOSURE

	RISK GRAND TOTAL												
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of aquatic life - Salt Watershed**	**Ingestion of aquatic life - Georgetown Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-66

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.99E-08	4.87E-08	2.55E-09	4.17E-09	5.00E-04	NA	4.0E-05	9.7E-05	--	--	--
Chromium	5.00E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	8.28E-08	2.03E-07	1.06E-08	1.74E-08	1.50E+00	NA	5.5E-08	1.4E-07	--	--	--
Selenium	5.77E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	9.55E-07	2.34E-06	1.23E-07	2.01E-07	5.00E-03	NA	1.9E-04	4.7E-04	--	--	--
Exposure Pathway/Receptor Totals												2.3E-04	5.7E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-67

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.99E-08	4.87E-08	2.55E-09	4.17E-09	5.00E-04	NA	4.0E-05	9.7E-05	--	--	--
Chromium	3.90E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	6.46E-08	1.58E-07	8.30E-09	1.36E-08	1.50E+00	NA	4.3E-08	1.1E-07	--	--	--
Selenium	7.30E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.21E-07	2.96E-07	1.55E-08	2.54E-08	5.00E-03	NA	2.4E-05	5.9E-05	--	--	--
Exposure Pathway/Receptor Totals												6.4E-05	1.6E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-68

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	6.00E-05	1.66E-04	4.05E-04	2.13E-05	3.48E-05	9.93E-09	2.43E-08	1.28E-09	2.09E-09	5.00E-04	NA	2.0E-05	4.9E-05	--	--	--
Chromium	3.00E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	4.97E-08	1.22E-07	6.39E-09	1.04E-08	1.50E+00	NA	3.3E-08	8.1E-08	--	--	--
Selenium	1.16E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.92E-07	4.70E-07	2.47E-08	4.03E-08	5.00E-03	NA	3.8E-05	9.4E-05	--	--	--
Exposure Pathway/Receptor Totals												5.8E-05	1.4E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-69

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF ELK AND WILD GAME - SKELETAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.10E-01	3.19E-06	4.64E-06	4.10E-07	3.98E-07	3.51E-07	5.10E-07	4.51E-08	4.37E-08	5.00E-04	NA	7.0E-04	1.0E-03	--	--	--
Selenium	3.80E-01	3.19E-06	4.64E-06	4.10E-07	3.98E-07	1.21E-06	1.76E-06	1.56E-07	1.51E-07	5.00E-03	NA	2.4E-04	3.5E-04	--	--	--
Exposure Pathway/Receptor Totals												9.4E-04	1.4E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-70

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF ELK AND WILD GAME - OFFAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	4.40E-01	1.41E-06	5.22E-07	1.81E-07	4.47E-08	6.19E-07	2.30E-07	7.96E-08	1.97E-08	5.00E-04	NA	1.2E-03	4.6E-04	--	--	--
Selenium	3.80E+00	1.41E-06	5.22E-07	1.81E-07	4.47E-08	5.34E-06	1.98E-06	6.87E-07	1.70E-07	5.00E-03	NA	1.1E-03	4.0E-04	--	--	--
Exposure Pathway/Receptor Totals												2.3E-03	8.6E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-71

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	7.40E-01	3.67E-05	6.83E-05	4.72E-06	5.86E-06	2.72E-05	5.06E-05	3.49E-06	4.33E-06	5.00E-03	NA	5.4E-03	1.0E-02	--	--	--
Exposure Pathway/Receptor Totals												5.4E-03	1.0E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-72

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	6.90E-01	2.24E-06	1.07E-05	2.89E-07	9.18E-07	1.55E-06	7.39E-06	1.99E-07	6.33E-07	5.00E-03	NA	3.1E-04	1.5E-03	--	--	--
Exposure Pathway/Receptor Totals												3.1E-04	1.5E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-73

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.41E-02	1.14E-04	1.93E-04	1.47E-05	1.66E-05	6.18E-06	1.05E-05	7.95E-07	8.97E-07	5.00E-04	NA	1.2E-02	2.1E-02	--	--	--
Chromium	4.50E-01	1.14E-04	1.93E-04	1.47E-05	1.66E-05	5.14E-05	8.70E-05	6.61E-06	7.46E-06	1.50E+00	NA	3.4E-05	5.8E-05	--	--	--
Selenium	2.88E+00	1.14E-04	1.93E-04	1.47E-05	1.66E-05	3.29E-04	5.57E-04	4.23E-05	4.77E-05	5.00E-03	NA	6.6E-02	1.1E-01	--	--	--
Exposure Pathway/Receptor Totals												7.8E-02	1.3E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-74

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.06E-02	1.14E-04	1.93E-04	1.47E-05	1.66E-05	3.50E-06	5.92E-06	4.50E-07	5.07E-07	5.00E-04	NA	7.0E-03	1.2E-02	--	--	--
Chromium	3.80E-01	1.14E-04	1.93E-04	1.47E-05	1.66E-05	4.34E-05	7.35E-05	5.58E-06	6.30E-06	1.50E+00	NA	2.9E-05	4.9E-05	--	--	--
Selenium	1.95E+00	1.14E-04	1.93E-04	1.47E-05	1.66E-05	2.23E-04	3.77E-04	2.87E-05	3.23E-05	5.00E-03	NA	4.5E-02	7.5E-02	--	--	--
Exposure Pathway/Receptor Totals												5.2E-02	8.7E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-75

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.76E-02	1.14E-04	1.93E-04	1.47E-05	1.66E-05	4.30E-06	7.27E-06	5.52E-07	6.23E-07	5.00E-04	NA	8.6E-03	1.5E-02	--	--	--
Chromium	4.00E-01	1.14E-04	1.93E-04	1.47E-05	1.66E-05	4.57E-05	7.73E-05	5.88E-06	6.63E-06	1.50E+00	NA	3.0E-05	5.2E-05	--	--	--
Selenium	2.24E+00	1.14E-04	1.93E-04	1.47E-05	1.66E-05	2.56E-04	4.33E-04	3.29E-05	3.71E-05	5.00E-03	NA	5.1E-02	8.7E-02	--	--	--
Exposure Pathway/Receptor Totals												6.0E-02	1.0E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-79

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	2.70E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.49E-07	4.44E-07	6.39E-08	3.80E-08	5.00E-04	NA	3.0E-04	8.9E-04	--	--	--
Chromium	1.07E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	5.90E-07	1.76E-06	2.53E-07	1.51E-07	1.50E+00	NA	3.9E-07	1.2E-06	--	--	--
Selenium	1.20E-02	5.52E-04	1.64E-03	2.37E-04	1.41E-04	6.62E-06	1.97E-05	2.84E-06	1.69E-06	5.00E-03	NA	1.3E-03	3.9E-03	--	--	--
Exposure Pathway/Receptor Totals												1.6E-03	4.8E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-80

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	6.62E-08	1.97E-07	2.84E-08	1.69E-08	5.00E-04	NA	1.3E-04	3.9E-04	--	--	--
Chromium	3.90E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.15E-07	6.41E-07	9.22E-08	5.50E-08	1.50E+00	NA	1.4E-07	4.3E-07	--	--	--
Selenium	3.93E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.17E-06	6.46E-06	9.29E-07	5.54E-07	5.00E-03	NA	4.3E-04	1.3E-03	--	--	--
Exposure Pathway/Receptor Totals												5.7E-04	1.7E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-81

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	6.00E-05	5.52E-04	1.64E-03	2.37E-04	1.41E-04	3.31E-08	9.86E-08	1.42E-08	8.45E-09	5.00E-04	NA	6.6E-05	2.0E-04	--	--	--
Chromium	3.50E-04	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.93E-07	5.75E-07	8.28E-08	4.93E-08	1.50E+00	NA	1.3E-07	3.8E-07	--	--	--
Selenium	1.80E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	9.93E-07	2.96E-06	4.26E-07	2.54E-07	5.00E-03	NA	2.0E-04	5.9E-04	--	--	--
Exposure Pathway/Receptor Totals												2.7E-04	7.9E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-82

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF ELK AND WILD GAME - SKELETAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.30E-01	7.54E-06	1.10E-05	3.23E-06	9.40E-07	9.80E-07	1.43E-06	4.20E-07	1.22E-07	5.00E-04	NA	2.0E-03	2.9E-03	--	--	--
Selenium	4.50E-01	7.54E-06	1.10E-05	3.23E-06	9.40E-07	3.39E-06	4.93E-06	1.45E-06	4.23E-07	5.00E-03	NA	6.8E-04	9.9E-04	--	--	--
Exposure Pathway/Receptor Totals												2.6E-03	3.8E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-83

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF ELK AND WILD GAME - OFFAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.10E-01	2.90E-07	1.16E-06	1.24E-07	9.94E-08	1.48E-07	5.92E-07	6.34E-08	5.07E-08	5.00E-04	NA	3.0E-04	1.2E-03	--	--	--
Selenium	4.86E+00	2.90E-07	1.16E-06	1.24E-07	9.94E-08	1.41E-06	5.64E-06	6.04E-07	4.83E-07	5.00E-03	NA	2.8E-04	1.1E-03	--	--	--
Exposure Pathway/Receptor Totals												5.8E-04	2.3E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-84

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	8.70E-01	3.17E-04	5.86E-04	1.36E-04	5.02E-05	2.76E-04	5.09E-04	1.18E-04	4.37E-05	5.00E-03	NA	5.5E-02	1.0E-01	--	--	--
Exposure Pathway/Receptor Totals												5.5E-02	1.0E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-85

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	7.70E-01	1.40E-05	6.59E-05	5.99E-06	5.65E-06	1.08E-05	5.08E-05	4.61E-06	4.35E-06	5.00E-03	NA	2.2E-03	1.0E-02	--	--	--
Exposure Pathway/Receptor Totals												2.2E-03	1.0E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-86

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	7.29E-02	3.57E-04	6.00E-04	1.53E-04	5.14E-05	2.60E-05	4.37E-05	1.12E-05	3.75E-06	5.00E-04	NA	5.2E-02	8.7E-02	--	--	--
Cadmium	6.90E-01	3.57E-04	6.00E-04	1.53E-04	5.14E-05	2.46E-04	4.14E-04	1.06E-04	3.55E-05	1.50E+00	NA	1.6E-04	2.8E-04	--	--	--
Cadmium	4.12E+00	3.57E-04	6.00E-04	1.53E-04	5.14E-05	1.47E-03	2.47E-03	6.31E-04	2.12E-04	5.00E-03	NA	2.9E-01	4.9E-01	--	--	--
Exposure Pathway/Receptor Totals												3.5E-01	5.8E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-87

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.06E-02	3.57E-04	6.00E-04	1.53E-04	5.14E-05	1.09E-05	1.84E-05	4.68E-06	1.57E-06	5.00E-04	NA	2.2E-02	3.7E-02	--	--	--
Chromium	5.20E-01	3.57E-04	6.00E-04	1.53E-04	5.14E-05	1.86E-04	3.12E-04	7.96E-05	2.67E-05	1.50E+00	NA	1.2E-04	2.1E-04	--	--	--
Selenium	2.77E+00	3.57E-04	6.00E-04	1.53E-04	5.14E-05	9.89E-04	1.66E-03	4.24E-04	1.42E-04	5.00E-03	NA	2.0E-01	3.3E-01	--	--	--
Exposure Pathway/Receptor Totals												2.2E-01	3.7E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-88

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-01	3.57E-04	6.00E-04	1.53E-04	5.14E-05	4.29E-05	7.20E-05	1.84E-05	6.17E-06	5.00E-04	NA	8.6E-02	1.4E-01	--	--	--
Chromium	6.50E-01	3.57E-04	6.00E-04	1.53E-04	5.14E-05	2.32E-04	3.90E-04	9.95E-05	3.34E-05	1.50E+00	NA	1.5E-04	2.6E-04	--	--	--
Selenium	5.35E+00	3.57E-04	6.00E-04	1.53E-04	5.14E-05	1.91E-03	3.21E-03	8.19E-04	2.75E-04	5.00E-03	NA	3.8E-01	6.4E-01	--	--	--
Exposure Pathway/Receptor Totals												4.7E-01	7.9E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-89

TIER 2 HAZARD AND RISK RESULTS FOR RECREATIONAL RECEPTORS
ADULT TOTAL HAZARD AND RISK
REASONABLE MAXIMUM EXPOSURE

ADULT TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackdoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Cadmium	3.0E-04	1.3E-04	6.6E-05	2.0E-03	3.0E-04	--	--	5.2E-02	2.2E-02	8.6E-02	5.5E-02	2.4E-02	8.8E-02
Chromium	3.9E-07	1.4E-07	1.3E-07	0.0E+00	0.0E+00	--	--	1.6E-04	1.2E-04	1.5E-04	1.6E-04	1.2E-04	1.5E-04
Selenium	1.3E-03	4.3E-04	2.0E-04	6.8E-04	2.8E-04	5.5E-02	2.2E-03	2.9E-01	2.0E-01	3.8E-01	3.5E-01	2.6E-01	4.4E-01
Exposure Pathway/Receptor Totals	1.6E-03	5.7E-04	2.7E-04	2.6E-03	5.8E-04	5.5E-02	2.2E-03	3.5E-01	2.2E-01	4.7E-01	4.1E-01	2.8E-01	5.3E-01

ADULT TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackdoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-90

TIER 2 HAZARD AND RISK RESULTS FOR RECREATIONAL RECEPTORS
CHILD TOTAL HAZARD AND RISK
REASONABLE MAXIMUM EXPOSURE

CHILD TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackdoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Cadmium	8.9E-04	3.9E-04	2.0E-04	2.9E-03	1.2E-03	--	--	8.7E-02	3.7E-02	1.4E-01	9.2E-02	4.1E-02	1.5E-01
Chromium	1.2E-06	4.3E-07	3.8E-07	0.0E+00	0.0E+00	--	--	2.8E-04	2.1E-04	2.6E-04	2.8E-04	2.1E-04	2.6E-04
Selenium	3.9E-03	1.3E-03	5.9E-04	9.9E-04	1.1E-03	1.0E-01	1.0E-02	4.9E-01	3.3E-01	6.4E-01	6.1E-01	4.5E-01	7.6E-01
Exposure Pathway/Receptor Totals	4.8E-03	1.7E-03	7.9E-04	3.8E-03	2.3E-03	1.0E-01	1.0E-02	5.8E-01	3.7E-01	7.9E-01	7.1E-01	4.9E-01	9.1E-01

CHILD TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackdoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-91

TIER 2 HAZARD AND RISK RESULTS FOR RECREATIONAL RECEPTORS
RISK GRAND TOTAL
REASONABLE MAXIMUM EXPOSURE

RISK GRAND TOTAL													
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life - Blackdoot/ Little Blackfoot Watershed**	**Ingestion of aquatic life - Salt Watershed**	**Ingestion of aquatic life - Georgetown Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Exposure Pathway/Receptor Totals	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Note:

-- Information is not available.

TABLE E-92

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	5.30E-08	1.30E-07	6.81E-09	1.11E-08	5.00E-04	NA	1.1E-04	2.6E-04	--	--	--
Chromium	5.00E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	2.21E-07	5.41E-07	2.84E-08	4.63E-08	1.50E+00	NA	1.5E-07	3.6E-07	--	--	--
Selenium	5.77E-03	4.41E-04	1.08E-03	5.68E-05	9.27E-05	2.55E-06	6.24E-06	3.28E-07	5.35E-07	5.00E-03	NA	5.1E-04	1.2E-03	--	--	--
Exposure Pathway/Receptor Totals												6.2E-04	1.5E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-93

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	5.30E-08	1.30E-07	6.81E-09	1.11E-08	5.00E-04	NA	1.1E-04	2.6E-04	--	--	--
Chromium	3.90E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	1.72E-07	4.22E-07	2.21E-08	3.61E-08	1.50E+00	NA	1.1E-07	2.8E-07	--	--	--
Selenium	7.30E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	3.22E-07	7.89E-07	4.14E-08	6.77E-08	5.00E-03	NA	6.4E-05	1.6E-04	--	--	--
Exposure Pathway/Receptor Totals												1.7E-04	4.2E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-94

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	6.00E-05	4.41E-04	1.08E-03	5.68E-05	9.27E-05	2.65E-08	6.49E-08	3.41E-09	5.56E-09	5.00E-04	NA	5.3E-05	1.3E-04	--	--	--
Chromium	3.00E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	1.32E-07	3.24E-07	1.70E-08	2.78E-08	1.50E+00	NA	8.8E-08	2.2E-07	--	--	--
Selenium	1.16E-03	4.41E-04	1.08E-03	5.68E-05	9.27E-05	5.12E-07	1.25E-06	6.58E-08	1.08E-07	5.00E-03	NA	1.0E-04	2.5E-04	--	--	--
Exposure Pathway/Receptor Totals												1.6E-04	3.8E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-95

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF ELK AND WILDGAME - SKELETAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.10E-01	3.19E-06	4.64E-06	4.10E-07	3.98E-07	3.51E-07	5.10E-07	4.51E-08	4.37E-08	5.00E-04	NA	7.0E-04	1.0E-03	--	--	--
Selenium	3.80E-01	3.19E-06	4.64E-06	4.10E-07	3.98E-07	1.21E-06	1.76E-06	1.56E-07	1.51E-07	5.00E-03	NA	2.4E-04	3.5E-04	--	--	--
Exposure Pathway/Receptor Totals												9.4E-04	1.4E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-96

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF ELK AND WILDGAME - OFFAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	4.40E-01	1.41E-06	5.22E-07	1.81E-07	4.47E-08	6.19E-07	2.30E-07	7.96E-08	1.97E-08	5.00E-04	NA	1.2E-03	4.6E-04	--	--	--
Selenium	3.80E+00	1.41E-06	5.22E-07	1.81E-07	4.47E-08	5.34E-06	1.98E-06	6.87E-07	1.70E-07	5.00E-03	NA	1.1E-03	4.0E-04	--	--	--
Exposure Pathway/Receptor Totals												2.3E-03	8.6E-04	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-97

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	7.40E-01	3.67E-05	6.83E-05	4.72E-06	5.86E-06	2.72E-05	5.06E-05	3.49E-06	4.33E-06	5.00E-03	NA	5.4E-03	1.0E-02	--	--	--
Exposure Pathway/Receptor Totals												5.4E-03	1.0E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-98

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL
CENTRAL TENDENCY EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	6.90E-01	2.24E-06	1.07E-05	2.89E-07	9.18E-07	1.55E-06	7.39E-06	1.99E-07	6.33E-07	5.00E-03	NA	3.1E-04	1.5E-03	--	--	--
Exposure Pathway/Receptor Totals												3.1E-04	1.5E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-99

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.41E-02	1.00E-03	1.68E-03	1.29E-04	1.44E-04	5.41E-05	9.09E-05	6.96E-06	7.79E-06	5.00E-04	NA	1.1E-01	1.8E-01	--	--	--
Chromium	4.50E-01	1.00E-03	1.68E-03	1.29E-04	1.44E-04	4.50E-04	7.56E-04	5.79E-05	6.48E-05	1.50E+00	NA	3.0E-04	5.0E-04	--	--	--
Selenium	2.88E+00	1.00E-03	1.68E-03	1.29E-04	1.44E-04	2.88E-03	4.84E-03	3.70E-04	4.15E-04	5.00E-03	NA	5.8E-01	9.7E-01	--	--	--
Exposure Pathway/Receptor Totals												6.8E-01	1.1E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-100

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.06E-02	1.00E-03	1.68E-03	1.29E-04	1.44E-04	3.06E-05	5.14E-05	3.93E-06	4.41E-06	5.00E-04	NA	6.1E-02	1.0E-01	--	--	--
Chromium	3.80E-01	1.00E-03	1.68E-03	1.29E-04	1.44E-04	3.80E-04	6.38E-04	4.89E-05	5.47E-05	1.50E+00	NA	2.5E-04	4.3E-04	--	--	--
Selenium	1.95E+00	1.00E-03	1.68E-03	1.29E-04	1.44E-04	1.95E-03	3.28E-03	2.51E-04	2.81E-04	5.00E-03	NA	3.9E-01	6.6E-01	--	--	--
Exposure Pathway/Receptor Totals												4.5E-01	7.6E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-101

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.76E-02	1.00E-03	1.68E-03	1.29E-04	1.44E-04	3.76E-05	6.32E-05	4.83E-06	5.41E-06	5.00E-04	NA	7.5E-02	1.3E-01	--	--	--
Chromium	4.00E-01	1.00E-03	1.68E-03	1.29E-04	1.44E-04	4.00E-04	6.72E-04	5.14E-05	5.76E-05	1.50E+00	NA	2.7E-04	4.5E-04	--	--	--
Selenium	2.24E+00	1.00E-03	1.68E-03	1.29E-04	1.44E-04	2.24E-03	3.76E-03	2.88E-04	3.23E-04	5.00E-03	NA	4.5E-01	7.5E-01	--	--	--
Exposure Pathway/Receptor Totals												5.2E-01	8.8E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-102

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA1

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	1.60E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	1.09E-05	1.02E-04	1.40E-06	8.74E-06	3.00E-04	1.50E+00	3.6E-02	3.4E-01	2.1E-06	1.3E-05	1.5E-05
Cadmium	2.87E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	1.96E-05	1.83E-04	2.52E-06	1.57E-05	5.00E-04	NA	3.9E-02	3.7E-01	--	--	--
Chromium	4.34E+02	6.85E-07	6.39E-06	8.81E-08	5.48E-07	2.98E-04	2.78E-03	3.83E-05	2.38E-04	1.50E+00	NA	2.0E-04	1.9E-03	--	--	--
Selenium	6.74E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.62E-05	4.31E-04	5.93E-06	3.69E-05	5.00E-03	NA	9.2E-03	8.6E-02	--	--	--
Exposure Pathway/Receptor Totals												8.5E-02	7.9E-01	2.1E-06	1.3E-05	1.5E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-103

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA2

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.97E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.77E-06	4.46E-05	6.14E-07	3.82E-06	3.00E-04	1.50E+00	1.6E-02	1.5E-01	9.2E-07	5.7E-06	6.6E-06
Cadmium	2.48E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	1.70E-06	1.59E-05	2.18E-07	1.36E-06	5.00E-04	NA	3.4E-03	3.2E-02	--	--	--
Chromium	6.16E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.22E-05	3.94E-04	5.42E-06	3.37E-05	1.50E+00	NA	2.8E-05	2.6E-04	--	--	--
Selenium	1.48E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	1.01E-06	9.46E-06	1.30E-07	8.11E-07	5.00E-03	NA	2.0E-04	1.9E-03	--	--	--
Exposure Pathway/Receptor Totals												2.0E-02	1.8E-01	9.2E-07	5.7E-06	6.6E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-104

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA3

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.70E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.59E-06	4.28E-05	5.90E-07	3.67E-06	3.00E-04	1.50E+00	1.5E-02	1.4E-01	8.9E-07	5.5E-06	6.4E-06
Cadmium	2.44E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	1.67E-06	1.56E-05	2.15E-07	1.34E-06	5.00E-04	NA	3.3E-03	3.1E-02	--	--	--
Chromium	7.10E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.86E-05	4.54E-04	6.25E-06	3.89E-05	1.50E+00	NA	3.2E-05	3.0E-04	--	--	--
Selenium	3.36E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	2.30E-06	2.15E-05	2.96E-07	1.84E-06	5.00E-03	NA	4.6E-04	4.3E-03	--	--	--
Exposure Pathway/Receptor Totals												1.9E-02	1.8E-01	8.9E-07	5.5E-06	6.4E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-105

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA4

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.44E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.41E-06	4.12E-05	5.67E-07	3.53E-06	3.00E-04	1.50E+00	1.5E-02	1.4E-01	8.5E-07	5.3E-06	6.1E-06
Cadmium	8.70E-01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	5.96E-07	5.56E-06	7.66E-08	4.77E-07	5.00E-04	NA	1.2E-03	1.1E-02	--	--	--
Chromium	5.09E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	3.48E-05	3.25E-04	4.48E-06	2.79E-05	1.50E+00	NA	2.3E-05	2.2E-04	--	--	--
Selenium	8.50E-01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	5.82E-07	5.43E-06	7.49E-08	4.66E-07	5.00E-03	NA	1.2E-04	1.1E-03	--	--	--
Exposure Pathway/Receptor Totals												1.6E-02	1.5E-01	8.5E-07	5.3E-06	6.1E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-106

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA5

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	4.35E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	2.98E-06	2.78E-05	3.83E-07	2.38E-06	3.00E-04	1.50E+00	9.9E-03	9.3E-02	5.7E-07	3.6E-06	4.1E-06
Cadmium	9.30E-01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	6.37E-07	5.95E-06	8.19E-08	5.10E-07	5.00E-04	NA	1.3E-03	1.2E-02	--	--	--
Chromium	3.75E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	2.57E-05	2.39E-04	3.30E-06	2.05E-05	1.50E+00	NA	1.7E-05	1.6E-04	--	--	--
Selenium	1.32E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	9.04E-07	8.44E-06	1.16E-07	7.23E-07	5.00E-03	NA	1.8E-04	1.7E-03	--	--	--
Exposure Pathway/Receptor Totals												1.1E-02	1.1E-01	5.7E-07	3.6E-06	4.1E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-107

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA6

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	7.07E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.84E-06	4.52E-05	6.23E-07	3.87E-06	3.00E-04	1.50E+00	1.6E-02	1.5E-01	9.3E-07	5.8E-06	6.7E-06
Cadmium	1.44E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	9.86E-07	9.21E-06	1.27E-07	7.89E-07	5.00E-04	NA	2.0E-03	1.8E-02	--	--	--
Chromium	4.95E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	3.39E-05	3.17E-04	4.36E-06	2.71E-05	1.50E+00	NA	2.3E-05	2.1E-04	--	--	--
Selenium	1.08E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	7.40E-07	6.90E-06	9.51E-08	5.92E-07	2.00E-02	NA	3.7E-05	3.5E-04	--	--	--
Exposure Pathway/Receptor Totals												1.8E-02	1.7E-01	9.3E-07	5.8E-06	6.7E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-108

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA7

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.56E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.49E-06	4.19E-05	5.78E-07	3.59E-06	3.00E-04	1.50E+00	1.5E-02	1.4E-01	8.7E-07	5.4E-06	6.3E-06
Cadmium	1.86E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	1.27E-06	1.19E-05	1.64E-07	1.02E-06	5.00E-04	NA	2.5E-03	2.4E-02	--	--	--
Chromium	5.80E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	3.97E-05	3.71E-04	5.11E-06	3.18E-05	1.50E+00	NA	2.6E-05	2.5E-04	--	--	--
Selenium	1.21E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	8.29E-07	7.74E-06	1.07E-07	6.63E-07	5.00E-03	NA	1.7E-04	1.5E-03	--	--	--
Exposure Pathway/Receptor Totals												1.8E-02	1.7E-01	8.7E-07	5.4E-06	6.3E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-109

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
CENTRAL TENDENCY EXPOSURE - RA8

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	7.19E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.92E-06	4.60E-05	6.33E-07	3.94E-06	3.00E-04	1.50E+00	1.6E-02	1.5E-01	9.5E-07	5.9E-06	6.9E-06
Cadmium	2.65E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	1.82E-06	1.69E-05	2.33E-07	1.45E-06	5.00E-04	NA	3.6E-03	3.4E-02	--	--	--
Chromium	6.92E+01	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.74E-05	4.42E-04	6.09E-06	3.79E-05	1.50E+00	NA	3.2E-05	2.9E-04	--	--	--
Selenium	6.08E+00	6.85E-07	6.39E-06	8.81E-08	5.48E-07	4.16E-06	3.89E-05	5.35E-07	3.33E-06	5.00E-03	NA	8.3E-04	7.8E-03	--	--	--
Exposure Pathway/Receptor Totals												2.1E-02	2.0E-01	9.5E-07	5.9E-06	6.9E-06

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-110

TIER 2 HAZARD AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
ADULT TOTAL HAZARD AND RISK
CENTRAL TENDENCY EXPOSURE

ADULT TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-02	1.6E-02	1.5E-02	1.5E-02	9.9E-03	1.6E-02	1.5E-02	1.6E-02	3.6E-02	3.6E-02	3.6E-02
Cadmium	1.1E-04	1.1E-04	5.3E-05	7.0E-04	1.2E-03	0.0E+00	0.0E+00	1.1E-01	6.1E-02	7.5E-02	3.9E-02	3.4E-03	3.3E-03	1.2E-03	1.3E-03	2.0E-03	2.5E-03	3.6E-03	1.5E-01	1.0E-01	1.2E-01
Chromium	1.5E-07	1.1E-07	8.8E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-04	2.5E-04	2.7E-04	2.0E-04	2.8E-05	3.2E-05	2.3E-05	1.7E-05	2.3E-05	2.6E-05	3.2E-05	5.0E-04	4.5E-04	4.7E-04
Selenium	5.1E-04	6.4E-05	1.0E-04	2.4E-04	1.1E-03	5.4E-03	3.1E-04	5.8E-01	3.9E-01	4.5E-01	9.2E-03	2.0E-04	4.6E-04	1.2E-04	1.8E-04	1.1E-05	1.7E-04	8.3E-04	5.9E-01	4.1E-01	4.6E-01
Exposure Pathway/Receptor Totals for Surface Soil RA1	6.2E-04	1.7E-04	1.6E-04	9.4E-04	2.3E-03	5.4E-03	3.1E-04	6.8E-01	4.5E-01	5.2E-01	8.5E-02	2.0E-02	1.9E-02	1.6E-02	1.1E-02	1.8E-02	1.8E-02	2.1E-02	7.8E-01	5.5E-01	6.2E-01
Exposure Pathway/Receptor Totals for Surface Soil RA2																			7.1E-01	4.8E-01	5.5E-01
Exposure Pathway/Receptor Totals for Surface Soil RA3																			7.1E-01	4.8E-01	5.5E-01
Exposure Pathway/Receptor Totals for Surface Soil RA4																			7.1E-01	4.8E-01	5.5E-01
Exposure Pathway/Receptor Totals for Surface Soil RA5																			7.1E-01	4.7E-01	5.4E-01
Exposure Pathway/Receptor Totals for Surface Soil RA6																			7.1E-01	4.8E-01	5.5E-01
Exposure Pathway/Receptor Totals for Surface Soil RA7																			7.1E-01	4.8E-01	5.5E-01
Exposure Pathway/Receptor Totals for Surface Soil RA8																			7.2E-01	4.8E-01	5.5E-01

ADULT TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	--	--	--	--	--	--	--	--	--	--	2.1E-06	9.2E-07	8.9E-07	8.5E-07	5.7E-07	9.3E-07	8.7E-07	9.5E-07	2.1E-06	2.1E-06	2.1E-06
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals for Surface Soil RA1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E-06	9.2E-07	8.9E-07	8.5E-07	5.7E-07	9.3E-07	8.7E-07	9.5E-07	2.1E-06	2.1E-06	2.1E-06
Exposure Pathway/Receptor Totals for Surface Soil RA2																			9.2E-07	9.2E-07	9.2E-07
Exposure Pathway/Receptor Totals for Surface Soil RA3																			8.9E-07	8.9E-07	8.9E-07
Exposure Pathway/Receptor Totals for Surface Soil RA4																			8.5E-07	8.5E-07	8.5E-07
Exposure Pathway/Receptor Totals for Surface Soil RA5																			5.7E-07	5.7E-07	5.7E-07
Exposure Pathway/Receptor Totals for Surface Soil RA6																			9.3E-07	9.3E-07	9.3E-07
Exposure Pathway/Receptor Totals for Surface Soil RA7																			8.7E-07	8.7E-07	8.7E-07
Exposure Pathway/Receptor Totals for Surface Soil RA8																			9.5E-07	9.5E-07	9.5E-07

Note:

-- Information is not available.

TABLE E-111

TIER 2 HAZARD AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
CHILD TOTAL HAZARD AND RISK
CENTRAL TENDENCY EXPOSURE

CHILD TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-01	1.5E-01	1.4E-01	1.4E-01	9.3E-02	1.5E-01	1.4E-01	1.5E-01	3.4E-01	3.4E-01	3.4E-01
Cadmium	2.6E-04	2.6E-04	1.3E-04	1.0E-03	4.6E-04	0.0E+00	0.0E+00	1.8E-01	1.0E-01	1.3E-01	3.7E-01	3.2E-02	3.1E-02	1.1E-02	1.2E-02	1.8E-02	2.4E-02	3.4E-02	5.5E-01	4.7E-01	4.9E-01
Chromium	3.6E-07	2.8E-07	2.2E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.0E-04	4.3E-04	4.5E-04	1.9E-03	2.6E-04	3.0E-04	2.2E-04	1.6E-04	2.1E-04	2.5E-04	2.9E-04	2.4E-03	2.3E-03	2.3E-03
Selenium	1.2E-03	1.6E-04	2.5E-04	3.5E-04	4.0E-04	1.0E-02	1.5E-03	9.7E-01	6.6E-01	7.5E-01	8.6E-02	1.9E-03	4.3E-03	1.1E-03	1.7E-03	1.0E-04	1.5E-03	7.8E-03	1.1E+00	7.5E-01	8.5E-01
Exposure Pathway/Receptor Totals for Surface Soil RA1	1.5E-03	4.2E-04	3.8E-04	1.4E-03	8.6E-04	1.0E-02	1.5E-03	1.1E+00	7.6E-01	8.8E-01	7.9E-01	1.8E-01	1.8E-01	1.5E-01	1.1E-01	1.7E-01	1.7E-01	2.0E-01	2.0E+00	1.6E+00	1.7E+00
Exposure Pathway/Receptor Totals for Surface Soil RA2																			1.3E+00	9.6E-01	1.1E+00
Exposure Pathway/Receptor Totals for Surface Soil RA3																			1.3E+00	9.5E-01	1.1E+00
Exposure Pathway/Receptor Totals for Surface Soil RA4																			1.3E+00	9.2E-01	1.0E+00
Exposure Pathway/Receptor Totals for Surface Soil RA5																			1.3E+00	8.8E-01	1.0E+00
Exposure Pathway/Receptor Totals for Surface Soil RA6																			1.3E+00	9.4E-01	1.1E+00
Exposure Pathway/Receptor Totals for Surface Soil RA7																			1.3E+00	9.4E-01	1.1E+00
Exposure Pathway/Receptor Totals for Surface Soil RA8																			1.4E+00	9.7E-01	1.1E+00

CHILD TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	--	--	--	--	--	--	--	--	--	--	1.3E-05	5.7E-06	5.5E-06	5.3E-06	3.6E-06	5.8E-06	5.4E-06	5.9E-06	1.3E-05	1.3E-05	1.3E-05
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals for Surface Soil 1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E-05	5.7E-06	5.5E-06	5.3E-06	3.6E-06	5.8E-06	5.4E-06	5.9E-06	1.3E-05	1.3E-05	1.3E-05
Exposure Pathway/Receptor Totals for Surface Soil 2																			5.7E-06	5.7E-06	5.7E-06
Exposure Pathway/Receptor Totals for Surface Soil 3																			5.5E-06	5.5E-06	5.5E-06
Exposure Pathway/Receptor Totals for Surface Soil 4																			5.3E-06	5.3E-06	5.3E-06
Exposure Pathway/Receptor Totals for Surface Soil 5																			3.6E-06	3.6E-06	3.6E-06
Exposure Pathway/Receptor Totals for Surface Soil 6																			5.8E-06	5.8E-06	5.8E-06
Exposure Pathway/Receptor Totals for Surface Soil 7																			5.4E-06	5.4E-06	5.4E-06
Exposure Pathway/Receptor Totals for Surface Soil 8																			5.9E-06	5.9E-06	5.9E-06

Note:

-- Information is not available.

TABLE E-112

TIER 2 HAZARD AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
RISK GRAND TOTAL
CENTRAL TENDENCY EXPOSURE

RISK GRAND TOTAL																					
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of aquatic life - Salt Watershed**	**Ingestion of aquatic life - Georgetown Watershed**	**Ingestion of surface soil - RA1**	**Ingestion of surface soil - RA2**	**Ingestion of surface soil - RA3**	**Ingestion of surface soil - RA4**	**Ingestion of surface soil - RA5**	**Ingestion of surface soil - RA6**	**Ingestion of surface soil - RA7**	**Ingestion of surface soil - RA8**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Arsenic	--	--	--	--	--	--	--	--	--	--	1.5E-05	6.6E-06	6.4E-06	6.1E-06	4.1E-06	6.7E-06	6.3E-06	6.9E-06	1.5E-05	1.5E-05	1.5E-05
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals for Surface Soil RA1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E-05	6.6E-06	6.4E-06	6.1E-06	4.1E-06	6.7E-06	6.3E-06	6.9E-06	1.5E-05	1.5E-05	1.5E-05
Exposure Pathway/Receptor Totals for Surface Soil RA2																			6.6E-06	6.6E-06	6.6E-06
Exposure Pathway/Receptor Totals for Surface Soil RA3																			6.4E-06	6.4E-06	6.4E-06
Exposure Pathway/Receptor Totals for Surface Soil RA4																			6.1E-06	6.1E-06	6.1E-06
Exposure Pathway/Receptor Totals for Surface Soil RA5																			4.1E-06	4.1E-06	4.1E-06
Exposure Pathway/Receptor Totals for Surface Soil RA6																			6.7E-06	6.7E-06	6.7E-06
Exposure Pathway/Receptor Totals for Surface Soil RA7																			6.3E-06	6.3E-06	6.3E-06
Exposure Pathway/Receptor Totals for Surface Soil RA8																			6.9E-06	6.9E-06	6.9E-06

Note:

-- Information is not available.

TABLE E-113

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	2.70E-04	1.56E-03	4.66E-03	6.70E-04	3.99E-04	4.22E-07	1.26E-06	1.81E-07	1.08E-07	5.00E-04	NA	8.4E-04	2.5E-03	--	--	--
Chromium	1.07E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	1.67E-06	4.98E-06	7.17E-07	4.27E-07	1.50E+00	NA	1.1E-06	3.3E-06	--	--	--
Selenium	1.20E-02	1.56E-03	4.66E-03	6.70E-04	3.99E-04	1.88E-05	5.59E-05	8.04E-06	4.79E-06	5.00E-03	NA	3.8E-03	1.1E-02	--	--	--
Exposure Pathway/Receptor Totals												4.6E-03	1.4E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-114

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-04	1.56E-03	4.66E-03	6.70E-04	3.99E-04	1.88E-07	5.59E-07	8.04E-08	4.79E-08	5.00E-04	NA	3.8E-04	1.1E-03	--	--	--
Chromium	3.90E-04	1.56E-03	4.66E-03	6.70E-04	3.99E-04	6.10E-07	1.82E-06	2.61E-07	1.56E-07	1.50E+00	NA	4.1E-07	1.2E-06	--	--	--
Selenium	3.93E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	6.14E-06	1.83E-05	2.63E-06	1.57E-06	5.00E-03	NA	1.2E-03	3.7E-03	--	--	--
Exposure Pathway/Receptor Totals												1.6E-03	4.8E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-115

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	6.00E-05	1.56E-03	4.66E-03	6.70E-04	3.99E-04	9.38E-08	2.79E-07	4.02E-08	2.40E-08	5.00E-04	NA	1.9E-04	5.6E-04	--	--	--
Chromium	3.50E-04	1.56E-03	4.66E-03	6.70E-04	3.99E-04	5.47E-07	1.63E-06	2.35E-07	1.40E-07	1.50E+00	NA	3.6E-07	1.1E-06	--	--	--
Selenium	1.80E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	2.81E-06	8.38E-06	1.21E-06	7.19E-07	5.00E-03	NA	5.6E-04	1.7E-03	--	--	--
Exposure Pathway/Receptor Totals												7.5E-04	2.2E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-116

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF ELK AND WILDGAME - SKELETAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.30E-01	9.28E-05	2.41E-04	3.98E-05	2.06E-05	1.21E-05	3.13E-05	5.17E-06	2.68E-06	5.00E-04	NA	2.4E-02	6.3E-02	--	--	--
Selenium	4.50E-01	9.28E-05	2.41E-04	3.98E-05	2.06E-05	4.18E-05	1.08E-04	1.79E-05	9.28E-06	5.00E-03	NA	8.4E-03	2.2E-02	--	--	--
Exposure Pathway/Receptor Totals												3.2E-02	8.4E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-117

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF ELK AND WILDGAME - OFFAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	5.10E-01	2.90E-07	1.16E-06	1.24E-07	9.94E-08	1.48E-07	5.92E-07	6.34E-08	5.07E-08	5.00E-04	NA	3.0E-04	1.2E-03	--	--	--
Selenium	4.86E+00	2.90E-07	1.16E-06	1.24E-07	9.94E-08	1.41E-06	5.64E-06	6.04E-07	4.83E-07	5.00E-03	NA	2.8E-04	1.1E-03	--	--	--
Exposure Pathway/Receptor Totals												5.8E-04	2.3E-03	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-118

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF BEEF CATTLE - SKELETAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	8.70E-01	3.17E-04	5.86E-04	1.36E-04	5.02E-05	2.76E-04	5.09E-04	1.18E-04	4.37E-05	5.00E-03	NA	5.5E-02	1.0E-01	--	--	--
Exposure Pathway/Receptor Totals												5.5E-02	1.0E-01	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-119

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF BEEF CATTLE - OFFAL
REASONABLE MAXIMUM EXPOSURE

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Selenium	7.70E-01	1.40E-05	6.59E-05	5.99E-06	5.65E-06	1.08E-05	5.08E-05	4.61E-06	4.35E-06	5.00E-03	NA	2.2E-03	1.0E-02	--	--	--
Exposure Pathway/Receptor Totals												2.2E-03	1.0E-02	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-120

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	7.29E-02	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.77E-04	2.97E-04	7.59E-05	2.55E-05	5.00E-04	NA	3.5E-01	5.9E-01	--	--	--
Chromium	6.90E-01	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.68E-03	2.82E-03	7.18E-04	2.41E-04	1.50E+00	NA	1.1E-03	1.9E-03	--	--	--
Selenium	4.12E+00	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.00E-02	1.68E-02	4.29E-03	1.44E-03	5.00E-03	NA	2.0E+00	3.4E+00	--	--	--
Exposure Pathway/Receptor Totals												2.4E+00	4.0E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-121

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	3.06E-02	2.43E-03	4.08E-03	1.04E-03	3.50E-04	7.43E-05	1.25E-04	3.18E-05	1.07E-05	5.00E-04	NA	1.5E-01	2.5E-01	--	--	--
Chromium	5.20E-01	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.26E-03	2.12E-03	5.41E-04	1.82E-04	1.50E+00	NA	8.4E-04	1.4E-03	--	--	--
Selenium	2.77E+00	2.43E-03	4.08E-03	1.04E-03	3.50E-04	6.73E-03	1.13E-02	2.88E-03	9.69E-04	5.00E-03	NA	1.3E+00	2.3E+00	--	--	--
Exposure Pathway/Receptor Totals												1.5E+00	2.5E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-122

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Cadmium	1.20E-01	2.43E-03	4.08E-03	1.04E-03	3.50E-04	2.91E-04	4.90E-04	1.25E-04	4.20E-05	5.00E-04	NA	5.8E-01	9.8E-01	--	--	--
Chromium	6.50E-01	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.58E-03	2.65E-03	6.77E-04	2.27E-04	1.50E+00	NA	1.1E-03	1.8E-03	--	--	--
Selenium	5.35E+00	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.30E-02	2.18E-02	5.57E-03	1.87E-03	5.00E-03	NA	2.6E+00	4.4E+00	--	--	--
Exposure Pathway/Receptor Totals												3.2E+00	5.3E+00	0.0E+00	0.0E+00	0.0E+00

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-123

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA1

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	1.60E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	2.18E-05	2.04E-04	9.36E-06	1.75E-05	3.00E-04	1.50E+00	7.3E-02	6.8E-01	1.4E-05	2.6E-05	4.0E-05
Cadmium	2.87E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	3.92E-05	3.66E-04	1.68E-05	3.14E-05	5.00E-04	NA	7.8E-02	7.3E-01	--	--	--
Chromium	4.34E+02	1.37E-06	1.28E-05	5.87E-07	1.10E-06	5.95E-04	5.55E-03	2.55E-04	4.76E-04	1.50E+00	NA	4.0E-04	3.7E-03	--	--	--
Selenium	6.74E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	9.23E-05	8.61E-04	3.96E-05	7.38E-05	5.00E-03	NA	1.8E-02	1.7E-01	--	--	--
Exposure Pathway/Receptor Totals												1.7E-01	1.6E+00	1.4E-05	2.6E-05	4.0E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-124

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA2

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.97E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	9.55E-06	8.91E-05	4.09E-06	7.64E-06	3.00E-04	1.50E+00	3.2E-02	3.0E-01	6.1E-06	1.1E-05	1.8E-05
Cadmium	2.48E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	3.40E-06	3.17E-05	1.46E-06	2.72E-06	5.00E-04	NA	6.8E-03	6.3E-02	--	--	--
Chromium	6.16E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	8.43E-05	7.87E-04	3.61E-05	6.75E-05	1.50E+00	NA	5.6E-05	5.2E-04	--	--	--
Selenium	1.48E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	2.03E-06	1.89E-05	8.69E-07	1.62E-06	5.00E-03	NA	4.1E-04	3.8E-03	--	--	--
Exposure Pathway/Receptor Totals												3.9E-02	3.6E-01	6.1E-06	1.1E-05	1.8E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-125

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA3

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.70E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	9.18E-06	8.57E-05	3.93E-06	7.34E-06	3.00E-04	1.50E+00	3.1E-02	2.9E-01	5.9E-06	1.1E-05	1.7E-05
Cadmium	2.44E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	3.34E-06	3.12E-05	1.43E-06	2.67E-06	5.00E-04	NA	6.7E-03	6.2E-02	--	--	--
Chromium	7.10E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	9.72E-05	9.07E-04	4.17E-05	7.78E-05	1.50E+00	NA	6.5E-05	6.0E-04	--	--	--
Selenium	3.36E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	4.60E-06	4.30E-05	1.97E-06	3.68E-06	5.00E-03	NA	9.2E-04	8.6E-03	--	--	--
Exposure Pathway/Receptor Totals												3.8E-02	3.6E-01	5.9E-06	1.1E-05	1.7E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-126

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA4

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.44E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	8.82E-06	8.23E-05	3.78E-06	7.06E-06	3.00E-04	1.50E+00	2.9E-02	2.7E-01	5.7E-06	1.1E-05	1.6E-05
Cadmium	8.70E-01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.19E-06	1.11E-05	5.11E-07	9.53E-07	5.00E-04	NA	2.4E-03	2.2E-02	--	--	--
Chromium	5.09E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	6.97E-05	6.50E-04	2.99E-05	5.57E-05	1.50E+00	NA	4.6E-05	4.3E-04	--	--	--
Selenium	8.50E-01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.16E-06	1.09E-05	4.99E-07	9.32E-07	5.00E-03	NA	2.3E-04	2.2E-03	--	--	--
Exposure Pathway/Receptor Totals												3.2E-02	3.0E-01	5.7E-06	1.1E-05	1.6E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-127

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA5

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	4.35E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	5.96E-06	5.56E-05	2.55E-06	4.77E-06	3.00E-04	1.50E+00	2.0E-02	1.9E-01	3.8E-06	7.2E-06	1.1E-05
Cadmium	9.30E-01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.27E-06	1.19E-05	5.46E-07	1.02E-06	5.00E-04	NA	2.5E-03	2.4E-02	--	--	--
Chromium	3.75E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	5.13E-05	4.79E-04	2.20E-05	4.11E-05	1.50E+00	NA	3.4E-05	3.2E-04	--	--	--
Selenium	1.32E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.81E-06	1.69E-05	7.75E-07	1.45E-06	5.00E-03	NA	3.6E-04	3.4E-03	--	--	--
Exposure Pathway/Receptor Totals												2.3E-02	2.1E-01	3.8E-06	7.2E-06	1.1E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-128

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA6

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	7.07E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	9.68E-06	9.04E-05	4.15E-06	7.75E-06	3.00E-04	1.50E+00	3.2E-02	3.0E-01	6.2E-06	1.2E-05	1.8E-05
Cadmium	1.44E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.97E-06	1.84E-05	8.45E-07	1.58E-06	5.00E-04	NA	3.9E-03	3.7E-02	--	--	--
Chromium	4.95E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	6.78E-05	6.33E-04	2.91E-05	5.43E-05	1.50E+00	NA	4.5E-05	4.2E-04	--	--	--
Selenium	1.08E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.48E-06	1.38E-05	6.34E-07	1.18E-06	5.00E-03	NA	3.0E-04	2.8E-03	--	--	--
Exposure Pathway/Receptor Totals												3.7E-02	3.4E-01	6.2E-06	1.2E-05	1.8E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-129

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA7

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	6.56E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	8.99E-06	8.39E-05	3.85E-06	7.19E-06	3.00E-04	1.50E+00	3.0E-02	2.8E-01	5.8E-06	1.1E-05	1.7E-05
Cadmium	1.86E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	2.55E-06	2.38E-05	1.09E-06	2.04E-06	5.00E-04	NA	5.1E-03	4.8E-02	--	--	--
Chromium	5.80E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	7.95E-05	7.42E-04	3.41E-05	6.36E-05	1.50E+00	NA	5.3E-05	4.9E-04	--	--	--
Selenium	1.21E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	1.66E-06	1.55E-05	7.10E-07	1.33E-06	5.00E-03	NA	3.3E-04	3.1E-03	--	--	--
Exposure Pathway/Receptor Totals												3.5E-02	3.3E-01	5.8E-06	1.1E-05	1.7E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-130

TIER 2 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE - RA8

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index		Cancer Risk		
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD							
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD	ADULT	CHILD	TOTAL
Arsenic	7.19E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	9.85E-06	9.19E-05	4.22E-06	7.88E-06	3.00E-04	1.50E+00	3.3E-02	3.1E-01	6.3E-06	1.2E-05	1.8E-05
Cadmium	2.65E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	3.63E-06	3.39E-05	1.56E-06	2.90E-06	5.00E-04	NA	7.3E-03	6.8E-02	--	--	--
Chromium	6.92E+01	1.37E-06	1.28E-05	5.87E-07	1.10E-06	9.47E-05	8.84E-04	4.06E-05	7.58E-05	1.50E+00	NA	6.3E-05	5.9E-04	--	--	--
Selenium	6.08E+00	1.37E-06	1.28E-05	5.87E-07	1.10E-06	8.33E-06	7.77E-05	3.57E-06	6.66E-06	5.00E-03	NA	1.7E-03	1.6E-02	--	--	--
Exposure Pathway/Receptor Totals												4.2E-02	3.9E-01	6.3E-06	1.2E-05	1.8E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion
1	ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-131

TIER 2 HAZARD AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
ADULT TOTAL HAZARD AND RISK
REASONABLE MAXIMUM EXPOSURE

ADULT TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-02	3.2E-02	3.1E-02	2.9E-02	2.0E-02	3.2E-02	3.0E-02	3.3E-02	7.3E-02	7.3E-02	7.3E-02
Cadmium	8.4E-04	3.8E-04	1.9E-04	2.4E-02	3.0E-04	0.0E+00	0.0E+00	3.5E-01	1.5E-01	5.8E-01	7.8E-02	6.8E-03	6.7E-03	2.4E-03	2.5E-03	3.9E-03	5.1E-03	7.3E-03	4.6E-01	2.5E-01	6.9E-01
Chromium	1.1E-06	4.1E-07	3.6E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-03	8.4E-04	1.1E-03	4.0E-04	5.6E-05	6.5E-05	4.6E-05	3.4E-05	4.5E-05	5.3E-05	6.3E-05	1.5E-03	1.2E-03	1.4E-03
Selenium	3.8E-03	1.2E-03	5.6E-04	8.4E-03	2.8E-04	5.5E-02	2.2E-03	2.0E+00	1.3E+00	2.6E+00	1.8E-02	4.1E-04	9.2E-04	2.3E-04	3.6E-04	3.0E-04	3.3E-04	1.7E-03	2.1E+00	1.4E+00	2.7E+00
Exposure Pathway/Receptor Totals for Surface Soil RA1	4.6E-03	1.6E-03	7.5E-04	3.2E-02	5.8E-04	5.5E-02	2.2E-03	2.4E+00	1.5E+00	3.2E+00	1.7E-01	3.9E-02	3.8E-02	3.2E-02	2.3E-02	3.7E-02	3.5E-02	4.2E-02	2.6E+00	1.8E+00	3.4E+00
Exposure Pathway/Receptor Totals for Surface Soil RA2																			2.5E+00	1.6E+00	3.3E+00
Exposure Pathway/Receptor Totals for Surface Soil RA3																			2.5E+00	1.6E+00	3.3E+00
Exposure Pathway/Receptor Totals for Surface Soil RA4																			2.5E+00	1.6E+00	3.3E+00
Exposure Pathway/Receptor Totals for Surface Soil RA5																			2.5E+00	1.6E+00	3.3E+00
Exposure Pathway/Receptor Totals for Surface Soil RA6																			2.5E+00	1.6E+00	3.3E+00
Exposure Pathway/Receptor Totals for Surface Soil RA7																			2.5E+00	1.6E+00	3.3E+00
Exposure Pathway/Receptor Totals for Surface Soil RA8																			2.5E+00	1.6E+00	3.3E+00

ADULT TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-05	6.1E-06	5.9E-06	5.7E-06	3.8E-06	5.7E-06	5.7E-06	5.7E-06	1.4E-05	1.4E-05	1.4E-05
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals for Surface Soil RA1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-05	6.1E-06	5.9E-06	5.7E-06	3.8E-06	5.7E-06	5.7E-06	5.7E-06	1.4E-05	1.4E-05	1.4E-05
Exposure Pathway/Receptor Totals for Surface Soil RA2																			6.1E-06	6.1E-06	6.1E-06
Exposure Pathway/Receptor Totals for Surface Soil RA3																			5.9E-06	5.9E-06	5.9E-06
Exposure Pathway/Receptor Totals for Surface Soil RA4																			5.7E-06	5.7E-06	5.7E-06
Exposure Pathway/Receptor Totals for Surface Soil RA5																			3.8E-06	3.8E-06	3.8E-06
Exposure Pathway/Receptor Totals for Surface Soil RA6																			5.7E-06	5.7E-06	5.7E-06
Exposure Pathway/Receptor Totals for Surface Soil RA7																			5.7E-06	5.7E-06	5.7E-06
Exposure Pathway/Receptor Totals for Surface Soil RA8																			5.7E-06	5.7E-06	5.7E-06

Note:

-- Information is not available.

TABLE E-132

TIER 2 HAZARD AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
CHILD TOTAL
REASONABLE MAXIMUM EXPOSURE

CHILD TOTAL HAZARD

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	3.0E-01	2.9E-01	2.7E-01	1.9E-01	3.0E-01	2.8E-01	3.1E-01	6.8E-01	6.8E-01	6.8E-01
Cadmium	2.5E-03	1.1E-03	5.6E-04	6.3E-02	1.2E-03	0.0E+00	0.0E+00	5.9E-01	2.5E-01	9.8E-01	7.3E-01	6.3E-02	6.2E-02	2.2E-02	2.4E-02	3.7E-02	4.8E-02	6.8E-02	1.4E+00	1.0E+00	1.8E+00
Chromium	3.3E-06	1.2E-06	1.1E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-03	1.4E-03	1.8E-03	3.7E-03	5.2E-04	6.0E-04	4.3E-04	3.2E-04	4.2E-04	4.9E-04	5.9E-04	5.6E-03	5.1E-03	5.5E-03
Selenium	1.1E-02	3.7E-03	1.7E-03	2.2E-02	1.1E-03	1.0E-01	1.0E-02	3.4E+00	2.3E+00	4.4E+00	1.7E-01	3.8E-03	8.6E-03	2.2E-03	3.4E-03	2.8E-03	3.1E-03	1.6E-02	3.7E+00	2.6E+00	4.7E+00
Exposure Pathway/Receptor Totals for Surface Soil RA1	1.4E-02	4.8E-03	2.2E-03	8.4E-02	2.3E-03	1.0E-01	1.0E-02	4.0E+00	2.5E+00	5.3E+00	1.6E+00	3.6E-01	3.6E-01	3.0E-01	2.1E-01	3.4E-01	3.3E-01	3.9E-01	5.8E+00	4.3E+00	7.1E+00
Exposure Pathway/Receptor Totals for Surface Soil RA2																			4.5E+00	3.1E+00	5.9E+00
Exposure Pathway/Receptor Totals for Surface Soil RA3																			4.5E+00	3.1E+00	5.9E+00
Exposure Pathway/Receptor Totals for Surface Soil RA4																			4.5E+00	3.0E+00	5.8E+00
Exposure Pathway/Receptor Totals for Surface Soil RA5																			4.4E+00	2.9E+00	5.8E+00
Exposure Pathway/Receptor Totals for Surface Soil RA6																			4.5E+00	3.1E+00	5.9E+00
Exposure Pathway/Receptor Totals for Surface Soil RA7																			4.5E+00	3.0E+00	5.9E+00
Exposure Pathway/Receptor Totals for Surface Soil RA8																			4.6E+00	3.1E+00	5.9E+00

CHILD TOTAL RISK

Chemical of Potential Concern	Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed	Ingestion of surface water - Salt Watershed	Ingestion of surface water - Georgetown Watershed	Ingestion of elk and wild game - skeletal	Ingestion of elk and wild game - offal	Ingestion of beef cattle - skeletal	Ingestion of beef cattle - offal	Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed	Ingestion of aquatic life - Salt Watershed	Ingestion of aquatic life - Georgetown Watershed	Ingestion of surface soil - RA1	Ingestion of surface soil - RA2	Ingestion of surface soil - RA3	Ingestion of surface soil - RA4	Ingestion of surface soil - RA5	Ingestion of surface soil - RA6	Ingestion of surface soil - RA7	Ingestion of surface soil - RA8	Blackfoot/ Little Blackfoot Watershed TOTAL	Salt Watershed TOTAL	Georgetown Watershed TOTAL
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E-05	1.1E-05	1.1E-05	1.1E-05	7.2E-06	1.2E-05	1.1E-05	1.1E-05	2.6E-05	2.6E-05	2.6E-05
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals for Surface Soil RA1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E-05	1.1E-05	1.1E-05	1.1E-05	7.2E-06	1.2E-05	1.1E-05	1.1E-05	2.6E-05	2.6E-05	2.6E-05
Exposure Pathway/Receptor Totals for Surface Soil RA2																			1.1E-05	1.1E-05	1.1E-05
Exposure Pathway/Receptor Totals for Surface Soil RA3																			1.1E-05	1.1E-05	1.1E-05
Exposure Pathway/Receptor Totals for Surface Soil RA4																			1.1E-05	1.1E-05	1.1E-05
Exposure Pathway/Receptor Totals for Surface Soil RA5																			7.2E-06	7.2E-06	7.2E-06
Exposure Pathway/Receptor Totals for Surface Soil RA6																			1.2E-05	1.2E-05	1.2E-05
Exposure Pathway/Receptor Totals for Surface Soil RA7																			1.1E-05	1.1E-05	1.1E-05
Exposure Pathway/Receptor Totals for Surface Soil RA8																			1.1E-05	1.1E-05	1.1E-05

Note:

-- Information is not available.

TABLE E-133

TIER 2 HAZARD AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
RISK GRAND TOTAL
REASONABLE MAXIMUM EXPOSURE

RISK GRAND TOTAL																					
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of elk and wild game - skeletal**	**Ingestion of elk and wild game - offal**	**Ingestion of beef cattle - skeletal**	**Ingestion of beef cattle - offal**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of aquatic life - Salt Watershed**	**Ingestion of aquatic life - Georgetown Watershed**	**Ingestion of surface soil - RA1**	**Ingestion of surface soil - RA2**	**Ingestion of surface soil - RA3**	**Ingestion of surface soil - RA4**	**Ingestion of surface soil - RA5**	**Ingestion of surface soil - RA6**	**Ingestion of surface soil - RA7**	**Ingestion of surface soil - RA8**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Arsenic	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-05	1.8E-05	1.7E-05	1.6E-05	1.1E-05	1.8E-05	1.7E-05	1.8E-05	4.0E-05	4.0E-05	4.0E-05
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Exposure Pathway/Receptor Totals for Surface Soil RA1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-05	1.8E-05	1.7E-05	1.6E-05	1.1E-05	1.8E-05	1.7E-05	1.8E-05	4.0E-05	4.0E-05	4.0E-05
Exposure Pathway/Receptor Totals for Surface Soil RA2																			1.8E-05	1.8E-05	1.8E-05
Exposure Pathway/Receptor Totals for Surface Soil RA3																			1.7E-05	1.7E-05	1.7E-05
Exposure Pathway/Receptor Totals for Surface Soil RA4																			1.6E-05	1.6E-05	1.6E-05
Exposure Pathway/Receptor Totals for Surface Soil RA5																			1.1E-05	1.1E-05	1.1E-05
Exposure Pathway/Receptor Totals for Surface Soil RA6																			1.8E-05	1.8E-05	1.8E-05
Exposure Pathway/Receptor Totals for Surface Soil RA7																			1.7E-05	1.7E-05	1.7E-05
Exposure Pathway/Receptor Totals for Surface Soil RA8																			1.8E-05	1.8E-05	1.8E-05

Note:

-- Information is not available.

TABLE E-134

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.39E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	2.30E-07	5.64E-07	2.96E-08	4.83E-08	5.00E-04	NA	4.6E-04	1.1E-03
Chromium	3.28E-06	1.66E-04	4.05E-04	2.13E-05	3.48E-05	5.43E-10	1.33E-09	6.98E-11	1.14E-10	1.50E+00	NA	3.6E-10	8.9E-10
Selenium	2.33E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	3.86E-07	9.45E-07	4.96E-08	8.10E-08	5.00E-03	NA	7.7E-05	1.9E-04
Exposure Pathway/Receptor Totals												5.4E-04	1.3E-03

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-135

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.20E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.98E-07	4.85E-07	2.55E-08	4.16E-08	5.00E-04	NA	4.0E-04	9.7E-04
Chromium	3.51E-06	1.66E-04	4.05E-04	2.13E-05	3.48E-05	5.81E-10	1.42E-09	7.47E-11	1.22E-10	1.50E+00	NA	3.9E-10	9.5E-10
Selenium	5.59E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	9.25E-08	2.27E-07	1.19E-08	1.94E-08	5.00E-03	NA	1.8E-05	4.5E-05
Exposure Pathway/Receptor Totals												4.1E-04	1.0E-03

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-136

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	mg/kg/day)-1	ADULT	CHILD
Cadmium	1.00E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.66E-07	4.05E-07	2.13E-08	3.48E-08	5.00E-04	NA	3.3E-04	8.1E-04
Chromium	5.00E-06	1.66E-04	4.05E-04	2.13E-05	3.48E-05	8.28E-10	2.03E-09	1.06E-10	1.74E-10	1.50E+00	NA	5.5E-10	1.4E-09
Selenium	6.11E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.01E-07	2.48E-07	1.30E-08	2.12E-08	5.00E-03	NA	2.0E-05	5.0E-05
Exposure Pathway/Receptor Totals												3.5E-04	8.6E-04

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-137

TEIR 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	7.40E-03	1.71E-04	2.87E-04	2.20E-05	2.46E-05	1.27E-06	2.12E-06	1.63E-07	1.82E-07	5.00E-04	NA	2.5E-03	4.2E-03
Selenium	4.50E-01	1.71E-04	2.87E-04	2.20E-05	2.46E-05	7.71E-05	1.29E-04	9.92E-06	1.11E-05	5.00E-03	NA	1.5E-02	2.6E-02
Exposure Pathway/Receptor Totals												1.8E-02	3.0E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-138

TIER 3 EXPOSURE AND HAZARD RESULTS FOR NATIVE AMERICAN RECEPTORS
ADULT TOTAL HAZARD
CENTRAL TENDENCY EXPOSURE

ADULT TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	4.6E-04	4.0E-04	3.3E-04	2.5E-03	3.0E-03	4.0E-04	3.3E-04
Chromium	3.6E-10	3.9E-10	5.5E-10	--	3.6E-10	3.9E-10	5.5E-10
Selenium	7.7E-05	1.8E-05	2.0E-05	1.5E-02	1.6E-02	1.8E-05	2.0E-05
Exposure Pathway/Receptor Totals	5.4E-04	4.1E-04	3.5E-04	1.8E-02	1.9E-02	4.1E-04	3.5E-04

Note:

-- Information is not available.

TABLE E-139

TIER 3 EXPOSURE AND HAZARD RESULTS FOR NATIVE AMERICAN RECEPTORS
CHILD TOTAL HAZARD
CENTRAL TENDENCY EXPOSURE

CHILD TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	1.1E-03	9.7E-04	8.1E-04	4.2E-03	5.4E-03	9.7E-04	8.1E-04
Chromium	8.9E-10	9.5E-10	1.4E-09	--	8.9E-10	9.5E-10	1.4E-09
Selenium	1.9E-04	4.5E-05	5.0E-05	2.6E-02	2.6E-02	4.5E-05	5.0E-05
Exposure Pathway/Receptor Totals	1.3E-03	1.0E-03	8.6E-04	3.0E-02	3.1E-02	1.0E-03	8.6E-04

Note:

-- Information is not available.

TABLE E-140

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.71E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	9.44E-07	2.81E-06	4.04E-07	2.41E-07	5.00E-04	NA	1.9E-03	5.6E-03
Chromium	5.26E-06	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.90E-09	8.65E-09	1.24E-09	7.41E-10	1.50E+00	NA	1.9E-09	5.8E-09
Selenium	5.42E-02	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.99E-05	8.91E-05	1.28E-05	7.64E-06	5.00E-03	NA	6.0E-03	1.8E-02
Exposure Pathway/Receptor Totals												7.9E-03	2.3E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-141

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	2.00E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.10E-06	3.29E-06	4.73E-07	2.82E-07	5.00E-04	NA	2.2E-03	6.6E-03
Chromium	7.00E-06	5.52E-04	1.64E-03	2.37E-04	1.41E-04	3.86E-09	1.15E-08	1.66E-09	9.86E-10	1.50E+00	NA	2.6E-09	7.7E-09
Selenium	7.30E-02	5.52E-04	1.64E-03	2.37E-04	1.41E-04	4.03E-05	1.20E-04	1.73E-05	1.03E-05	5.00E-03	NA	8.1E-03	2.4E-02
Exposure Pathway/Receptor Totals												1.0E-02	3.1E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-142

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.00E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	5.52E-07	1.64E-06	2.37E-07	1.41E-07	5.00E-04	NA	1.1E-03	3.3E-03
Chromium	5.00E-06	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.76E-09	8.22E-09	1.18E-09	7.05E-10	1.50E+00	NA	1.8E-09	5.5E-09
Selenium	3.43E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.89E-06	5.64E-06	8.11E-07	4.83E-07	5.00E-03	NA	3.8E-04	1.1E-03
Exposure Pathway/Receptor Totals												1.5E-03	4.4E-03

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-143

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR NATIVE AMERICAN RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.26E-02	5.36E-04	9.00E-04	2.30E-04	7.71E-05	6.75E-06	1.13E-05	2.89E-06	9.72E-07	5.00E-04	NA	1.4E-02	2.3E-02
Selenium	7.70E-01	5.36E-04	9.00E-04	2.30E-04	7.71E-05	4.13E-04	6.93E-04	1.77E-04	5.94E-05	5.00E-03	NA	8.3E-02	1.4E-01
Exposure Pathway/Receptor Totals												9.6E-02	1.6E-01

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-144

TIER 3 EXPOSURE AND HAZARD RESULTS FOR NATIVE AMERICAN RECEPTORS
ADULT TOTAL HAZARD
REASONABLE MAXIMUM EXPOSURE

ADULT TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgtown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgtown Watershed TOTAL**
Cadmium	1.9E-03	2.2E-03	1.1E-03	1.4E-02	1.5E-02	2.2E-03	1.1E-03
Chromium	1.9E-09	2.6E-09	1.8E-09	--	1.9E-09	2.6E-09	1.8E-09
Selenium	6.0E-03	8.1E-03	3.8E-04	8.3E-02	8.8E-02	8.1E-03	3.8E-04
Exposure Pathway/Receptor Totals	7.9E-03	1.0E-02	1.5E-03	9.6E-02	1.0E-01	1.0E-02	1.5E-03

Note:

-- Information is not available.

TABLE E-145

TIER 3 EXPOSURE AND HAZARD RESULTS FOR NATIVE AMERICAN RECEPTORS
CHILD TOTAL HAZARD
REASONABLE MAXIMUM EXPOSURE

CHILD TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgtown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgtown Watershed TOTAL**
Cadmium	5.6E-03	6.6E-03	3.3E-03	2.3E-02	2.8E-02	6.6E-03	3.3E-03
Chromium	5.8E-09	7.7E-09	5.5E-09	--	5.8E-09	7.7E-09	5.5E-09
Selenium	1.8E-02	2.4E-02	1.1E-03	1.4E-01	1.6E-01	2.4E-02	1.1E-03
Exposure Pathway/Receptor Totals	2.3E-02	3.1E-02	4.4E-03	1.6E-01	1.8E-01	3.1E-02	4.4E-03

Note:

-- Information is not available.

TABLE E-146

TIER 3 EXPOSURE AND HAZARD RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

		ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD					
	EPC	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	RfD	Slope Factor	Hazard Index	
Potential Concern	**(mg/kg)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)-1**	**ADULT**	**CHILD**
Cadmium	1.39E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	2.30E-07	5.64E-07	2.96E-08	4.83E-08	1.50E+00	NA	1.5E-07	3.8E-07
Chromium	3.28E-06	1.66E-04	4.05E-04	2.13E-05	3.48E-05	5.43E-10	1.33E-09	6.98E-11	1.14E-10	6.00E-02	NA	9.1E-09	2.2E-08
Selenium	2.33E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	3.86E-07	9.45E-07	4.96E-08	8.10E-08	5.00E-03	NA	7.7E-05	1.9E-04
Exposure Pathway/Receptor Totals												7.7E-05	1.9E-04

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-147

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.20E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.98E-07	4.85E-07	2.55E-08	4.16E-08	1.50E+00	NA	1.3E-07	3.2E-07
Chromium	3.51E-06	1.66E-04	4.05E-04	2.13E-05	3.48E-05	5.81E-10	1.42E-09	7.47E-11	1.22E-10	6.00E-02	NA	9.7E-09	2.4E-08
Selenium	5.59E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	9.25E-08	2.27E-07	1.19E-08	1.94E-08	5.00E-03	NA	1.8E-05	4.5E-05
Exposure Pathway/Receptor Totals												1.9E-05	4.6E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-148

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.00E-03	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.66E-07	4.05E-07	2.13E-08	3.48E-08	1.50E+00	NA	1.1E-07	2.7E-07
Chromium	5.00E-06	1.66E-04	4.05E-04	2.13E-05	3.48E-05	8.28E-10	2.03E-09	1.06E-10	1.74E-10	6.00E-02	NA	1.4E-08	3.4E-08
Selenium	6.11E-04	1.66E-04	4.05E-04	2.13E-05	3.48E-05	1.01E-07	2.48E-07	1.30E-08	2.12E-08	5.00E-03	NA	2.0E-05	5.0E-05
Exposure Pathway/Receptor Totals												2.0E-05	5.0E-05

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-149

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.50E-03	1.14E-04	1.93E-04	1.47E-05	1.66E-05	1.71E-07	2.90E-07	2.20E-08	2.49E-08	1.50E+00	NA	1.1E-07	1.9E-07
Selenium	1.92E+00	1.14E-04	1.93E-04	1.47E-05	1.66E-05	2.19E-04	3.71E-04	2.82E-05	3.18E-05	5.00E-03	NA	4.4E-02	7.4E-02
Exposure Pathway/Receptor Totals												4.4E-02	7.4E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-150

TIER 3 EXPOSURE AND HAZARD RESULTS FOR RECREATIONAL RECEPTORS
ADULT TOTAL HAZARD
CENTRAL TENDENCY EXPOSURE

ADULT TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Boron	4.6E-04	4.0E-04	3.3E-04	1.7E-03	2.2E-03	4.0E-04	3.3E-04
Cadmium	1.5E-07	1.3E-07	1.1E-07	1.1E-07	2.7E-07	1.3E-07	1.1E-07
Nickel	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Exposure Pathway/Receptor Totals	7.7E-05	1.9E-05	2.0E-05	4.4E-02	4.4E-02	1.9E-05	2.0E-05

Note:

-- Information is not available.

TABLE E-151

TIER 3 EXPOSURE AND HAZARD RESULTS FOR RECREATIONAL RECEPTORS
CHILD TOTAL HAZARD
REASONABLE MAXIMUM EXPOSURE

CHILD TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Boron	1.1E-03	9.7E-04	8.1E-04	2.9E-03	4.0E-03	9.7E-04	8.1E-04
Cadmium	3.8E-07	3.2E-07	2.7E-07	1.9E-07	5.7E-07	3.2E-07	2.7E-07
Nickel	0.0E+00	0.0E+00	0.0E+00	0.0E+00	--	--	--
Exposure Pathway/Receptor Totals	1.9E-04	4.6E-05	5.0E-05	7.4E-02	7.4E-02	4.6E-05	5.0E-05

Note:

-- Information is not available.

TABLE E-152

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.71E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	9.44E-07	2.81E-06	4.04E-07	2.41E-07	5.00E-04	NA	1.9E-03	5.6E-03
Chromium	5.26E-06	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.90E-09	8.65E-09	1.24E-09	7.41E-10	1.50E+00	NA	1.9E-09	5.8E-09
Selenium	5.42E-02	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.99E-05	8.91E-05	1.28E-05	7.64E-06	5.00E-03	NA	6.0E-03	1.8E-02
Exposure Pathway/Receptor Totals												7.9E-03	2.3E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-153

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	2.00E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.10E-06	3.29E-06	4.73E-07	2.82E-07	5.00E-04	NA	2.2E-03	6.6E-03
Chromium	7.00E-06	5.52E-04	1.64E-03	2.37E-04	1.41E-04	3.86E-09	1.15E-08	1.66E-09	9.86E-10	1.50E+00	NA	2.6E-09	7.7E-09
Selenium	7.30E-02	5.52E-04	1.64E-03	2.37E-04	1.41E-04	4.03E-05	1.20E-04	1.73E-05	1.03E-05	5.00E-03	NA	8.1E-03	2.4E-02
Exposure Pathway/Receptor Totals												1.0E-02	3.1E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-154

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.00E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	5.52E-07	1.64E-06	2.37E-07	1.41E-07	5.00E-04	NA	1.1E-03	3.3E-03
Chromium	5.00E-06	5.52E-04	1.64E-03	2.37E-04	1.41E-04	2.76E-09	8.22E-09	1.18E-09	7.05E-10	1.50E+00	NA	1.8E-09	5.5E-09
Selenium	3.43E-03	5.52E-04	1.64E-03	2.37E-04	1.41E-04	1.89E-06	5.64E-06	8.11E-07	4.83E-07	5.00E-03	NA	3.8E-04	1.1E-03
Exposure Pathway/Receptor Totals												1.5E-03	4.4E-03

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-155

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR RECREATIONAL RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	3.15E-02	3.57E-04	6.00E-04	1.53E-04	5.14E-05	1.13E-05	1.89E-05	4.82E-06	1.62E-06	5.00E-04	NA	2.3E-02	3.8E-02
Selenium	2.56E+00	3.57E-04	6.00E-04	1.53E-04	5.14E-05	9.14E-04	1.54E-03	3.92E-04	1.32E-04	5.00E-03	NA	1.8E-01	3.1E-01
Exposure Pathway/Receptor Totals												2.1E-01	3.5E-01

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-156

TIER 3 EXPOSURE AND HAZARD RESULTS FOR RECREATIONAL RECEPTORS
ADULT TOTAL HAZARD
REASONABLE MAXIMUM EXPOSURE

ADULT TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	1.9E-03	2.2E-03	1.1E-03	2.3E-02	2.4E-02	2.2E-03	1.1E-03
Chromium	1.9E-09	2.6E-09	1.8E-09	--	1.9E-09	2.6E-09	1.8E-09
Selenium	6.0E-03	8.1E-03	3.8E-04	1.8E-01	1.9E-01	8.1E-03	3.8E-04
Exposure Pathway/Receptor Totals	7.9E-03	1.0E-02	1.5E-03	2.1E-01	2.1E-01	1.0E-02	1.5E-03

Note:

-- Information is not available.

TABLE E-157

TIER 3 EXPOSURE AND HAZARD RESULTS FOR RECREATIONAL RECEPTORS
CHILD TOTAL HAZARD
REASONABLE MAXIMUM EXPOSURE

CHILD TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	5.6E-03	6.6E-03	3.3E-03	3.8E-02	4.3E-02	6.6E-03	3.3E-03
Chromium	5.8E-09	7.7E-09	5.5E-09	--	5.8E-09	7.7E-09	5.5E-09
Selenium	1.8E-02	2.4E-02	1.1E-03	3.1E-01	3.3E-01	2.4E-02	1.1E-03
Exposure Pathway/Receptor Totals	2.3E-02	3.1E-02	4.4E-03	3.5E-01	3.7E-01	3.1E-02	4.4E-03

Note:

-- Information is not available.

TABLE E-158

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.39E-03	4.41E-04	1.08E-03	5.68E-05	9.27E-05	6.14E-07	1.50E-06	7.89E-08	1.29E-07	5.00E-04	NA	1.2E-03	3.0E-03
Chromium	3.28E-06	4.41E-04	1.08E-03	5.68E-05	9.27E-05	1.45E-09	3.55E-09	1.86E-10	3.04E-10	1.50E+00	NA	9.7E-10	2.4E-09
Selenium	2.33E-03	4.41E-04	1.08E-03	5.68E-05	9.27E-05	1.03E-06	2.52E-06	1.32E-07	2.16E-07	5.00E-03	NA	2.1E-04	5.0E-04
Exposure Pathway/Receptor Totals												1.4E-03	3.5E-03

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-159

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.20E-03	4.41E-04	1.08E-03	5.68E-05	9.27E-05	5.29E-07	1.29E-06	6.80E-08	1.11E-07	5.00E-04	NA	1.1E-03	2.6E-03
Chromium	3.51E-06	4.41E-04	1.08E-03	5.68E-05	9.27E-05	1.55E-09	3.80E-09	1.99E-10	3.25E-10	1.50E+00	NA	1.0E-09	2.5E-09
Selenium	5.59E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	2.47E-07	6.04E-07	3.17E-08	5.18E-08	5.00E-03	NA	4.9E-05	1.2E-04
Exposure Pathway/Receptor Totals												1.1E-03	2.7E-03

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-160

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
CENTRAL TENDENCY EXPOSURE - GEORGETOWN WATERSHED

		ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD					
	EPC	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	RfD	Slope Factor	Hazard Index	
Chemical of Potential Concern	**(mg/kg)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)**	**(mg/kg/day)-1**	**ADULT**	**CHILD**
Cadmium	1.00E-03	4.41E-04	1.08E-03	5.68E-05	9.27E-05	4.41E-07	1.08E-06	5.68E-08	9.27E-08	5.00E-04	NA	8.8E-04	2.2E-03
Chromium	5.00E-06	4.41E-04	1.08E-03	5.68E-05	9.27E-05	2.21E-09	5.41E-09	2.84E-10	4.63E-10	1.50E+00	NA	1.5E-09	3.6E-09
Selenium	6.11E-04	4.41E-04	1.08E-03	5.68E-05	9.27E-05	2.70E-07	6.61E-07	3.47E-08	5.66E-08	5.00E-03	NA	5.4E-05	1.3E-04
Exposure Pathway/Receptor Totals												9.4E-04	2.3E-03

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-161

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
CENTRAL TENDENCY EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

		ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD					
	EPC	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	RfD	Slope Factor	Hazard Index	
Chemical of Potential Concern	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.50E-03	1.00E-03	1.68E-03	1.29E-04	1.44E-04	1.50E-06	2.52E-06	1.93E-07	2.16E-07	5.00E-04	NA	3.0E-03	5.0E-03
Selenium	1.92E+00	1.00E-03	1.68E-03	1.29E-04	1.44E-04	1.92E-03	3.23E-03	2.47E-04	2.76E-04	5.00E-03	NA	3.8E-01	6.5E-01
Exposure Pathway/Receptor Totals												3.9E-01	6.5E-01

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-162

TIER 3 EXPOSURE AND HAZARD RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
ADULT TOTAL HAZARD
CENTRAL TENDENCY EXPOSURE

ADULT TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	1.2E-03	1.1E-03	8.8E-04	3.0E-03	4.2E-03	1.1E-03	8.8E-04
Chromium	9.7E-10	1.0E-09	1.5E-09	0.0E+00	9.7E-10	1.0E-09	1.5E-09
Selenium	2.1E-04	4.9E-05	5.4E-05	3.8E-01	3.8E-01	4.9E-05	5.4E-05
Exposure Pathway/Receptor Totals	1.4E-03	1.1E-03	9.4E-04	3.9E-01	3.9E-01	1.1E-03	9.4E-04

TABLE E-163

TIER 3 EXPOSURE AND HAZARD RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
CHILD TOTAL HAZARD
CENTRAL TENDENCY EXPOSURE

CHILD TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	3.0E-03	2.6E-03	2.2E-03	5.0E-03	8.0E-03	2.6E-03	2.2E-03
Chromium	2.4E-09	2.5E-09	3.6E-09	0.0E+00	2.4E-09	2.5E-09	3.6E-09
Selenium	5.0E-04	1.2E-04	1.3E-04	6.5E-01	6.5E-01	1.2E-04	1.3E-04
Exposure Pathway/Receptor Totals	3.5E-03	2.7E-03	2.3E-03	6.5E-01	6.5E-01	2.7E-03	2.3E-03

TABLE E-164

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.71E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	2.67E-06	7.96E-06	1.15E-06	6.83E-07	5.00E-04	NA	5.3E-03	1.6E-02
Chromium	5.26E-06	1.56E-03	4.66E-03	6.70E-04	3.99E-04	8.22E-09	2.45E-08	3.52E-09	2.10E-09	1.50E+00	NA	5.5E-09	1.6E-08
Selenium	5.42E-02	1.56E-03	4.66E-03	6.70E-04	3.99E-04	8.47E-05	2.52E-04	3.63E-05	2.16E-05	5.00E-03	NA	1.7E-02	5.0E-02
Exposure Pathway/Receptor Totals												2.2E-02	6.6E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-165

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - SALT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	2.00E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	3.13E-06	9.32E-06	1.34E-06	7.98E-07	5.00E-04	NA	6.3E-03	1.9E-02
Chromium	7.00E-06	1.56E-03	4.66E-03	6.70E-04	3.99E-04	1.09E-08	3.26E-08	4.69E-09	2.79E-09	1.50E+00	NA	7.3E-09	2.2E-08
Selenium	7.30E-02	1.56E-03	4.66E-03	6.70E-04	3.99E-04	1.14E-04	3.40E-04	4.89E-05	2.91E-05	5.00E-03	NA	2.3E-02	6.8E-02
Exposure Pathway/Receptor Totals												2.9E-02	8.7E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-166

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF SURFACE WATER
REASONABLE MAXIMUM EXPOSURE - GEORGETOWN WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD				
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1	ADULT	CHILD
Cadmium	1.00E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	1.56E-06	4.66E-06	6.70E-07	3.99E-07	5.00E-04	NA	3.1E-03	9.3E-03
Chromium	5.00E-06	1.56E-03	4.66E-03	6.70E-04	3.99E-04	7.82E-09	2.33E-08	3.35E-09	2.00E-09	1.50E+00	NA	5.2E-09	1.6E-08
Selenium	3.43E-03	1.56E-03	4.66E-03	6.70E-04	3.99E-04	5.36E-06	1.60E-05	2.30E-06	1.37E-06	5.00E-03	NA	1.1E-03	3.2E-03
Exposure Pathway/Receptor Totals												4.2E-03	1.3E-02

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-167

TIER 3 EXPOSURE, HAZARD, AND RISK RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
INGESTION OF AQUATIC LIFE
REASONABLE MAXIMUM EXPOSURE - BLACKFOOT/LITTLE BLACKFOOT WATERSHED

Chemical of Potential Concern	EPC	ADD Exposure Factor[1]		LADD Exposure Factor[1]		ADD		LADD		RfD	Slope Factor	Hazard Index	
		ADULT	CHILD	ADULT	CHILD	ADULT	CHILD	ADULT	CHILD			ADULT	CHILD
	(mg/kg)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)	(mg/kg/day)-1		
Cadmium	1.26E-02	2.43E-03	4.08E-03	1.04E-03	3.50E-04	3.06E-05	5.14E-05	1.31E-05	4.41E-06	5.00E-04	NA	6.1E-02	1.0E-01
Selenium	7.70E-01	2.43E-03	4.08E-03	1.04E-03	3.50E-04	1.87E-03	3.14E-03	8.01E-04	2.69E-04	5.00E-03	NA	3.7E-01	6.3E-01
Exposure Pathway/Receptor Totals												4.4E-01	7.3E-01

Notes:

--	Value could not be calculated
ADD	Average daily dose
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NA	Information not available
LADD	Lifetime average daily dose
RfD	Reference dose ingestion

1 ADD and LADD exposure factors represent the product of all exposure parameter values other than EPC

TABLE E-168

TIER 3 EXPOSURE AND HAZARD RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
ADULT TOTAL HAZARD
REASONABLE MAXIMUM EXPOSURE

ADULT TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	5.3E-03	6.3E-03	3.1E-03	6.1E-02	6.7E-02	6.3E-03	3.1E-03
Chromium	5.5E-09	7.3E-09	5.2E-09	--	5.5E-09	7.3E-09	5.2E-09
Selenium	1.7E-02	2.3E-02	1.1E-03	3.7E-01	3.9E-01	2.3E-02	1.1E-03
Exposure Pathway/Receptor Totals	2.2E-02	2.9E-02	4.2E-03	4.4E-01	4.6E-01	2.9E-02	4.2E-03

Note:

-- Information is not available.

TABLE E-169

TIER 3 EXPOSURE AND HAZARD RESULTS FOR SUBSISTENCE LIFESTYLE RECEPTORS
CHILD TOTAL HAZARD
REASONABLE MAXIMUM EXPOSURE

CHILD TOTAL HAZARD							
Chemical of Potential Concern	**Ingestion of surface water - Blackfoot/ Little Blackfoot Watershed**	**Ingestion of surface water - Salt Watershed**	**Ingestion of surface water - Georgetown Watershed**	**Ingestion of aquatic life - Blackfoot/ Little Blackfoot Watershed**	**Blackfoot/ Little Blackfoot Watershed TOTAL**	**Salt Watershed TOTAL**	**Georgetown Watershed TOTAL**
Cadmium	1.6E-02	1.9E-02	9.3E-03	1.0E-01	1.2E-01	1.9E-02	9.3E-03
Chromium	1.6E-08	2.2E-08	1.6E-08	--	1.6E-08	2.2E-08	1.6E-08
Selenium	5.0E-02	6.8E-02	3.2E-03	6.3E-01	6.8E-01	6.8E-02	3.2E-03
Exposure Pathway/Receptor Totals	6.6E-02	8.7E-02	1.3E-02	7.3E-01	8.0E-01	8.7E-02	1.3E-02

Note:

-- Information is not available.

APPENDIX F

ECOLOGICAL TOXICITY PROFILES

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ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
BCF	Bioconcentration factor
BHC	Gamma-benzene hexachloride
COPEC	Chemical of potential ecological concern
DCE	Dichloroethene
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethene
DDT	Dichlorodiphenyltrichloroethane
DNA	Deoxyribonucleic acid
EC	Effects concentration
EPA	U.S. Environmental Protection Agency
GTF	Glucose tolerance factor
HSDB	Hazardous Substances Database
ICA	International Copper Association
ILL	Incipient lethal level
Koc	Organic carbon/water partition coefficient
Kow	Octanol-Water coefficient
LC	Lethal concentration
LOEC	Lowest observed effect concentration
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
mg/L	Milligram per liter
mg/m^3	Milligram per cubic meter
NAS	National Academy of Sciences
NCTS	Naval Computer and Telecommunications Station
NOAEL	No observed adverse effect level
NRCC	National Research Council Canada
PAH	Polynuclear aromatic hydrocarbon
PCA	1,1,2,2-tetrachloroethane
PCB	Polychlorinated biphenyl
PCE	Perchloroethylene
PCDD	Polychlorodibenzodioxin
PCDF	Polychlorodibenzofuran
PCP	Pentachlorophenol
ppm	Part per million
PRG	Preliminary remediation goal

ACRONYMS AND ABBREVIATIONS (continued)

redox	Oxidation-reduction
RBC	Risk-based concentration
TCDD	2,3,7,8-tetrachlorodibenzodioxin
TCE	Trichloroethylene
TRV	Toxicity reference value
USFWS	U.S. Fish and Wildlife Service
USPHS	U.S. Public Health Service
VOC	Volatile organic compound
WHO	World Health Organization

1.0 INTRODUCTION

The following sections present identified literature data on toxicological effects of chemicals of potential ecological concern (COPEC).

Bioconcentration in this document is defined as the net accumulation of a substance by an organism as a result of uptake from an aqueous solution. Bioaccumulation is defined as the net accumulation of a substance by an organism as a result of uptake from all environmental sources, including food and water, that are ingested. The amount of a substance that is bioaccumulated in an organism also could be defined as the body burden of the substance in an organism. Biomagnification is defined as the sequential increase in concentration of a chemical from one trophic level to the next.

1.1 CADMIUM

Cadmium is a naturally occurring element. It is used in the production of nickel-cadmium batteries, metal plating, pigments, plastics, synthetics, and alloys. Cadmium in soils may leach into water, especially under acidic conditions (Callahan and others 1979; Elinder 1985, as cited in Agency of Toxic Substances and Disease Registry [ATSDR] 1993c), and cadmium-containing soil particles may be distributed into the air or eroded into water (ATSDR 1993a). In the aquatic environment, the bioavailability of cadmium depends on such factors as pH, redox potential, water hardness, and the presence of other complexing agents. The most bioavailable form of cadmium is the Cd^{+2} ion. An increase in temperature or salinity will increase the bioavailable form of cadmium and as a result, increase the bioaccumulation and toxicity of cadmium to aquatic organisms. A decrease in pH will increase the amount of cadmium ions in water and increase bioaccumulation in aquatic organisms (Sadiq 1992).

Cadmium has no essential biological function and is highly toxic to plants and animals. It is a carcinogen and teratogen and a suspected mutagen. However, carcinogenic effects have only been documented by the inhalation pathway. Cadmium is associated with severe sublethal effects on reproduction at relatively low environmental concentrations (Eisler 1985a). Aquatic and terrestrial organisms at all trophic levels bioconcentrate and bioaccumulate cadmium (Eisler 1985a). Bioconcentration in fish depends on the pH and the organic content of the water (John and others 1987, as cited in ATSDR 1993a). Although some data suggest that lower trophic levels display biomagnification of cadmium, available data, particularly for animals at the top of the food chain, are inconclusive (Beyer and others 1996; Gochfield and Burger 1982, as cited in ATSDR 1993a).

1.1.1 Plants

Cadmium is known to be toxic to plants at much lower soil concentrations than other heavy metals. Cadmium is more readily taken up by plants than other metals (U.S. Environmental Protection Agency [EPA] 1981) and as a result, some plants can accumulate high levels of cadmium in developing leaflets (Morishita and Boratynski 1992).

1.1.2 Invertebrates

Very little information was available concerning the effects of cadmium on invertebrates. Some insects can accumulate large quantities of cadmium without observable adverse effects (Jamil and Hussain 1992). Certain insects, such as caddis flies, can accumulate high levels of cadmium in their gill tissue (Sadiq 1992).

1.1.3 Amphibians and Reptiles

No information was identified concerning the effects of cadmium on amphibians and reptiles.

1.1.4 Fish and Aquatic Organisms

Marine organisms appear more resistant to cadmium than are freshwater organisms. Cadmium accumulates in the gill tissue of mussels, the digestive glands of scallops, and the liver and kidney of bony fish and sharks (Loring and Prosi 1986, Bryan and Gibbs 1973, and Grimanis and others 1978, as cited in Sadiq 1992). In general, however, cadmium accumulates in the liver and kidney of fish (Sindayigaya and others 1994; Sadiq 1992). Cadmium has been shown to be highly toxic in aquatic environments and has been implicated as the cause of deleterious effects on fish and aquatic organisms, including increased mortality, respiratory disruptions, altered enzyme levels, abnormal muscular contractions, reduced growth, and reduced reproduction (Eisler 1985a). Cadmium concentrations in water caused damage to the reproductive organs of fish, a decrease in the survival rate of fish embryos, and a reduction of growth rates of fry (EPA 1976). Crustaceans appear to be more sensitive to cadmium concentrations, compared with fish and mollusks (Sadiq 1992), and younger stages of aquatic life appear to be more sensitive to cadmium than adults (Sadiq 1992).

1.1.5 Birds

Sublethal effects in birds include growth retardation, nephrotoxicity, anemia, damage to the testicles and absorptive epithelium of the duodenum, reduced egg production, and effects on calcium absorption (Scheuhammer 1987).

1.1.6 Mammals

In mammalian species, cadmium concentrates in the liver and kidneys and is excreted in the urine at a very slow rate. The acute toxic effects of cadmium given orally include nausea, vomiting, salivation, diarrhea, and abdominal cramps. Immediate death may be caused by shock and dehydration; renal and cardiopulmonary failure may cause death a week or so after ingestion. Chronic toxicity effects of cadmium given orally to rats are decreased motor skills, peripheral neuropathy, weakness, and muscle atrophy. When inhaled, cadmium is a carcinogen that can produce tumors in the lung, trachea, and bronchus.

Cadmium is a known developmental toxin causing teratogenic and mutagenic effects. Parental doses of cadmium have been shown to decrease testosterone and produce adverse effects on the testes and prostate of test animals. Prenatal exposure to cadmium has fetotoxic effects, such as reduced fetal weights (ATSDR 1993a), and can cause adverse effects during development of the lung, brain, testes, eye, and palate (Domingo 1994). It is believed that small amounts of cadmium could affect embryonic deoxyribonucleic acid (DNA) and protein synthesis (Domingo 1994).

1.2 CHROMIUM

Chromium is a metal that is listed by EPA as one of 129 priority pollutants (Keith and Telliard 1979), and is considered to be one of the 14 most noxious heavy metals (Jenkins 1981). Chromium also is listed among the 25 hazardous substances thought to pose the most significant potential threat to human health at priority Superfund sites (Department of Health and Human Services [DHHS] and EPA 1987). Chromium received special attention in studies of subsurface agricultural irrigation drainage waters of the San Joaquin Valley of California, because it was determined to be a “substance of definite concern” (Moore and others 1990).

Chromium can exist in oxidation states ranging from -2 to +6, but is most frequently found in the environment in the trivalent and hexavalent oxidation states (Eisler 1986). The trivalent and hexavalent forms are the most important, because the +2, +4, and +5 forms are unstable and are rapidly converted to +3, which is oxidized to +6 (Eisler 1986). Chromium compounds are stable in the trivalent state and occur in nature in this state in ores such as ferrochromite. The hexavalent state is the second most stable state. Although hexavalent chromium rarely occurs naturally, it is produced from anthropogenic sources (ATSDR 1993b). Most of the hexavalent chromium in the environment is a result of domestic and industrial emissions. Interaction of hexavalent chromic oxide, dichromate, or chromate compounds with organic compounds can result in reduction to the comparatively less toxic trivalent form (Eisler 1986). Hexavalent chromium is often in the form of chromates, dichromates, or chromic acid; most have a yellow color, and all are toxic (Grolier Electronic Publishing 1988; Meyers 1990). Both trivalent and hexavalent chromium occur as dissolved chromium (Hem 1989).

EPA regards all chromium compounds as toxic, although the most toxic and carcinogenic chromium compounds tend to be the strong oxidizing agents, with an oxidation state of +6 (Meyers 1990). Hexavalent chromium compounds tend to be strong oxidizers and are associated with cancer risk and kidney damage (Meyers 1990). Divalent and trivalent compounds of chromium often (not always) have a lower toxicity or biological hazard associated with them (Moore and others 1990; Patnaik 1992). The hazards associated with chromium are highly related to chemical speciation (Long and Morgan 1990; Meyers 1990).

The toxic mechanism of action differs for hexavalent chromium as compared to trivalent chromium (Moore and others 1990). Hexavalent chromium causes cellular damage through its role as a strong oxidizing agent, whereas trivalent chromium can inhibit various enzyme systems or react with organic molecules (Moore and others 1990). Strong oxidizing agents can cause damage to DNA and many other tissue structures.

As in the case of other metals, the overall hazard presented by chromium may be partly related to the solubility of the specific form of chromium (Meyers 1990). Substances having a low solubility in water often are not as easily absorbed through the gastrointestinal tract, as are those substances with higher solubilities (Meyers 1990). Some hexavalent chromium compounds tend to be more toxic than the trivalent compounds, not only because the oxidizing potential is high, but because some of the hexavalent forms more easily penetrate biological membranes (Eisler 1986). Trivalent chromium has low toxicity because of poor membrane permeability and noncorrosivity, while hexavalent chromium is highly toxic

because it possesses strong oxidizing characteristics and readily pushes through membranes (Nation Research Council Canada [NRCC] 1977; Hazardous Substances Database [HSDB] 1999).

Both trivalent and hexavalent chromium are significant from the standpoint of potential impacts to fish and wildlife (Eisler 1986; Rompala and others 1984). Most of the notoriety associated with chromium as a potentially harmful environmental contaminant, however, is caused by the toxic, carcinogenic, oxidizing agent and reproductive risk hazards of hexavalent chromium compounds (HSDB 1999; Patnaik 1992; Manahan 1992; Meyers 1990; Jones 1990).

Little is known about the relationship between concentrations of total chromium in the environment and biological effects on the organisms living there (Eisler 1986). Depending on the physical and chemical state of the chromium, the same elemental concentration has a wide variety of mobilities and reactivates and therefore produces different effects (Eisler 1986).

Certain hexavalent chromium compounds, when administered through inhalation at high doses, have the potential to induce lung tumors in humans and experimental animals (Jones 1990). However, at low levels of exposure hexavalent chromium ions are reduced in epithelial lining fluid of the respiratory tract, blood, and other fluids, before the hexavalent ions can interact with DNA, unless the dose is sufficient to overwhelm the body's reduction capacity (Jones 1990).

Small amounts of trivalent chromium are considered to be essential in animals and humans (HSDB 1999). Trivalent chromium is an essential human and animal nutrient at levels of 50 to 200 micrograms per day (Jones 1990).

Trivalent chromium is the only form of chromium known to play a beneficial, biological role. The form must be supplied as a stable complex, because trivalent chromium exists as a relatively insoluble macromolecule at normal blood pH. The known biological effect of trivalent chromium is the maintenance of normal glucose tolerance (Moore and others 1990).

Trivalent chromium is an essential element for fungi and vertebrates in general (HSDB 1999; Manahan 1992). Trivalent chromium is considered to be essential for glucose and lipid metabolism in mammals, and a deficiency of it produces symptoms of diabetes mellitus (Manahan 1992; HSDB 1999). Trivalent chromium is essential for the maintenance of normal glucose tolerance in animals and humans, and the

factor or group of factors containing trivalent chromium (called glucose tolerance factor [GTF]) has been suggested to be responsible for this favorable action of chromium (HSDB 1999).

1.2.1 Plants

The greatest chromium hazard to plants is posed in acidic, sandy soil with low organic content (HSDB 1999). In plants, chromium interferes with uptake translocation, and accumulation by plant tops of calcium, potassium, magnesium, phosphorus, boron, and copper aggravates iron deficiency chlorosis by interfering with iron metabolism (HSDB 1999).

Chromium is not an essential element in plants. The hexavalent form is more soluble and available to plants than the trivalent form and is considered to be the more toxic form. In soils with a normal Eh and pH range, hexavalent chromium, a strong oxidant, is likely to be reduced to the less-available trivalent chromium, although trivalent chromium may be oxidized to hexavalent chromium in the presence of oxidized manganese (Bartlett and James 1979). In nutrient solution, however, both trivalent and hexavalent chromium are taken up about equally by plants and are toxic to plants (McGrath 1982). Hexavalent chromium is more mobile in plants than trivalent chromium, but translocation varies with plant type. After plant uptake, chromium generally remains in the roots because of the many binding sites in the cell wall, particularly the trivalent chromium ions (Smith and others 1989). Symptoms of toxicity include stunted growth, poorly developed roots, and leaf curling.

1.2.2 Invertebrates

Little information was identified on the effects of chromium on invertebrates. Polychaete worms, clams, crabs, and oysters have been shown to take up chromium; excess chromium in these species leads to decreased weight gain, increased oxygen consumption, impaired reproduction, and increased hematocrit (Moore and others 1990).

1.2.3 Amphibians and Reptiles

No information was identified on the effects of chromium on amphibians and reptiles.

1.2.4 Fish and Aquatic Organisms

Chromium toxicity to aquatic biota is influenced significantly by abiotic variables such as water hardness, temperature, pH, and salinity. Biological factors, such as species, life stage, and potential differences in sensitivities of local populations, influence the susceptibility of the organisms to chromium toxicity.

It has been reported that freshwater fish seem to be relatively tolerant of chromium (EPA 1988; Flora and others 1984).

Rainbow trout exposed to excessive hexavalent chromium developed severe gill damage, precipitated by hypertrophy and hyperplasis (Moore and others 1990). Toxicity in aquatic species is known to be affected by water hardness, pH, temperature, species, and organism size (Moore and others 1990). Hard water conditions promote the toxicity of hexavalent chromium (Moore and others 1990).

1.2.5 Birds

No information was identified on the effects of chromium on birds.

1.2.6 Mammals

In mammals, trivalent chromium is an essential nutrient. Adequate trivalent chromium nutrition improves growth and longevity and, along with insulin, helps to maintain correct glucose, lipid, and protein metabolism (NRCC 1976; HSDB 1999). The biologically active form of chromium, called the GTF, is a complex of chromium, nicotinic acid, and possibly, amino acids (ATSDR 1993b).

Chromium is considered to be a significant potential threat to human health. However, in trace amounts, chromium is considered to be one of the least toxic elements, because normal stomach pH converts hexavalent chromium to trivalent chromium (Moore and others 1990). One to two hundred times the normal, total body load of chromium usually can be tolerated in mammals without evidence of negative effects (Moore and others 1990). The therapeutic dose to toxic dose ratio for trivalent chromium in rats has been calculated to be about 1:10,000 (Moore and others 1990).

Studies with mammals have suggested that trivalent chromium is not well absorbed from the intestinal tract. For example, rat studies have indicated that only a few percent of an oral chromium +3 dose

crosses the intestinal wall, regardless of previous dietary history. However, in studies of small intestinal absorption in black ducks (*Anas rubripes*), Eastin and others (Eisler1986a), measured equal rates of absorption of trivalent hexavalent chromium. Also, it was noted that the ionic form of chromium influenced the degree of its absorption, with anionic chromium complexes being better absorbed (Moore and others 1990).

Although trivalent chromium is an essential nutrient, exposure to high levels through inhalation, ingestion, or dermal contact may cause some health effects (ATSDR 1993b). In general, the toxicity of trivalent chromium to mammals is low, because membrane permeability is poor and it is noncorrosive (Eisler 1986). However, chromium deficiency is unknown, and too much chromium can be harmful to humans (American Medical Association 1989).

1.3 COPPER

Copper is a naturally occurring element that is widely distributed in the environment. Copper is the main component of alloys, which include brass, bronze, and gun metal. Copper is an essential trace mineral nutrient and a toxicant (ATSDR 1990).

Copper is very mobile under oxidizing and acidic conditions and immobile in organic-rich and reducing environments. Adsorption increases with pH and higher organic matter content. In aquatic systems, copper binds primarily to organic matter and forms complexes with both organic and inorganic ligands (mainly with calcium carbonate) that settle out in sediments (Kirk-Othmer 1965). Under normal pH and redox conditions, copper tends to be present in sediments in the form of organic complexes and coprecipitates with iron and manganese oxides and cupric carbonate complexes.

Copper is an essential nutrient and is homeostatically controlled; therefore, biomagnification is not a significant fate process for copper. Bioaccumulated copper is stored in the liver, kidney, bone marrow, and hair (Talmage and Walton 1991). Fish can bioconcentrate copper, with bioconcentration factors (BCF) ranging from the tens to the hundreds. Mollusks have BCFs for copper as high as 30,000 (Perwack and others 1980; Chapman and others 1968; Raymont 1972).

1.3.1 Plants

Based on yield reductions of 14 to 28 percent in agronomic and grassland plants, 100 milligrams per kilogram (mg/kg) of total copper in the soil is considered to be a threshold concentration for toxicity to plants (International Copper Association [ICA] 1992).

Copper is a micronutrient essential for plant nutrition and is required as a cofactor for many enzymes. Furthermore, it is an essential part of a copper protein involved in photosynthesis. Root absorption appears to be passive, perhaps in organo-copper complexes (Jarvis and Whitehead 1983), and active through a specific carrier (Fernandes and Henriques 1991). When copper is adsorbed to cells in the root system, it may result in low-copper soils. The form in which copper is taken into the root affects its binding there (Wallace and Romney 1977). Copper can be transported in the xylem and phloem of plants complexed with amino acids.

The most common toxicity symptoms include reduced growth, poorly developed root systems, and leaf chlorosis (Wong and Bradshaw 1982). The basic deleterious effect of copper is related to the root system, where it interferes with enzyme functioning (Mukherji and Das Gupta 1972), but it also strongly interferes with photosynthesis and fatty acid synthesis (Smith and others 1985).

1.3.2 Invertebrates

Copper is used as an ingredient in many fungicides and insecticides applied to agricultural crops (Meister 1995). Based on yield reductions of 14 to 28 percent in agronomic and grassland plants, 100 mg/kg of total copper in the soil is considered to be a threshold concentration for toxicity to soil invertebrates (ICA 1992).

1.3.3 Amphibians and Reptiles

Copper is highly toxic to amphibians. Environmental conditions, including pH and water hardness, and the life stage of the amphibian exposed affect the organism's sensitivity and adverse response to exposure to metal concentrations in water. Copper increased rates of mortality in high-pH and low-hardness water environments (Horne and Dunson 1995). Although information concerning amphibians and metal toxicity is limited, it is believed that the primary mechanism of action of metal-induced toxicity and low pH environments is body loss of sodium across the gill surface (Horne and Dunson 1995). Tadpoles were

affected adversely when exposed to aqueous copper concentrations (Owen 1981). Copper is toxic to certain types of frogs and salamanders during both acute and chronic exposure studies, causing embryonic curling, body loss of sodium, and mortality (Horne and Dunson 1995). Earlier life stages of amphibians appear to be more sensitive to copper toxicity than later life stages (Horne and Dunson 1995).

No information was identified on the effects of copper in reptiles.

1.3.4 Fish and Aquatic Organisms

Copper is highly toxic in aquatic environments and is a priority pollutant (EPA 1992). Copper is toxic to many fish and aquatic organisms, including mussels, stripped bass, bluegill, and carp. Copper is mainly accumulated in the gill, liver, filaments, stomach, and intestine; however, the gill is the primary organ for concentrating copper in aquatic organisms (Owen 1981). Copper concentrations can significantly affect fish egg hatchability and reduce fry growth (EPA 1976). The age and species of organism influence the toxicity characteristics of copper. In general, younger organisms are affected at lower concentration levels.

1.3.5 Birds

Copper can produce toxic effects in birds. Diets containing elevated copper levels can slow the growth rate, diminish egg production, and cause developmental abnormalities in different avian species (Owen 1981).

1.3.6 Mammals

Toxic effects of copper have been studied on many animals, including cats, dogs, cattle, sheep, rats, mice, horses, guinea pigs, pigs, and monkeys. Different species of animals display varying levels of sensitivity to copper. However, the main organ affected by exposure to copper is the liver, where copper primarily accumulates in subcellular organelles, causing liver cirrhosis. In addition to liver cirrhosis, copper exposure can cause necrotic kidney tubules and brain damage (Owen 1981). Acute, toxic effects of copper given orally include gastrointestinal irritation, vomiting (including blood), low blood pressure, jaundice caused by liver necrosis, and coma. Chronic exposure to copper can cause accumulation of copper in the body, leading to lesions in the liver, brain, and eye and hemolytic anemia.

1.4 NICKEL

Nickel is a naturally occurring metal. Nickel is mined for use in electroplating, iron and steel processing, nickel-cadmium batteries, fuel combustion, and a variety of other applications.

Nickel has many oxidation states: -1, 0, +1, +2, +3, and +4. However, nickel(+2) is the most common form present in the environment (Environment Canada 1994). Nickel is strongly sorbed by soil, although to a lesser degree than lead, copper, and zinc (Rai and Zachara 1984; Alloway 1990). Nickel adsorption depends strongly on pH (Rai and Zachara 1984; Alloway 1990). Many forms of nickel are found in soil, and many factors affect the extent to which these different forms of nickel are adsorbed, making nickel adsorption highly site-specific. Amorphous oxides of iron, manganese, and clay minerals are the most important adsorbents of nickel in soil. In alkaline soils, adsorption may be irreversible, thereby limiting nickel's availability and mobility. Cations, such as calcium and magnesium, reportedly reduce adsorption as a result of competition for binding sites, whereas anions, like sulfate, reduce adsorption because of complexation. In an aquatic environment, environmental factors, such as pH, redox potential, and organic matter content, can affect the fate, transport, and biological availability of nickel (Environment Canada 1994).

BCFs for nickel have been reported between 120 to 550 for submerged lichens; 770 to 1,500 for submerged mosses; 2,000 to 4,500 for *Daphnia*; 200 to 1,000 for clams, zooplankton, and benthos; and 230 to 330 for fish (Dietz 1973, Cowgill 1976, Mathis and Cummings 1973, Hutchison and others 1976, all as cited in Environment Canada 1994). Recent studies of nickel levels in voles and rabbits living on sludge-amended land did not indicate any accumulation of nickel in these herbivores or in the plants on which they fed (Alberici and others 1989, Dressler and others 1986, as cited in ATSDR 1993c). Animals appear to be able to regulate the amount of nickel that is accumulated in the body and as a result, biomagnification in upper trophic levels is believed to be insignificant (Environment Canada 1994).

1.4.1 Plants

Nickel tends to be less available in soils than zinc or cadmium but is generally more available to plants than copper (Alloway 1990). The soil chemistry of nickel is relatively simple and is largely based on its occurrence as divalent nickel(+2). Nickel becomes more soluble with decreasing pH, allowing more nickel to be bioavailable to plants. Clay content and texture of the soil also will influence bioavailability of nickel to plants. Depending on these factors and on nickel's biological role as an ultra-trace element,

nickel is bioconcentrated by plants; the greatest bioconcentration occurs in soils that have naturally high levels of nickel, where some plants are classified as "hyperaccumulators" (Alloway 1990). Similar patterns of nickel bioconcentration also occur in highly contaminated soils (for example, near nickel and copper smelters).

Effects of nickel toxicity on plants include reduced growth of roots and shoots, poor branching, deformation of plant parts, decreased dry matter production, leaf spotting, abnormal flower shape, mitotic root-tip disturbance, germination inhibition, and chlorosis (Mishra and Kar 1974, Rauser 1978, McIlveen and Negusanti In Press, all as cited in Environment Canada 1994).

1.4.2 Invertebrates

Little information was identified on effects of nickel on invertebrates. However, microorganism growth and survival were reduced as a result of elevated nickel exposure (Babich and Stotzky 1982, as cited in Environment Canada 1994).

1.4.3 Amphibians and Reptiles

Nickel exposure in amphibians has been observed to slow down the response time of the potassium system in myelinated nerve fibers (Arhem 1980, as cited in Power and others 1989). In addition, nickel also has been observed to alter sodium permeability across cell membranes in amphibians (Arhem 1980, as cited in Power and others 1989).

1.4.4 Fish and Aquatic Organisms

Nickel is both a carcinogen and a mutagen in the aquatic environment (EPA 1992). Observed effects of nickel exposure in an aquatic environment to fish and invertebrates include tissue damage, genotoxicity, and decreased growth (Environment Canada 1994). Mollusks and crustaceans appear to be more sensitive to nickel exposure than other aquatic organisms (Environment Canada 1994).

1.4.5 Birds

Elevated dietary concentrations of nickel caused growth inhibition in poultry. The expression of nickel toxicity is influenced by the age, reproductive status, nutritional content of the diet, and exposure duration

in test organisms. This information should be considered in the interpretation of the risk posed by nickel to terrestrial wildlife (NAS 1980).

No effects were observed on adult mallards exposed to nickel in their diet. No effects to adult mallards were observed regarding body weight, histological changes in liver and kidneys, tissue damage, blood chemistry, egg-laying ability, hatchability percentages, and hatchling survival to 14 days of age (Eastin and O'Shea 1981, as cited in Environment Canada 1994). However, mallard ducklings fed diets containing elevated nickel concentrations up to 90 days were observed to develop tremors and ataxia (Cain and Pafford 1981, as cited in Environment Canada 1994). Newly hatched chickens also were observed to have slower growth rates as a result of diets containing elevated nickel concentrations (Ling and Leach 1979, as cited in Environment Canada 1994).

1.4.6 Mammals

Growth inhibition was the primary effect to domestic livestock fed elevated levels of nickel in their diet. The expression of nickel toxicity was observed to be influenced by the age, reproductive status, nutritional content of the diet, and exposure duration in test organisms. This information should be considered in the interpretation of risk posed by nickel to terrestrial wildlife (NAS 1980).

Rats, in a subchronic gavage study of nickel chloride in water, experienced lethargy, ataxia, irregular breathing, reduced body temperature, and discolored extremities (EPA 1999). Inhalation of nickel subsulfide in rats increased the incidence of lung tumors (ATSDR 1993c). The central nervous system appears to be the target organ for nickel oral toxicity, while the lung is the target organ for inhalation exposure.

1.5 SELENIUM

Selenium is an essential trace element but is harmful at concentrations only slightly higher than the nutritional requirement (Eisler 1985b). Results of laboratory studies and field investigations with fish, mammals, and birds have led to general agreement that elevated concentrations of selenium in diet or water are associated with reproductive abnormalities and growth retardation. Not as extensively documented, are reports of selenium-induced chromosomal aberrations, intestinal lesions, shifts in species composition of freshwater algal communities, swimming impairment of protozoa, and behavioral modifications (Eisler 1985b).

In aerobic waters, selenium is present in the quadravalent oxidation state as selenite or in the hexavalent oxidation state as selenate. These chemical species are very soluble, and most of the selenium discharged into the aquatic environment is transported in these forms to the ocean. Selenium has a sorptive affinity for hydrous metals oxides, clays, and organic materials. Sorption by sediments or suspended solids can result in enrichment of selenium concentrations in sediment beds. Sorption or precipitation with hydrous iron oxides is probably the major control on mobility of selenium in aerobic waters. Selenium can be methylated by a variety of organisms, including benthic microflora. In a reducing environment, hydrogen selenide may be formed. Both the methylated forms and hydrogen selenide are volatile and may escape to the atmosphere. Formation of volatile selenium compounds in the sediments can remobilize sorbed selenium (Eisler 1985b).

Current understanding of selenium toxicology indicates that ecological effects are primarily caused by selenium in the food chain, rather than selenium dissolved in the water column (Philips 1988, Luoma and others 1992, as cited in Taylor and others 1992). Once in the water column, selenium enters the food chain through bioconcentration by phytoplankton, which are then consumed in large quantities by crustaceans and bivalves. Fish and waterfowl, in turn, eat crustaceans and bivalves. Bioconcentration, bioaccumulation, and biomagnification of selenium can increase selenium levels more than 1,000-fold from water to fish and animals (Saiki and Lowe 1987, as cited in Taylor and others 1992). The greatest step increase occurs between water and phytoplankton and other aquatic plants; subsequent steps in the food chain typically increase selenium concentrations by a factor of 2 to 6 (Lemly and Smith 1987, as cited in Taylor and others 1992). BCFs for various species of marine algae range from 16,000 to 337,000, depending on the species and water column levels (Zhang and others 1990, as cited in Taylor and others 1992).

1.5.1 Plants

Selenium has been observed to cause growth retardation in freshwater green algae (Hutchinson and Stokes 1975, Klaverkamp and others 1983, as cited in Eisler 1985b).

Selenium is not proven to be essential for plant growth. It is absorbed by plants as selenite or selenate or in organic form, and the selenate may be more toxic. It is believed that selenate is taken up actively, while selenite uptake is largely passive (Peterson and Girling 1981). Selenium is translocated to all parts of the plant, including the seed, in low-molecular-weight compounds (Broyer and others 1972). Toxicity symptoms include chlorosis, stunting, and yellowing of the leaves. The mechanism of toxicity is thought

to be indiscriminate replacement of sulphur by selenium in proteins and nucleic acids, with disruptions in metabolism (Trelease and others 1960).

1.5.2 Invertebrates

No information was identified on the adverse effects of selenium on invertebrates.

1.5.3 Amphibians and Reptiles

Little information was identified on the effects of selenium on amphibians and reptiles. One report states that during frog development, cranial and vertebral deformities and lower survival were documented when exposed to selenium concentrations (Browne and Dumont 1979, as cited in Eisler 1985b).

1.5.4 Fish and Aquatic Organisms

In general, selenite is more toxic to earlier life stages, and the degree of the effect is increased with increasing temperatures (Klaverkamp and others 1983, as cited in Eisler 1985b). Selenium is teratogenic, and its toxicity depends greatly on its chemical form (Eisler 1985b). It has been suggested that selenite is more toxic than selenate and is preferentially concentrated over selenate by mussels (EPA 1990, as cited in Eisler 1985b). Signs of selenium poisoning include loss of equilibrium, lethargy, loss of coordination, muscle spasms, protruding eyes, swollen abdomen, liver degeneration and swelling, reduced blood hemoglobin levels, increased white blood cell numbers, swollen gill lamella with extensive cellular vacuolization, and necrotic and degenerating ovarian follicles (Ellis and others 1937, Sorenson 1984, as cited in Eisler 1985b). Elevated concentrations of selenium were observed to cause reproductive failure, anemia, reduced hatch, reduced growth, reduced swimming rate, and chromosomal aberrations in aquatic organisms (Hodson and others 1980, Adams 1976, Bovee and O'Brien 1982, and Krishnaja and Rege 1982, all as cited in Eisler 1985b).

1.5.5 Birds

Selenium exposure in the diet or drinking water of avian species is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation (Eisler 1985b). Selenium has been observed to cause reduced hatching of eggs, decreased egg weight,

decreased egg production, anemia, and embryo deformation, including deformed eyes, beaks, wings, and feet (Ort and Latshaw 1978, Harr 1979, as cited in Eisler 1985b).

1.5.6 Mammals

Chronic effects of selenium on mammals include reproductive abnormalities such as congenital malformations; reduced numbers of young in litters; high mortality of young; infertility among surviving young in rats, mice, swine, and cattle; and intestinal lesions (Harr 1978, NCRR 1983, as cited in Eisler 1985b).

Chronic exposure of selenium, known as alkali disease, has been observed in cattle, hogs, and horses that graze on feed containing elevated levels of selenium. Adverse effects include deformed hooves; hair loss; lassitude; articular cartilage erosion; reduced conception; increased reabsorption of fetuses; and heart, kidney, and liver degeneration (Eisler 1985b).

1.6 VANADIUM

Vanadium is a natural element in the earth. It is a white to gray metal that is often found as crystals. It has no particular odor. In the environment, it is usually combined with other elements such as oxygen, sodium, sulfur, or chloride.

Natural vanadium consists of two isotopes, V-50 and V-51, the former being slightly radioactive, with a half-life of 6.0E15 years. Seven other radioisotopes of the element have been synthesized (Kerr 1988). Vanadium exhibits oxidation states of -1, 0, +1, +2, +3, +4, and +5 in a wide variety of complex ions and coordination complexes (Kerr 1988). Three oxidation states (+3 to +5) can be stable in water (Hem 1989). These three states are the only forms with any biological significance (Morrell and others 1985). The +4 and +5 states are the most significant oxidation states in living organisms, while the +3 state occurs solely in one group of marine chordates (Morrell and others 1985). In aqueous solution, vanadium in the +5 state exists as various oxoions referred to as “vanadates.” The exact nature of the vanadate species in solution is pH- and concentration-dependent. Also, the exact species present cannot be determined unless the solution is allowed to stand for many days, because equilibrium among species is slowly attained (Morrell and others 1985).

The chemistry of vanadium in the +4 state centers around the vanadium oxide ion. This species undergoes a number of hydrolysis reactions with increasing solution pH. At lower pH (<5.0), vanadium oxide and vanadium hydroxide dominate, whereas at more alkaline pH (>5.0), a variety of forms exist. In an alkaline environment, these ionic forms are also subject to air oxidation in the absence of suitable chelating agents (Morrell and others 1985). Both the +4 and +5 oxidation states have a notable tendency to form stable chelates with a variety of organic and inorganic ligands (such as ketones, aldehydes, catechols, amino compounds, and phenols). Chelate formation can alter the oxidation state from +5 to +4 (Morrell and others 1985).

The forms of vanadium most likely to be found at waste sites are not well known. One manmade form, vanadium oxide (vanadium bound to oxygen), is most often used by industry in making steel. Vanadium oxide can be a yellow-orange powder, dark-gray flakes, or yellow crystals. Much smaller amounts are used in making rubber, plastics, ceramics, and certain other chemicals (ATSDR 1992).

Vanadium is a transition metal with complex aqueous geochemistry (Hem 1989). Vanadium is ubiquitous in the biosphere, resulting in detectable trace levels in most living organisms (Morrell and others 1985). Increases in human-induced vanadium emissions, caused by the combustion of fossil fuels, equal natural emissions from continental dust, marine aerosols, and volcanic activity (Morrell and others 1985).

Vanadium is found in ore, along with uranium (Hem 1989). About 80 percent of vanadium production is used to make ferrovanadium or as a steel additive (Kerr 1988).

Vanadium is found in many petroleum products, because it occurs naturally in fuel oils and coal (ATSDR 1992). It is also a by-product of petroleum refining (Klassen and others 1991).

Vanadium and its compounds are toxic, though this toxicity is variable (Kerr 1988; Klaasen and others 1991; Lewis 1993). Toxicity depends on the valence; it increases with increasing valence, with pentavalent vanadium being most toxic. In addition, vanadium is toxic as a cation and as an anion (NRCC 1977; Fleishman 1988; HSDB 1999). Vanadium is considered to be 1 of the 14 most noxious heavy metals (Jenkins 1981). Vanadium toxicity is attributed to its ability to inhibit enzyme systems, such as monamine oxidase, ATPase, tyrosinase, choline esterase, and cholesterol synthetase (Leland and Kuwabara 1985).

1.6.1 Plants

Small amounts of vanadium in the environment tend to stimulate plants, but large amounts are toxic (Brooks 1972). Essential for the growth of fungi and algae, it stimulates photosynthesis in higher plants (Venugopal and Luckey 1978; Schiffer 1989; HSDB 1999).

Levels of vanadium (parts per million [ppm] dry weight) considered to be phytotoxic are 150 (Warsaw, Poland), 50 (Warsaw, Poland) and 60 (Ontario, Canada) (Kabata-Pendias and Pendias 1992). Ten to 20 ppm vanadium in solution are harmful to plants, but larger amounts can be tolerated by legumes that use vanadium in the nitrogen fixation process (Brooks 1972). As little as 0.5 mg/kg of vanadium reduces the growth of flax, peas, soybeans, and cabbage affected by aqueous vanadium levels as low as 10 to 20 milligrams per liter (mg/L). Usually, vanadium induces ion deficiency chlorosis by interfering with iron absorption. Levels of other essential elements, such as manganese, copper, calcium, and phosphorus, also are reduced by vanadium. Excess vanadium can therefore affect the trace element nutritional value of plants (NRCC 1980; HSDB 1999).

The 1985 study on the potential of vanadium to inhibit sodium-potassium Na-K ATPases in plants (Morrell and others 1985) explored the similarity between both plant uptake and transport of both the +4 and +5 ionic states of vanadium and supports the hypothesis of biotransformation of vanadium during root uptake by plants. Although the extent of reduction is unclear, this process generally seems to involve the reduction of +5 vanadium to +4. Even at a pH of 7, the presence of chelating agents (such as ketones and aldehydes) in cell walls would indicate the potential of ready reduction of vanadium by root tissues. The resulting +4 complexes would be extremely stable, rendering the bulk of any free-space vanadium physiologically unavailable. Therefore, the interaction of vanadium with common organic constituents of living matter currently appears to control vanadate's disruptive potential.

Although this reduction of +5 vanadium to +4, leading to the immobilization of vanadium within the root tissue, is hypothesized to occur, it does not preclude the possibility that vanadium in the +5 state also is present in these tissues. Considering the ubiquitous nature of sodium-potassium ATPases in the membrane system and the ability of vanadium in the +5 state (vanadate) to inhibit sodium-potassium ATPases, the effects of vanadate on all living systems are potentially harmful. Given the marked increase in human-induced atmospheric vanadium concentrations, conditions may be created that allow free access to vanadate ions in living systems.

1.6.2 Invertebrates

Little information was available on the effects of vanadium on invertebrates. Vanadium is an oxygen-carrying metal in some invertebrates (Venugopal and Luckey 1978; Schiffer 1989; HSDB 1999).

1.6.3 Amphibians and Reptiles

No information was identified on the effects of vanadium on amphibians and reptiles.

1.6.4 Fish and Aquatic Organisms

A growth feeding trial was conducted in which juvenile rainbow trout (initial weight 2.9 grams per fish) were fed diets supplemented with 0 to 10 grams of vanadium (as sodium orthovanadate) per kilogram diet for 12 weeks at 15 degrees Celsius. All levels of supplemented vanadium significantly reduced growth and feeding response in the trout. At high levels of dietary vanadium (> 493 mg/kg), feed avoidance and increased mortalities were apparent in the trout. The vanadium retention factor (carcass vanadium per total amount of vanadium consumed) and carcass concentration factor (carcass vanadium concentration per dietary vanadium content) increased in relation to the dietary vanadium level, indicating a bioaccumulation of vanadium in these fish. This is in direct contrast to the apparently low bioaccumulation of waterborne vanadium in trout. The minimum dietary vanadium toxicity level could not be determined; however, it is probably a diet of less than 10 mg/kg vanadium. The major biochemical and physiological effect of vanadium in the trout would appear to be increased in vivo lipid oxidation (Hilton and Bettger 1988; HSDB 1999).

1.6.5 Birds

Some vanadium compounds produce mutation effects in birds (Lewis 1993). Dietary vanadium has been shown to suppress egg production of laying hens (Rompala and others 1984). Dietary vanadium at levels as low as 0.5 mg/kg have been shown to alter metabolism in mallards (White and others 1980).

1.6.6 Mammals

Vanadium toxicity is attributed to its ability to inhibit enzyme systems, such as monoamine oxidase, ATPase, tyrosinase, choline esterase, and cholesterol synthetase (Luckey and Venugopal 1977; Leland and Kuwabara 1985; HSDB 1999).

Pregnant Sprague-Dawley rats given orally 20 milligrams per kilogram per day (mg/kg/day) of vanadium (as sodium metavanadate) displayed embryotoxicity but no teratogencity (Paternain and others 1987; HSDB 1999).

Wistar rats of both sexes received vanadium in drinking water in the amount of 23 to 29 mg/kg per body weight, in the form of ammonium metavanadate, for periods of 2, 4, and 8 weeks. Animals treated in this way ate less food and drank less ammonium metavanadate solution compared with the amount of water consumed by the controls; they suffered from diarrhea, and because of this, the increment in body weight was reduced. Vanadium decreased erythropoiesis and maturation of red blood cells, which was expressed by a reduced erythrocyte count and hemoglobin level and increased reticulocyte and polychromatophilic erythrocyte count in the peripheral blood (HSDB 1999).

1.7 ZINC

Zinc is an essential trace element for all living organisms, and zinc deficiency can be a problem for both plants and animals. Zinc is primarily used as a protective coating for metals and in the production of alloys, such as bronze and brass. Adverse effects of zinc exposure to animals include growth retardation, testicular atrophy, skin changes, and poor appetite (Prasad 1979, as cited in Eisler 1993). Most of the zinc introduced into aquatic environments eventually is partitioned into sediment. Zinc released from sediment is enhanced under conditions of high dissolved oxygen, low salinity, and low pH. Dissolved zinc usually consists of the hydrated zinc ion and various organic and inorganic complexes. In reducing conditions, organically bound zinc typically forms insoluble sulfides (MacDonald 1993).

BCFs vary widely between and within species of aquatic organisms (Eisler 1993). In marine environments, the most effective zinc accumulators included red and brown algae, ostreid and crassotreid oysters, and scallops. Invertebrates can bioaccumulate large quantities of zinc (Jamil and Hussein 1992), which potentially could be passed on to upper trophic-level consumers. Studies show that bony structures can act as long-term repositories for zinc (Macapinlac and others 1966). Zinc concentrations have been

shown to increase with increasing trophic levels from phytoplankton to zooplankton but not to fish (Balasubramanian and others 1995).

1.7.1 Plants

Zinc is an essential nutrient for plant growth in small amounts but is toxic to plants at elevated levels. Zinc can cause significant adverse effects on growth, survival, and reproduction in representative sensitive species of aquatic plants (Eisler 1993). Elevated levels of zinc in soil can cause mortality in some terrestrial plants and inhibit photosynthesis in others (Eisler 1993).

1.7.2 Invertebrates

Certain terrestrial and aquatic invertebrates are sensitive to zinc. Reduced growth, inhibited reproduction, and reduced survival are effects that zinc can have on both terrestrial and aquatic invertebrates (Eisler 1993).

1.7.3 Amphibians and Reptiles

Environmental conditions, including pH and water hardness, and the life stage of the amphibian exposed both affect the organism's sensitivity and adverse response to exposure to metal concentrations in water. Although information concerning amphibians and metal toxicity is limited, the primary mechanism of action of metal-induced toxicity and low pH environments is believed to be body loss of sodium across the gill surface (MacDonald and Wood 1993, as cited in Horne and Dunson 1995). In one study, no significant effects occurred of acute and chronic exposures of frogs and salamanders and their larvae to zinc (Horne and Dunson 1995). In addition, the pH of the aquatic environment had no effect on the toxicity of zinc, unlike the other metals that were studied (Horne and Dunson 1995).

However, another study observed that zinc caused significant adverse effects on growth, survival, and reproduction in representative sensitive species of amphibians (Eisler 1993). In this study, zinc was shown to cause teratogenic effects to frog embryos (Eisler 1993).

1.7.4 Fish and Aquatic Organisms

The gill epithelium is the primary route of zinc entry into the body of fish (Eisler 1993). Zinc can cause significant adverse effects on growth, survival, and reproduction in representative, sensitive species of protozoa, sponges, mollusks, crustaceans, echinoderms, and fish (Eisler 1993). Zinc has been shown to cause teratogenic effects to fish embryos (Eisler 1993).

1.7.5 Birds

Different species of birds have varying sensitivities to zinc exposure. Acute effects of zinc in ducks caused mortality and pancreatic degradation (Eisler 1993). Reduced growth and death were observed in poultry chicks fed diets containing elevated zinc levels. Younger stages of life appear to be more sensitive to zinc exposure. The pancreas and bone are primary target organs of zinc in birds (Eisler 1993). Decreased weight gain was observed in Japanese quail, chickens, and turkeys fed diets containing zinc (NAS 1980).

1.7.6 Mammals

Zinc is relatively nontoxic in mammals; however, excessive zinc intake adversely affects survival of all tested mammals and produces a wide variety of neurological, hematological, immunological, hepatic, renal, cardiovascular, developmental, and genotoxic effects (Eisler 1993). The pancreas and bone are primary target organs of zinc exposure in mammals (Eisler 1993). Toxic effects of zinc can be observed in many domestic animals, including dogs, cats, ferrets, cattle, sheep, and horses, as a result of ingesting zinc-containing objects (Eisler 1993). Zinc concentrations in the diet of pregnant rats and sheep caused increased incidence of hypocuprosis, still births, and fetal resorptions (Ketchenson and others 1969, Campbell and Mill 1979, as cited in Domingo 1994).

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APPENDIX G

AREA WIDE ECOLOGICAL RISK ASSESSMENT
HAZARD CALCULATIONS

TABLE G-1

BIOTRANSFER FACTORS FOR CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

(Page 1 of 1)

COPEC	BTF Overall Soil to Overall Plant	BTF Sediment to Aquatic Plant	BTF Riparian Soil to Riparian Plant
Cadmium	0.244	0.253	0.470
Chromium	0.026	0.346	0.027
Copper	0.324	0.440	0.354
Nickel	0.039	0.304	0.049
Selenium	0.240	0.816	0.319
Vanadium	0.013	0.066	0.017
Zinc	0.262	0.438	0.385

Notes:

BTF Biotransfer factor
COPEC Chemical of potential ecological concern

TABLE G-2

TIER 1 HAZARD QUOTIENTS FOR THE NORTHERN BOBWHITE

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	2.71E-02	5.40E-04	1.20E+02	6.48E-02	2.66E-02	2.37E-02	2.45E-01	2.94E+01	6.95E-01	3.98E-03	7.00E+01	2.79E-01	1.00E+00	1.00E+00	1.89E-01	5.49E+00	8.00E-02	7.99E-01	6.00E-02	9.16E+01
Chromium	2.71E-02	5.40E-04	1.50E+03	8.10E-01	2.66E-02	2.37E-02	2.64E-02	3.95E+01	9.36E-01	3.98E-03	2.60E+01	1.04E-01	1.00E+00	1.00E+00	1.89E-01	9.78E+00	1.00E+00	1.25E+00	6.85E-01	1.43E+01
Copper	2.71E-02	5.40E-04	2.10E+02	1.13E-01	2.66E-02	2.37E-02	3.24E-01	6.81E+01	1.61E+00	3.98E-03	4.90E+01	1.95E-01	1.00E+00	1.00E+00	1.89E-01	1.02E+01	2.30E+00	6.39E-01	1.80E+00	5.64E+00
Nickel	2.71E-02	5.40E-04	4.60E+02	2.48E-01	2.66E-02	2.37E-02	3.98E-02	1.83E+01	4.34E-01	3.98E-03	1.20E+01	4.78E-02	1.00E+00	1.00E+00	1.89E-01	3.86E+00	1.38E+00	6.14E-01	1.09E+00	3.54E+00
Selenium	2.71E-02	5.40E-04	1.50E+03	8.10E-01	2.66E-02	2.37E-02	2.40E-01	3.60E+02	8.52E+00	3.98E-03	8.00E+01	3.19E-01	1.00E+00	1.00E+00	1.89E-01	5.11E+01	2.30E-01	1.11E+00	1.62E-01	3.16E+02
Vanadium	2.71E-02	5.40E-04	1.20E+03	6.48E-01	2.66E-02	2.37E-02	1.33E-02	1.59E+01	3.77E-01	3.98E-03	6.20E+01	2.47E-01	1.00E+00	1.00E+00	1.89E-01	6.73E+00	1.14E+01	1.17E+00	7.92E+00	8.50E-01
Zinc	2.71E-02	5.40E-04	2.00E+03	1.08E+00	2.66E-02	2.37E-02	2.63E-01	5.25E+02	1.24E+01	3.98E-03	4.00E+02	1.59E+00	1.00E+00	1.00E+00	1.89E-01	7.99E+01	1.72E+01	9.55E-01	1.24E+01	6.42E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-3

TIER 1 HAZARD QUOTIENTS FOR THE EASTERN COTTONTAIL

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	1.01E-01	2.42E-03	1.20E+02	2.90E-01	9.82E-02	1.03E-01	2.45E-01	2.94E+01	3.03E+00	1.00E+00	1.00E+00	7.00E-01	4.74E+00	6.00E-02	3.22E-02	4.99E-02	9.50E+01
Chromium	1.01E-01	2.42E-03	1.50E+03	3.63E+00	9.82E-02	1.03E-01	2.64E-02	3.95E+01	4.08E+00	1.00E+00	1.00E+00	7.00E-01	1.10E+01	2.74E+03	3.50E-01	2.63E+03	4.19E-03
Copper	1.01E-01	2.42E-03	2.10E+02	5.08E-01	9.82E-02	1.03E-01	3.24E-01	6.81E+01	7.02E+00	1.00E+00	1.00E+00	7.00E-01	1.08E+01	2.67E+00	3.00E-02	2.21E+00	4.87E+00
Nickel	1.01E-01	2.42E-03	4.60E+02	1.11E+00	9.82E-02	1.03E-01	3.98E-02	1.83E+01	1.89E+00	1.00E+00	1.00E+00	7.00E-01	4.29E+00	1.33E-01	2.48E-01	1.25E-01	3.43E+01
Selenium	1.01E-01	2.42E-03	1.50E+03	3.63E+00	9.82E-02	1.03E-01	2.40E-01	3.60E+02	3.71E+01	1.00E+00	1.00E+00	7.00E-01	5.82E+01	5.00E-02	2.46E-02	4.09E-02	1.42E+03
Vanadium	1.01E-01	2.42E-03	1.20E+03	2.90E+00	9.82E-02	1.03E-01	1.33E-02	1.59E+01	1.64E+00	1.00E+00	1.00E+00	7.00E-01	6.49E+00	2.10E-01	2.60E-01	1.98E-01	3.28E+01
Zinc	1.01E-01	2.42E-03	2.00E+03	4.84E+00	9.82E-02	1.03E-01	2.63E-01	5.25E+02	5.42E+01	1.00E+00	1.00E+00	7.00E-01	8.43E+01	9.60E+00	2.55E-02	7.87E+00	1.07E+01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-4

TIER 1 HAZARD QUOTIENTS FOR THE AMERICAN ROBIN

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	1.76E-02	3.50E-04	1.20E+02	4.20E-02	1.73E-02	8.98E-03	2.45E-01	2.94E+01	2.64E-01	8.98E-03	7.00E+01	6.29E-01	1.00E+00	1.00E+00	6.40E-01	1.46E+00	8.00E-02	7.99E-01	4.82E-02	3.03E+01
Chromium	1.76E-02	3.50E-04	1.50E+03	5.25E-01	1.72E-02	8.98E-03	2.64E-02	3.95E+01	3.55E-01	8.98E-03	2.60E+01	2.34E-01	1.00E+00	1.00E+00	6.40E-01	1.74E+00	1.00E+00	1.25E+00	5.51E-01	3.16E+00
Copper	1.76E-02	3.50E-04	2.10E+02	7.35E-02	1.72E-02	8.98E-03	3.24E-01	6.81E+01	6.12E-01	8.98E-03	4.90E+01	4.40E-01	1.00E+00	1.00E+00	6.40E-01	1.76E+00	2.30E+00	6.39E-01	1.45E+00	1.21E+00
Nickel	1.76E-02	3.50E-04	4.60E+02	1.61E-01	1.72E-02	8.98E-03	3.98E-02	1.83E+01	1.65E-01	8.98E-03	1.20E+01	1.08E-01	1.00E+00	1.00E+00	6.40E-01	6.77E-01	1.38E+00	6.14E-01	8.77E-01	7.73E-01
Selenium	1.76E-02	3.50E-04	1.50E+03	5.25E-01	1.72E-02	8.98E-03	2.40E-01	3.60E+02	3.23E+00	8.98E-03	8.00E+01	7.19E-01	1.00E+00	1.00E+00	6.40E-01	7.00E+00	2.30E-01	1.11E+00	1.30E-01	5.39E+01
Vanadium	1.76E-02	3.50E-04	1.20E+03	4.20E-01	1.72E-02	8.98E-03	1.33E-02	1.59E+01	1.43E-01	8.98E-03	6.20E+01	5.57E-01	1.00E+00	1.00E+00	6.40E-01	1.75E+00	1.14E+01	1.17E+00	6.37E+00	2.75E-01
Zinc	1.76E-02	3.50E-04	2.00E+03	7.00E-01	1.72E-02	8.98E-03	2.63E-01	5.25E+02	4.72E+00	8.98E-03	4.00E+02	3.59E+00	1.00E+00	1.00E+00	6.40E-01	1.41E+01	1.72E+01	9.55E-01	1.00E+01	1.41E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-5

TIER 1 HAZARD QUOTIENTS FOR THE DEER MOUSE

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.54E-03	7.00E-05	1.20E+02	8.40E-03	3.47E-03	1.97E-03	2.45E-01	2.94E+01	5.78E-02	1.64E-03	7.00E+01	1.15E-01	1.00E+00	1.00E+00	2.00E-02	9.06E+00	6.00E-02	3.22E-02	6.17E-02	1.47E+02
Chromium	3.54E-03	7.00E-05	1.50E+03	1.05E-01	3.46E-03	1.97E-03	2.64E-02	3.95E+01	7.78E-02	1.64E-03	2.60E+01	4.27E-02	1.00E+00	1.00E+00	2.00E-02	1.13E+01	2.74E+03	3.50E-01	3.25E+03	3.47E-03
Copper	3.54E-03	7.00E-05	2.10E+02	1.47E-02	3.46E-03	1.97E-03	3.24E-01	6.81E+01	1.34E-01	1.64E-03	4.90E+01	8.05E-02	1.00E+00	1.00E+00	2.00E-02	1.15E+01	2.67E+00	3.00E-02	2.74E+00	4.19E+00
Nickel	3.54E-03	7.00E-05	4.60E+02	3.22E-02	3.46E-03	1.97E-03	3.98E-02	1.83E+01	3.61E-02	1.64E-03	1.20E+01	1.97E-02	1.00E+00	1.00E+00	2.00E-02	4.40E+00	1.33E-01	2.48E-01	1.55E-01	2.84E+01
Selenium	3.54E-03	7.00E-05	1.50E+03	1.05E-01	3.46E-03	1.97E-03	2.40E-01	3.60E+02	7.09E-01	1.64E-03	8.00E+01	1.31E-01	1.00E+00	1.00E+00	2.00E-02	4.73E+01	5.00E-02	2.46E-02	5.06E-02	9.34E+02
Vanadium	3.54E-03	7.00E-05	1.20E+03	8.40E-02	3.46E-03	1.97E-03	1.33E-02	1.59E+01	3.13E-02	1.64E-03	6.20E+01	1.02E-01	1.00E+00	1.00E+00	2.00E-02	1.09E+01	2.10E-01	2.60E-01	2.45E-01	4.43E+01
Zinc	3.54E-03	7.00E-05	2.00E+03	1.40E-01	3.46E-03	1.97E-03	2.63E-01	5.25E+02	1.03E+00	1.64E-03	4.00E+02	6.57E-01	1.00E+00	1.00E+00	2.00E-02	9.16E+01	9.60E+00	2.55E-02	9.74E+00	9.40E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-6

TIER 1 HAZARD QUOTIENTS FOR THE SONG SPARROW

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	6.37E-03	1.27E-04	1.20E+02	1.53E-02	2.03E-01	3.10E-04	6.29E-05	6.24E-03	6.50E-03	4.71E-01	5.65E+01	3.67E-01	1.00E+00	1.00E+00	2.32E-02	1.65E+01	8.00E-02
Chromium	6.37E-03	1.27E-04	1.50E+03	1.91E-01	2.03E-01	4.60E-03	9.34E-04	6.22E-03	6.50E-03	2.73E-02	4.09E+01	2.66E-01	1.00E+00	1.00E+00	2.32E-02	1.98E+01	1.00E+00
Copper	6.37E-03	1.27E-04	2.10E+02	2.68E-02	2.03E-01	1.50E-02	3.05E-03	6.22E-03	6.50E-03	3.55E-01	7.45E+01	4.84E-01	1.00E+00	1.00E+00	2.32E-02	2.22E+01	2.30E+00
Nickel	6.37E-03	1.27E-04	4.60E+02	5.86E-02	2.03E-01	4.30E-02	8.73E-03	6.22E-03	6.50E-03	4.94E-02	2.27E+01	1.48E-01	1.00E+00	1.00E+00	2.32E-02	9.30E+00	1.38E+00
Selenium	6.37E-03	1.27E-04	1.50E+03	1.91E-01	2.03E-01	1.14E+00	2.31E-01	6.22E-03	6.50E-03	3.20E-01	4.80E+02	3.12E+00	1.00E+00	1.00E+00	2.32E-02	1.53E+02	2.30E-01
Vanadium	6.37E-03	1.27E-04	1.20E+03	1.53E-01	2.03E-01	6.20E-03	1.26E-03	6.22E-03	6.50E-03	1.75E-02	2.10E+01	1.37E-01	1.00E+00	1.00E+00	2.32E-02	1.26E+01	1.14E+01
Zinc	6.37E-03	1.27E-04	2.00E+03	2.55E-01	2.03E-01	1.10E-01	2.23E-02	6.22E-03	6.50E-03	3.86E-01	7.71E+02	5.01E+00	1.00E+00	1.00E+00	2.32E-02	2.28E+02	1.72E+01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.99E-01	3.94E-02	4.19E+02
Chromium	1.25E+00	4.50E-01	4.39E+01
Copper	6.39E-01	1.18E+00	1.88E+01
Nickel	6.14E-01	7.16E-01	1.30E+01
Selenium	1.11E+00	1.06E-01	1.44E+03
Vanadium	1.17E+00	5.20E+00	2.42E+00
Zinc	9.55E-01	8.17E+00	2.80E+01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-6

TIER 1 HAZARD QUOTIENTS FOR THE SONG SPARROW

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose/allometrically adjusted TRV.

TABLE G-7

TIER 1 HAZARD QUOTIENTS FOR THE MEADOW VOLE

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)
Cadmium	7.44E-03	1.80E-04	1.20E+02	2.16E-02	1.39E-01	3.10E-04	4.31E-05	7.26E-03	7.47E-03	4.71E-01	5.65E+01	4.22E-01	1.52E-04	7.00E+01	1.07E-02	1.00E+00	1.00E+00	3.60E-02	1.26E+01
Chromium	7.44E-03	1.80E-04	1.50E+03	2.70E-01	1.39E-01	4.60E-03	6.39E-04	7.26E-03	7.47E-03	2.73E-02	4.09E+01	3.06E-01	1.52E-04	2.60E+01	3.96E-03	1.00E+00	1.00E+00	3.60E-02	1.61E+01
Copper	7.44E-03	1.80E-04	2.10E+02	3.78E-02	1.39E-01	1.50E-02	2.08E-03	7.26E-03	7.47E-03	3.55E-01	7.45E+01	5.57E-01	1.52E-04	4.90E+01	7.47E-03	1.00E+00	1.00E+00	3.60E-02	1.68E+01
Nickel	7.44E-03	1.80E-04	4.60E+02	8.28E-02	1.39E-01	4.30E-02	5.97E-03	7.26E-03	7.47E-03	4.94E-02	2.27E+01	1.70E-01	1.52E-04	1.20E+01	1.83E-03	1.00E+00	1.00E+00	3.60E-02	7.24E+00
Selenium	7.44E-03	1.80E-04	1.50E+03	2.70E-01	1.39E-01	1.14E+00	1.58E-01	7.26E-03	7.47E-03	3.20E-01	4.80E+02	3.59E+00	1.52E-04	2.60E+02	3.96E-02	1.00E+00	1.00E+00	3.60E-02	1.13E+02
Vanadium	7.44E-03	1.80E-04	1.20E+03	2.16E-01	1.39E-01	6.20E-03	8.61E-04	7.26E-03	7.47E-03	1.75E-02	2.10E+01	1.57E-01	1.52E-04	6.20E+01	9.45E-03	1.00E+00	1.00E+00	3.60E-02	1.07E+01
Zinc	7.44E-03	1.80E-04	2.00E+03	3.60E-01	1.39E-01	1.10E-01	1.53E-02	7.26E-03	7.47E-03	3.86E-01	7.71E+02	5.76E+00	1.52E-04	4.00E+02	6.10E-02	1.00E+00	1.00E+00	3.60E-02	1.72E+02

COPEC	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.00E-02	3.22E-02	5.96E-02	2.12E+02
Chromium	2.74E+03	3.50E-01	3.14E+03	5.13E-03
Copper	2.67E+00	3.00E-02	2.64E+00	6.35E+00
Nickel	1.33E-01	2.48E-01	1.49E-01	4.84E+01
Selenium	5.00E-02	2.46E-02	4.89E-02	2.30E+03
Vanadium	2.10E-01	2.60E-01	2.37E-01	4.50E+01
Zinc	9.60E+00	2.55E-02	9.41E+00	1.83E+01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

Notes (continued):

TABLE G-7

TIER 1 HAZARD QUOTIENTS FOR THE MEADOW VOLE

(Page 1 of 2)

1 The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-8

TIER 1 HAZARD QUOTIENTS FOR THE RED-WINGED BLACKBIRD

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	SUF	TTC
Cadmium	9.70E-03	2.41E-04	1.20E+02	2.89E-02	1.63E-01	3.10E-04	5.05E-05	9.51E-03	7.92E-03	4.71E-01	5.65E+01	4.47E-01	1.98E-03	7.00E+01	1.39E-01	1.00E+00	1.00E+00
Chromium	9.70E-03	2.41E-04	1.50E+03	3.62E-01	1.63E-01	4.60E-03	7.49E-04	9.51E-03	7.92E-03	2.73E-02	4.09E+01	3.24E-01	1.98E-03	2.60E+01	5.15E-02	1.00E+00	1.00E+00
Copper	9.70E-03	2.41E-04	2.10E+02	5.06E-02	1.63E-01	1.50E-02	2.44E-03	9.51E-03	7.92E-03	3.55E-01	7.45E+01	5.90E-01	1.98E-03	4.90E+01	9.70E-02	1.00E+00	1.00E+00
Nickel	9.70E-03	2.41E-04	4.60E+02	1.11E-01	1.63E-01	4.30E-02	7.00E-03	9.51E-03	7.92E-03	4.94E-02	2.27E+01	1.80E-01	1.98E-03	1.20E+01	2.38E-02	1.00E+00	1.00E+00
Selenium	9.70E-03	2.41E-04	1.50E+03	3.62E-01	1.63E-01	1.14E+00	1.86E-01	9.51E-03	7.92E-03	3.20E-01	4.80E+02	3.80E+00	1.98E-03	2.60E+02	5.15E-01	1.00E+00	1.00E+00
Vanadium	9.70E-03	2.41E-04	1.20E+03	2.89E-01	1.63E-01	6.20E-03	1.01E-03	9.51E-03	7.92E-03	1.75E-02	2.10E+01	1.67E-01	1.98E-03	6.20E+01	1.23E-01	1.00E+00	1.00E+00
Zinc	9.70E-03	2.41E-04	2.00E+03	4.82E-01	1.63E-01	1.10E-01	1.79E-02	9.51E-03	7.92E-03	3.86E-01	7.71E+02	6.11E+00	1.98E-03	4.00E+02	7.92E-01	1.00E+00	1.00E+00

COPEC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	4.30E-02	1.43E+01	8.00E-02	7.99E-01	4.46E-02	3.21E+02
Chromium	4.30E-02	1.72E+01	1.00E+00	1.25E+00	5.10E-01	3.37E+01
Copper	4.30E-02	1.72E+01	2.30E+00	6.39E-01	1.34E+00	1.28E+01
Nickel	4.30E-02	7.48E+00	1.38E+00	6.14E-01	8.11E-01	9.23E+00
Selenium	4.30E-02	1.13E+02	2.30E-01	1.11E+00	1.20E-01	9.41E+02
Vanadium	4.30E-02	1.35E+01	1.14E+01	1.17E+00	5.89E+00	2.29E+00
Zinc	4.30E-02	1.72E+02	1.72E+01	9.55E-01	9.25E+00	1.86E+01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-8

TIER 1 HAZARD QUOTIENTS FOR THE RED-WINGED BLACKBIRD

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-9

TIER 1 HAZARD QUOTIENTS FOR THE GREAT BLUE HERON

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration in Dry Weight (mg/kg)	Fish Daily Dose[1] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[3] (mg/kg/day)	TRV (mg/kg/day)	Test Species Body Weight (kg)
Cadmium	1.34E-01	9.30E-04	1.40E+01	1.30E-02	5.22E-02	3.10E-04	1.62E-05	1.33E-01	1.35E-01	1.50E+00	2.02E-01	1.00E+00	1.00E+00	2.09E+00	1.03E-01	8.00E-02	7.99E-01
Chromium	1.34E-01	9.30E-04	1.91E+02	1.78E-01	5.22E-02	4.60E-03	2.40E-04	1.33E-01	1.35E-01	3.60E+00	4.84E-01	1.00E+00	1.00E+00	2.09E+00	3.17E-01	1.00E+00	1.25E+00
Copper	1.34E-01	9.30E-04	1.02E+02	9.49E-02	5.22E-02	1.50E-02	7.82E-04	1.33E-01	1.35E-01	7.70E+00	1.04E+00	1.00E+00	1.00E+00	2.09E+00	5.41E-01	2.30E+00	6.39E-01
Nickel	1.34E-01	9.30E-04	1.64E+02	1.53E-01	5.22E-02	4.30E-02	2.24E-03	1.33E-01	1.35E-01	1.20E+00	1.61E-01	1.00E+00	1.00E+00	2.09E+00	1.51E-01	1.38E+00	6.14E-01
Selenium	1.34E-01	9.30E-04	1.88E+02	1.75E-01	5.22E-02	1.14E+00	5.95E-02	1.33E-01	1.35E-01	3.30E+01	4.44E+00	1.00E+00	1.00E+00	2.09E+00	2.24E+00	2.30E-01	1.11E+00
Vanadium	1.34E-01	9.30E-04	1.33E+02	1.24E-01	5.22E-02	6.20E-03	3.23E-04	1.33E-01	1.35E-01	3.00E-01	4.04E-02	1.00E+00	1.00E+00	2.09E+00	7.86E-02	1.14E+01	1.17E+00
Zinc	1.34E-01	9.30E-04	8.66E+02	8.05E-01	5.22E-02	1.10E-01	5.74E-03	1.33E-01	1.35E-01	1.24E+02	1.67E+01	1.00E+00	1.00E+00	2.09E+00	8.37E+00	1.72E+01	9.55E-01

COPEC	Allometrically Adjusted TRV[5] (mg/kg/day)	HQ (based on adjusted TRV)[6]
Cadmium	8.16E-02	1.26E+00
Chromium	1.01E+00	3.14E-01
Copper	2.36E+00	2.30E-01
Nickel	1.41E+00	1.07E-01
Selenium	2.33E-01	9.60E+00
Vanadium	1.15E+01	6.82E-03
Zinc	1.75E+01	4.79E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-9

TIER 1 HAZARD QUOTIENTS FOR THE GREAT BLUE HERON

(Page 1 of 2)

Notes (continued):

[1] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[2] Total prey ingestion rate was 99.3 percent of the total ingestion rate, based on the soil ingestion rate.

[3] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[4] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[5] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[6] The HQ was calculated using total daily dose/allometrically adjusted TRV.

TABLE G-10

TIER 1 HAZARD QUOTIENTS FOR THE MALLARD DUCK

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[3] (mg/kg)	Aquatic Plant Daily Dose[1] (mg/day)	Benthic Invertebrate Ingestion Rate (kg/day)	Benthic Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Benthic Invertebrate Daily Dose[1] (mg/kg)	SUF	TTC
Cadmium	1.24E-01	4.10E-03	1.40E+01	5.74E-02	8.44E-02	3.10E-04	2.62E-05	1.20E-01	3.25E-02	2.54E-01	3.55E+00	1.16E-01	9.60E-02	8.46E-01	8.12E-02	1.00E+00	1.00E+00
Chromium	1.24E-01	4.10E-03	1.91E+02	7.83E-01	8.44E-02	4.60E-03	3.88E-04	1.20E-01	3.25E-02	3.46E-01	6.62E+01	2.15E+00	9.60E-02	2.54E-01	2.44E-02	1.00E+00	1.00E+00
Copper	1.24E-01	4.10E-03	1.02E+02	4.18E-01	8.44E-02	1.50E-02	1.27E-03	1.20E-01	3.25E-02	4.41E-01	4.50E+01	1.46E+00	9.60E-02	1.00E+00	9.61E-02	1.00E+00	1.00E+00
Nickel	1.24E-01	4.10E-03	1.64E+02	6.72E-01	8.44E-02	4.30E-02	3.63E-03	1.20E-01	3.25E-02	3.05E-01	4.99E+01	1.62E+00	9.60E-02	5.92E-01	5.68E-02	1.00E+00	1.00E+00
Selenium	1.24E-01	4.10E-03	1.88E+02	7.71E-01	8.44E-02	1.14E+00	9.62E-02	1.20E-01	3.25E-02	8.17E-01	1.54E+02	4.99E+00	9.60E-02	4.16E+00	3.99E-01	1.00E+00	1.00E+00
Vanadium	1.24E-01	4.10E-03	1.33E+02	5.45E-01	8.44E-02	6.20E-03	5.23E-04	1.20E-01	3.25E-02	6.60E-02	8.78E+00	2.85E-01	9.60E-02	2.54E-01	2.44E-02	1.00E+00	1.00E+00
Zinc	1.24E-01	4.10E-03	8.66E+02	3.55E+00	8.44E-02	1.10E-01	9.28E-03	1.20E-01	3.25E-02	4.39E-01	3.80E+02	1.23E+01	9.60E-02	1.72E+01	1.65E+00	1.00E+00	1.00E+00

COPEC	Body Weight (kg)	Total Daily Dose[4] (mg/kg/day)	TRV[5] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Cadmium	1.04E+00	2.44E-01	8.00E-02	7.99E-01	8.44E-02	2.89E+00
Chromium	1.04E+00	2.84E+00	1.00E+00	1.25E+00	9.64E-01	2.94E+00
Copper	1.04E+00	1.90E+00	2.30E+00	6.39E-01	2.54E+00	7.47E-01
Nickel	1.04E+00	2.26E+00	1.38E+00	6.14E-01	1.53E+00	1.47E+00
Selenium	1.04E+00	6.00E+00	2.30E-01	1.11E+00	2.27E-01	2.64E+01
Vanadium	1.04E+00	8.20E-01	1.14E+01	1.17E+00	1.11E+01	7.36E-02
Zinc	1.04E+00	1.68E+01	1.72E+01	9.55E-01	1.75E+01	9.61E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-10

TIER 1 HAZARD QUOTIENTS FOR THE MALLARD DUCK

(Page 1 of 2)

Notes (continued):

[1] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[2] Total prey ingestion rate was 96.7 percent of the total ingestion rate, based on the soil ingestion rate.

[3] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[4] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[5] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[6] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[7] The HQ was calculated using total daily dose/allometrically adjusted TRV.

TABLE G-11

TIER 1 HAZARD QUOTIENTS FOR THE RACCOON

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	1.55E-01	1.46E-02	1.20E+02	1.75E+00	1.46E-02	1.40E+01	2.04E-01	8.29E-02	3.10E-04	2.57E-05	1.41E-01	4.54E-02	2.54E-01	3.55E+00	1.61E-01	4.54E-02	4.71E-01	5.65E+01	2.56E+00
Chromium	1.55E-01	1.46E-02	1.50E+03	2.19E+01	1.46E-02	1.91E+02	2.79E+00	8.29E-02	4.60E-03	3.81E-04	1.41E-01	4.54E-02	3.46E-01	6.62E+01	3.00E+00	4.54E-02	2.73E-02	4.09E+01	1.86E+00
Copper	1.55E-01	1.46E-02	2.10E+02	3.06E+00	1.46E-02	1.02E+02	1.49E+00	8.29E-02	1.50E-02	1.24E-03	1.41E-01	4.54E-02	4.41E-01	4.50E+01	2.04E+00	4.54E-02	3.55E-01	7.45E+01	3.38E+00
Nickel	1.55E-01	1.46E-02	4.60E+02	6.71E+00	1.46E-02	1.64E+02	2.39E+00	8.29E-02	4.30E-02	3.56E-03	1.41E-01	4.54E-02	3.05E-01	4.99E+01	2.27E+00	4.54E-02	4.94E-02	2.27E+01	1.03E+00
Selenium	1.55E-01	1.46E-02	1.50E+03	2.19E+01	1.46E-02	1.88E+02	2.74E+00	8.29E-02	1.14E+00	9.45E-02	1.41E-01	4.54E-02	8.17E-01	1.54E+02	6.97E+00	4.54E-02	3.20E-01	4.80E+02	2.18E+01
Vanadium	1.55E-01	1.46E-02	1.20E+03	1.75E+01	1.46E-02	1.33E+02	1.94E+00	8.29E-02	6.20E-03	5.14E-04	1.41E-01	4.54E-02	6.60E-02	8.78E+00	3.99E-01	4.54E-02	1.75E-02	2.10E+01	9.55E-01
Zinc	1.55E-01	1.46E-02	2.00E+03	2.92E+01	1.46E-02	8.66E+02	1.26E+01	8.29E-02	1.10E-01	9.12E-03	1.41E-01	4.54E-02	4.39E-01	3.80E+02	1.72E+01	4.54E-02	3.86E-01	7.71E+02	3.50E+01

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration in Dry Weight (mg/kg)	Fish Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	5.99E-02	7.00E+01	4.20E+00	1.71E-02	1.40E-01	2.40E-03	3.43E-03	1.50E+00	5.14E-03	1.00E+00	1.00E+00	5.90E+00	1.51E+00	6.00E-02	3.22E-02	4.39E-02	3.43E+01
Chromium	5.99E-02	2.60E+01	1.56E+00	1.71E-02	1.50E+00	2.57E-02	3.43E-03	3.60E+00	1.23E-02	1.00E+00	1.00E+00	5.90E+00	5.28E+00	2.74E+03	3.50E-01	2.31E+03	2.28E-03
Copper	5.99E-02	4.90E+01	2.94E+00	1.71E-02	5.10E+00	8.73E-02	3.43E-03	7.70E+00	2.64E-02	1.00E+00	1.00E+00	5.90E+00	2.21E+00	2.67E+00	3.00E-02	1.94E+00	1.14E+00
Nickel	5.99E-02	1.20E+01	7.19E-01	1.71E-02	1.60E+00	2.74E-02	3.43E-03	1.20E+00	4.11E-03	1.00E+00	1.00E+00	5.90E+00	2.23E+00	1.33E-01	2.48E-01	1.10E-01	2.03E+01
Selenium	5.99E-02	2.60E+02	1.56E+01	1.71E-02	7.00E+00	1.20E-01	3.43E-03	3.30E+01	1.13E-01	1.00E+00	1.00E+00	5.90E+00	1.17E+01	5.00E-02	2.46E-02	3.60E-02	3.26E+02
Vanadium	5.99E-02	6.20E+01	3.72E+00	1.71E-02	2.60E-01	4.45E-03	3.43E-03	3.00E-01	1.03E-03	1.00E+00	1.00E+00	5.90E+00	4.16E+00	2.10E-01	2.60E-01	1.74E-01	2.39E+01
Zinc	5.99E-02	4.00E+02	2.40E+01	1.71E-02	2.20E+01	3.77E-01	3.43E-03	1.24E+02	4.25E-01	1.00E+00	1.00E+00	5.90E+00	2.01E+01	9.60E+00	2.55E-02	6.92E+00	2.91E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value

TABLE G-11

TIER 1 HAZARD QUOTIENTS FOR THE RACCOON

(Page 1 of 2)

Notes (continued):

TTC Trophic transfer coefficient

1 The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-12

TIER 1 HAZARD QUOTIENTS FOR THE MINK

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	3.17E-02	2.98E-03	1.20E+02	3.58E-01	2.98E-03	1.40E+01	4.17E-02	1.04E-01	3.10E-04	3.22E-05	2.87E-02	1.66E-03	2.54E-01	3.55E+00	5.91E-03	1.66E-03	4.71E-01	5.65E+01	9.39E-02
Chromium	3.17E-02	2.98E-03	1.50E+03	4.47E+00	2.98E-03	1.91E+02	5.69E-01	1.04E-01	4.60E-03	4.78E-04	2.87E-02	1.66E-03	3.46E-01	6.62E+01	1.10E-01	1.66E-03	2.73E-02	4.09E+01	6.80E-02
Copper	3.17E-02	2.98E-03	2.10E+02	6.26E-01	2.98E-03	1.02E+02	3.04E-01	1.04E-01	1.50E-02	1.56E-03	2.87E-02	1.66E-03	4.41E-01	4.50E+01	7.47E-02	1.66E-03	3.55E-01	7.45E+01	1.24E-01
Nickel	3.17E-02	2.98E-03	4.60E+02	1.37E+00	2.98E-03	1.64E+02	4.89E-01	1.04E-01	4.30E-02	4.47E-03	2.87E-02	1.66E-03	3.05E-01	4.99E+01	8.30E-02	1.66E-03	4.94E-02	2.27E+01	3.78E-02
Selenium	3.17E-02	2.98E-03	1.50E+03	4.47E+00	2.98E-03	1.88E+02	5.60E-01	1.04E-01	1.14E+00	1.18E-01	2.87E-02	1.66E-03	8.17E-01	1.54E+02	2.55E-01	1.66E-03	3.20E-01	4.80E+02	7.98E-01
Vanadium	3.17E-02	2.98E-03	1.20E+03	3.58E+00	2.98E-03	1.33E+02	3.96E-01	1.04E-01	6.20E-03	6.44E-04	2.87E-02	1.66E-03	6.60E-02	8.78E+00	1.46E-02	1.66E-03	1.75E-02	2.10E+01	3.50E-02
Zinc	3.17E-02	2.98E-03	2.00E+03	5.96E+00	2.98E-03	8.66E+02	2.58E+00	1.04E-01	1.10E-01	1.14E-02	2.87E-02	1.66E-03	4.39E-01	3.80E+02	6.31E-01	1.66E-03	3.86E-01	7.71E+02	1.28E+00

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration in Dry Weight (mg/kg)	Fish Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	2.76E-03	7.00E+01	1.93E-01	2.03E-03	1.40E-01	2.84E-04	2.69E-02	1.50E+00	4.03E-02	1.00E+00	1.00E+00	5.68E-01	1.29E+00	6.00E-02	3.22E-02	5.05E-02	2.56E+01
Chromium	2.76E-03	2.60E+01	7.19E-02	2.03E-03	1.50E+00	3.04E-03	2.69E-02	3.60E+00	9.67E-02	1.00E+00	1.00E+00	5.68E-01	9.49E+00	2.74E+03	3.50E-01	2.66E+03	3.57E-03
Copper	2.76E-03	4.90E+01	1.35E-01	2.03E-03	5.10E+00	1.03E-02	2.69E-02	7.70E+00	2.07E-01	1.00E+00	1.00E+00	5.68E-01	2.61E+00	2.67E+00	3.00E-02	2.24E+00	1.17E+00
Nickel	2.76E-03	1.20E+01	3.32E-02	2.03E-03	1.60E+00	3.25E-03	2.69E-02	1.20E+00	3.22E-02	1.00E+00	1.00E+00	5.68E-01	3.62E+00	1.33E-01	2.48E-01	1.27E-01	2.86E+01
Selenium	2.76E-03	2.60E+02	7.19E-01	2.03E-03	7.00E+00	1.42E-02	2.69E-02	3.30E+01	8.87E-01	1.00E+00	1.00E+00	5.68E-01	1.38E+01	5.00E-02	2.46E-02	4.14E-02	3.32E+02
Vanadium	2.76E-03	6.20E+01	1.71E-01	2.03E-03	2.60E-01	5.28E-04	2.69E-02	3.00E-01	8.06E-03	1.00E+00	1.00E+00	5.68E-01	7.40E+00	2.10E-01	2.60E-01	2.00E-01	3.69E+01
Zinc	2.76E-03	4.00E+02	1.11E+00	2.03E-03	2.20E+01	4.46E-02	2.69E-02	1.24E+02	3.33E+00	1.00E+00	1.00E+00	5.68E-01	2.63E+01	9.60E+00	2.55E-02	7.97E+00	3.30E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value

TABLE G-12

TIER 1 HAZARD QUOTIENTS FOR THE MINK

(Page 1 of 2)

Notes (continued):

TTC Trophic transfer coefficient

[1] The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-13

TIER 1 HAZARD QUOTIENTS FOR THE COYOTE – WASTE ROCK

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)
Cadmium	2.51E-01	7.03E-03	1.20E+02	8.44E-01	9.79E-02	3.10E-04	3.03E-05	2.44E-01	2.58E-02	2.45E-01	2.94E+01	7.58E-01	2.33E-01	1.40E-01	3.26E-02	1.00E+00	1.00E+00	9.50E+00	1.72E-01
Chromium	2.51E-01	7.03E-03	1.50E+03	1.05E+01	9.79E-02	4.60E-03	4.50E-04	2.44E-01	2.58E-02	2.64E-02	3.95E+01	1.02E+00	2.33E-01	1.50E+00	3.49E-01	1.00E+00	1.00E+00	9.50E+00	1.25E+00
Copper	2.51E-01	7.03E-03	2.10E+02	1.48E+00	9.79E-02	1.50E-02	1.47E-03	2.44E-01	2.58E-02	3.24E-01	6.81E+01	1.76E+00	2.33E-01	5.10E+00	1.19E+00	1.00E+00	1.00E+00	9.50E+00	4.66E-01
Nickel	2.51E-01	7.03E-03	4.60E+02	3.23E+00	9.79E-02	4.30E-02	4.21E-03	2.44E-01	2.58E-02	3.98E-02	1.83E+01	4.73E-01	2.33E-01	1.60E+00	3.72E-01	1.00E+00	1.00E+00	9.50E+00	4.30E-01
Selenium	2.51E-01	7.03E-03	1.50E+03	1.05E+01	9.79E-02	1.14E+00	1.12E-01	2.44E-01	2.58E-02	2.40E-01	3.60E+02	9.30E+00	2.33E-01	7.00E+00	1.63E+00	1.00E+00	1.00E+00	9.50E+00	2.27E+00
Vanadium	2.51E-01	7.03E-03	1.20E+03	8.44E+00	9.79E-02	6.20E-03	6.07E-04	2.44E-01	2.58E-02	1.33E-02	1.59E+01	4.11E-01	2.33E-01	2.60E-01	6.05E-02	1.00E+00	1.00E+00	9.50E+00	9.38E-01
Zinc	2.51E-01	7.03E-03	2.00E+03	1.41E+01	9.79E-02	1.10E-01	1.08E-02	2.44E-01	2.58E-02	2.63E-01	5.25E+02	1.36E+01	2.33E-01	2.20E+01	5.12E+00	1.00E+00	1.00E+00	9.50E+00	3.45E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.8 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.2 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-14

TIER 1 HAZARD QUOTIENTS FOR THE NORTHERN HARRIER – WASTE ROCK

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Invertebrate Ingestion Rate (kg/day)	Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[4] (mg/kg/day)	TRV[5] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Cadmium	4.82E-02	3.40E-04	1.20E+02	4.08E-02	4.79E-02	1.21E-03	7.00E+01	8.50E-02	4.74E-02	1.40E-01	6.63E-03	1.00E+00	1.00E+00	4.35E-01	3.04E-01	8.00E-02	7.99E-01	7.08E-02	4.30E+00
Chromium	4.82E-02	3.40E-04	1.50E+03	5.10E-01	4.79E-02	1.21E-03	2.60E+01	3.16E-02	4.74E-02	1.50E+00	7.10E-02	1.00E+00	1.00E+00	4.35E-01	1.41E+00	1.00E+00	1.25E+00	8.10E-01	1.74E+00
Copper	4.82E-02	3.40E-04	2.10E+02	7.14E-02	4.79E-02	1.21E-03	4.90E+01	5.95E-02	4.74E-02	5.10E+00	2.42E-01	1.00E+00	1.00E+00	4.35E-01	8.56E-01	2.30E+00	6.39E-01	2.13E+00	4.02E-01
Nickel	4.82E-02	3.40E-04	4.60E+02	1.56E-01	4.79E-02	1.21E-03	1.20E+01	1.46E-02	4.74E-02	1.60E+00	7.58E-02	1.00E+00	1.00E+00	4.35E-01	5.67E-01	1.38E+00	6.14E-01	1.29E+00	4.40E-01
Selenium	4.82E-02	3.40E-04	1.50E+03	5.10E-01	4.79E-02	1.21E-03	8.00E+01	9.71E-02	4.74E-02	7.00E+00	3.31E-01	1.00E+00	1.00E+00	4.35E-01	2.16E+00	2.30E-01	1.11E+00	1.91E-01	1.13E+01
Vanadium	4.82E-02	3.40E-04	1.20E+03	4.08E-01	4.79E-02	1.21E-03	6.20E+01	7.53E-02	4.74E-02	2.60E-01	1.23E-02	1.00E+00	1.00E+00	4.35E-01	1.14E+00	1.14E+01	1.17E+00	9.35E+00	1.22E-01
Zinc	4.82E-02	3.40E-04	2.00E+03	6.80E-01	4.79E-02	1.21E-03	4.00E+02	4.86E-01	4.74E-02	2.20E+01	1.04E+00	1.00E+00	1.00E+00	4.35E-01	5.07E+00	1.72E+01	9.55E-01	1.47E+01	3.45E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 0.7 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 99.3 percent of the total ingestion rate, based on the soil ingestion rate.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-15

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD – BLACKFOOT WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)
Cadmium	1.21E-02	2.41E-04	1.68E+00	4.05E-04	1.51E-01	3.37E-04	5.09E-05	1.18E-02	9.84E-03	4.71E-01	7.91E-01	7.78E-03	2.46E-03	5.92E+00	1.46E-02	1.00E+00	1.00E+00	5.90E-02	3.87E-01
Chromium	1.21E-02	2.41E-04	6.19E+01	1.49E-02	1.51E-01	9.13E-04	1.38E-04	1.18E-02	9.84E-03	2.73E-02	1.69E+00	1.66E-02	2.46E-03	6.82E+00	1.68E-02	1.00E+00	1.00E+00	5.90E-02	8.21E-01
Copper	1.21E-02	2.41E-04	1.86E+01	4.48E-03	1.51E-01	6.52E-04	9.83E-05	1.18E-02	9.84E-03	3.55E-01	6.60E+00	6.49E-02	2.46E-03	1.42E+01	3.49E-02	1.00E+00	1.00E+00	5.90E-02	1.77E+00
Nickel	1.21E-02	2.41E-04	3.10E+01	7.47E-03	1.51E-01	7.28E-03	1.10E-03	1.18E-02	9.84E-03	4.94E-02	1.53E+00	1.51E-02	2.46E-03	2.98E+00	7.33E-03	1.00E+00	1.00E+00	5.90E-02	5.25E-01
Selenium	1.21E-02	2.41E-04	1.88E+00	4.52E-04	1.51E-01	1.10E-02	1.66E-03	1.18E-02	9.84E-03	3.20E-01	6.01E-01	5.91E-03	2.46E-03	2.05E+01	5.04E-02	1.00E+00	1.00E+00	5.90E-02	9.90E-01
Vanadium	1.21E-02	2.41E-04	5.81E+01	1.40E-02	1.51E-01	2.71E-03	4.08E-04	1.18E-02	9.84E-03	1.75E-02	1.02E+00	1.00E-02	2.46E-03	1.46E+01	3.59E-02	1.00E+00	1.00E+00	5.90E-02	1.02E+00
Zinc	1.21E-02	2.41E-04	1.17E+02	2.82E-02	1.51E-01	4.00E-02	6.04E-03	1.18E-02	9.84E-03	3.86E-01	4.51E+01	4.44E-01	2.46E-03	2.02E+02	4.97E-01	1.00E+00	1.00E+00	5.90E-02	1.65E+01

COPEC	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	8.00E-02	7.99E-01	4.75E-02	8.14E+00
Chromium	1.00E+00	1.25E+00	5.43E-01	1.51E+00
Copper	2.30E+00	6.39E-01	1.43E+00	1.24E+00
Nickel	1.38E+00	6.14E-01	8.64E-01	6.08E-01
Selenium	2.30E-01	1.11E+00	1.28E-01	7.74E+00
Vanadium	1.14E+01	1.17E+00	6.27E+00	1.63E-01
Zinc	1.72E+01	9.55E-01	9.86E+00	1.68E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-15

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD – BLACKFOOT WATERSHED

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-16

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE GREAT BLUE HERON – BLACKFOOT WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration in Dry Weight (mg/kg)	Fish Daily Dose[1] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose (mg/kg)	TRV[4] (mg/kg/day)	Test Species Body Weight (kg)	Body Weight (kg)
Selenium	1.18E-01	8.30E-04	3.72E+00	3.09E-03	4.64E-02	1.10E-02	5.12E-04	1.17E-01	1.19E-01	1.32E+01	1.57E+00	1.00E+00	1.00E+00	2.09E+00	7.53E-01	2.30E-01	1.11E+00	1.18E-01

COPEC	Allometrically Adjusted TRV[5] (mg/kg/day)	HQ (based on adjusted TRV)[6]
Selenium	2.61E-01	2.88E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 99.3 percent of the total ingestion rate, based on the soil ingestion rate.

3 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

4 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

5 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

6 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-17

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MALLARD DUCK – BLACKFOOT WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[3] (mg/kg)	Aquatic Plant Daily Dose[1] (mg/kg)	Benthic Invertebrate Ingestion Rate (kg/day)	Benthic Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Benthic Invertebrate Daily Dose[1] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[4] (mg/kg/day)
Chromium	9.02E-02	2.98E-03	4.49E+01	1.34E-01	5.64E-02	9.13E-04	5.15E-05	8.72E-02	2.36E-02	3.46E-01	1.55E+01	3.67E-01	6.97E-02	4.47E-01	3.11E-02	1.00E+00	1.00E+00	1.13E+00	4.69E-01
Nickel	9.02E-02	2.98E-03	2.42E+01	7.23E-02	5.64E-02	7.28E-03	4.11E-04	8.72E-02	2.36E-02	3.05E-01	7.39E+00	1.74E-01	6.97E-02	6.36E-01	4.43E-02	1.00E+00	1.00E+00	1.13E+00	2.57E-01
Selenium	9.02E-02	2.98E-03	3.72E+00	1.11E-02	5.64E-02	1.10E-02	6.23E-04	8.72E-02	2.36E-02	8.17E-01	3.04E+00	7.17E-02	6.97E-02	3.65E+00	2.54E-01	1.00E+00	1.00E+00	1.13E+00	2.98E-01

COPEC	TRV[5] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjuste d TRV)[7]
Chromium	1.00E+00	1.25E+00	9.81E-01	4.78E-01
Nickel	1.38E+00	6.14E-01	1.56E+00	1.65E-01
Selenium	2.30E-01	1.11E+00	2.31E-01	1.29E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 96.7 percent of the total ingestion rate, based on the soil ingestion rate.

3 Prey tissue concentration was calculated by mu ltiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-18

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK – BLACKFOOT WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)
Cadmium	4.18E-02	1.96E-03	1.68E+00	3.29E-03	1.96E-03	2.17E+00	4.25E-03	1.01E-01	3.37E-04	3.39E-05	3.79E-02	2.19E-03	4.71E-01	7.91E-01	1.73E-03	2.19E-03	2.54E-01	5.50E-01	1.21E-03
Copper	4.18E-02	1.96E-03	1.86E+01	3.65E-02	1.96E-03	1.16E+01	2.27E-02	1.01E-01	6.52E-04	6.56E-05	3.79E-02	2.19E-03	3.55E-01	6.60E+00	1.45E-02	2.19E-03	4.41E-01	5.12E+00	1.12E-02
Nickel	4.18E-02	1.96E-03	3.10E+01	6.07E-02	1.96E-03	2.42E+01	4.75E-02	1.01E-01	7.28E-03	7.32E-04	3.79E-02	2.19E-03	4.94E-02	1.53E+00	3.36E-03	2.19E-03	3.05E-01	7.39E+00	1.62E-02
Selenium	4.18E-02	1.96E-03	1.88E+00	3.68E-03	1.96E-03	3.72E+00	7.29E-03	1.01E-01	1.10E-02	1.11E-03	3.79E-02	2.19E-03	3.20E-01	6.01E-01	1.32E-03	2.19E-03	8.17E-01	3.04E+00	6.66E-03
Vanadium	4.18E-02	1.96E-03	5.81E+01	1.14E-01	1.96E-03	3.62E+01	7.09E-02	1.01E-01	2.71E-03	2.72E-04	3.79E-02	2.19E-03	1.75E-02	1.02E+00	2.23E-03	2.19E-03	6.60E-02	2.39E+00	5.23E-03
Zinc	4.18E-02	1.96E-03	1.17E+02	2.29E-01	1.96E-03	1.06E+02	2.08E-01	1.01E-01	4.00E-02	4.03E-03	3.79E-02	2.19E-03	3.86E-01	4.51E+01	9.88E-02	2.19E-03	4.39E-01	4.65E+01	1.02E-01

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.64E-03	5.92E+00	2.16E-02	2.68E-03	2.75E-02	7.36E-05	3.54E-02	2.53E-01	8.97E-03	1.00E+00	1.00E+00	8.52E-01	4.83E-02	6.00E-02	3.22E-02	4.93E-02	9.80E-01
Copper	3.64E-03	1.42E+01	5.17E-02	2.68E-03	1.19E+00	3.19E-03	3.54E-02	4.40E+00	1.56E-01	1.00E+00	1.00E+00	8.52E-01	3.47E-01	2.67E+00	3.00E-02	2.18E+00	1.59E-01
Nickel	3.64E-03	2.98E+00	1.09E-02	2.68E-03	1.64E-01	4.40E-04	3.54E-02	5.28E-01	1.87E-02	1.00E+00	1.00E+00	8.52E-01	1.86E-01	1.33E-01	2.48E-01	1.24E-01	1.51E+00
Selenium	3.64E-03	2.05E+01	7.47E-02	2.68E-03	4.16E-01	1.11E-03	3.54E-02	1.32E+01	4.67E-01	1.00E+00	1.00E+00	8.52E-01	6.61E-01	5.00E-02	2.46E-02	4.04E-02	1.64E+01
Vanadium	3.64E-03	1.46E+01	5.32E-02	2.68E-03	9.06E-02	2.42E-04	3.54E-02	2.34E-01	8.28E-03	1.00E+00	1.00E+00	8.52E-01	2.98E-01	2.10E-01	2.60E-01	1.96E-01	1.53E+00
Zinc	3.64E-03	2.02E+02	7.36E-01	2.68E-03	1.55E+01	4.16E-02	3.54E-02	8.57E+01	3.04E+00	1.00E+00	1.00E+00	8.52E-01	5.23E+00	9.60E+00	2.55E-02	7.78E+00	6.72E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-18

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK – BLACKFOOT WATERSHED

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-19

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE NORTHERN BOBWHITE – BLACKFOOT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	2.68E-02	5.40E-04	2.66E+00	1.44E-03	2.63E-02	2.34E-02	2.45E-01	6.51E-01	1.53E-02	3.94E-03	5.59E+00	2.20E-02	1.00E+00	1.00E+00	1.91E-01	2.03E-01	8.00E-02	7.99E-01	6.01E-02	3.37E+00
Chromium	2.68E-02	5.40E-04	6.69E+01	3.61E-02	2.63E-02	2.34E-02	2.64E-02	1.76E+00	4.13E-02	3.94E-03	7.07E+00	2.79E-02	1.00E+00	1.00E+00	1.91E-01	5.52E-01	1.00E+00	1.25E+00	6.87E-01	8.03E-01
Copper	2.68E-02	5.40E-04	1.98E+01	1.07E-02	2.63E-02	2.34E-02	3.24E-01	6.41E+00	1.50E-01	3.94E-03	1.56E+01	6.16E-02	1.00E+00	1.00E+00	1.91E-01	1.17E+00	2.30E+00	6.39E-01	1.81E+00	6.45E-01
Nickel	2.68E-02	5.40E-04	3.21E+01	1.73E-02	2.63E-02	2.34E-02	3.98E-02	1.28E+00	2.99E-02	3.94E-03	3.25E+00	1.28E-02	1.00E+00	1.00E+00	1.91E-01	3.14E-01	1.38E+00	6.14E-01	1.09E+00	2.88E-01
Selenium	2.68E-02	5.40E-04	2.62E+00	1.41E-03	2.63E-02	2.34E-02	2.40E-01	6.28E-01	1.47E-02	3.94E-03	1.21E+01	4.77E-02	1.00E+00	1.00E+00	1.91E-01	3.34E-01	2.30E-01	1.11E+00	1.62E-01	2.07E+00
Zinc	2.68E-02	5.40E-04	1.50E+02	8.10E-02	2.63E-02	2.34E-02	2.63E-01	3.94E+01	9.23E-01	3.94E-03	1.95E+02	7.69E-01	1.00E+00	1.00E+00	1.91E-01	9.28E+00	1.72E+01	9.55E-01	1.25E+01	7.45E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-20

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE EASTERN COTTONTAIL – BLACKFOOT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.87E-02	1.89E-03	2.66E+00	5.03E-03	7.68E-02	8.07E-02	2.45E-01	6.51E-01	5.25E-02	1.00E+00	1.00E+00	1.23E+00	4.67E-02	6.00E-02	3.22E-02	4.82E-02	9.69E-01
Copper	7.87E-02	1.89E-03	1.98E+01	3.74E-02	7.68E-02	8.07E-02	3.24E-01	6.41E+00	5.17E-01	1.00E+00	1.00E+00	1.23E+00	4.51E-01	2.67E+00	3.00E-02	2.14E+00	2.11E-01
Nickel	7.87E-02	1.89E-03	3.21E+01	6.06E-02	7.68E-02	8.07E-02	3.98E-02	1.28E+00	1.03E-01	1.00E+00	1.00E+00	1.23E+00	1.33E-01	1.33E-01	2.48E-01	1.21E-01	1.10E+00
Selenium	7.87E-02	1.89E-03	2.62E+00	4.95E-03	7.68E-02	8.07E-02	2.40E-01	6.28E-01	5.07E-02	1.00E+00	1.00E+00	1.23E+00	4.52E-02	5.00E-02	2.46E-02	3.95E-02	1.14E+00
Vanadium	7.87E-02	1.89E-03	6.07E+01	1.15E-01	7.68E-02	8.07E-02	1.33E-02	8.05E-01	6.50E-02	1.00E+00	1.00E+00	1.23E+00	1.46E-01	2.10E-01	2.60E-01	1.91E-01	7.63E-01
Zinc	7.87E-02	1.89E-03	1.50E+02	2.83E-01	7.68E-02	8.07E-02	2.63E-01	3.94E+01	3.18E+00	1.00E+00	1.00E+00	1.23E+00	2.81E+00	9.60E+00	2.55E-02	7.61E+00	3.69E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-21

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE AMERICAN ROBIN – BLACKFOOT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	1.45E-02	2.90E-04	2.66E+00	7.72E-04	1.42E-02	7.39E-03	2.45E-01	6.51E-01	4.81E-03	7.39E-03	5.59E+00	4.13E-02	1.00E+00	1.00E+00	7.73E-02	6.06E-01	8.00E-02	7.99E-01	5.01E-02	1.21E+01
Chromium	1.45E-02	2.90E-04	6.69E+01	1.94E-02	1.42E-02	7.39E-03	2.64E-02	1.76E+00	1.30E-02	7.39E-03	7.07E+00	5.23E-02	1.00E+00	1.00E+00	7.73E-02	1.10E+00	1.00E+00	1.25E+00	5.73E-01	1.91E+00
Copper	1.45E-02	2.90E-04	1.98E+01	5.73E-03	1.42E-02	7.39E-03	3.24E-01	6.41E+00	4.74E-02	7.39E-03	1.56E+01	1.16E-01	1.00E+00	1.00E+00	7.73E-02	2.18E+00	2.30E+00	6.39E-01	1.51E+00	1.45E+00
Selenium	1.45E-02	2.90E-04	2.62E+00	7.59E-04	1.42E-02	7.39E-03	2.40E-01	6.28E-01	4.64E-03	7.39E-03	1.21E+01	8.94E-02	1.00E+00	1.00E+00	7.73E-02	1.23E+00	2.30E-01	1.11E+00	1.35E-01	9.08E+00
Zinc	1.45E-02	2.90E-04	1.50E+02	4.35E-02	1.42E-02	7.39E-03	2.63E-01	3.94E+01	2.91E-01	7.39E-03	1.95E+02	1.44E+00	1.00E+00	1.00E+00	7.73E-02	2.30E+01	1.72E+01	9.55E-01	1.04E+01	2.21E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-22

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE DEER MOUSE – BLACKFOOT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.42E-03	7.00E-05	2.66E+00	1.86E-04	3.35E-03	1.90E-03	2.45E-01	6.51E-01	1.24E-03	1.59E-03	5.59E+00	8.87E-03	1.00E+00	1.00E+00	2.10E-02	4.90E-01	6.00E-02	3.22E-02	6.16E-02	7.96E+00
Copper	3.42E-03	7.00E-05	1.98E+01	1.38E-03	3.35E-03	1.90E-03	3.24E-01	6.41E+00	1.22E-02	1.59E-03	1.56E+01	2.48E-02	1.00E+00	1.00E+00	2.10E-02	1.83E+00	2.67E+00	3.00E-02	2.73E+00	6.70E-01
Nickel	3.42E-03	7.00E-05	3.21E+01	2.24E-03	3.35E-03	1.90E-03	3.98E-02	1.28E+00	2.43E-03	1.59E-03	3.25E+00	5.16E-03	1.00E+00	1.00E+00	2.10E-02	4.68E-01	1.33E-01	2.48E-01	1.54E-01	3.04E+00
Selenium	3.42E-03	7.00E-05	2.62E+00	1.83E-04	3.35E-03	1.90E-03	2.40E-01	6.28E-01	1.19E-03	1.59E-03	1.21E+01	1.92E-02	1.00E+00	1.00E+00	2.10E-02	9.81E-01	5.00E-02	2.46E-02	5.05E-02	1.94E+01
Vanadium	3.42E-03	7.00E-05	6.07E+01	4.25E-03	3.35E-03	1.90E-03	1.33E-02	8.05E-01	1.53E-03	1.59E-03	1.42E+01	2.26E-02	1.00E+00	1.00E+00	2.10E-02	1.35E+00	2.10E-01	2.60E-01	2.44E-01	5.53E+00
Zinc	3.42E-03	7.00E-05	1.50E+02	1.05E-02	3.35E-03	1.90E-03	2.63E-01	3.94E+01	7.49E-02	1.59E-03	1.95E+02	3.10E-01	1.00E+00	1.00E+00	2.10E-02	1.88E+01	9.60E+00	2.55E-02	9.71E+00	1.94E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

[1] The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-23

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE SONG SPARROW – BLACKFOOT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.43E-03	1.29E-04	1.68E+00	2.16E-04	2.26E-01	3.37E-04	7.61E-05	6.30E-03	6.56E-03	4.71E-01	7.91E-01	5.19E-03	1.00E+00	1.00E+00	2.35E-02	2.34E-01	8.00E-02	7.99E-01	3.95E-02	5.91E+00
Chromium	6.43E-03	1.29E-04	6.19E+01	7.96E-03	2.26E-01	9.13E-04	2.06E-04	6.30E-03	6.56E-03	2.73E-02	1.69E+00	1.11E-02	1.00E+00	1.00E+00	2.35E-02	8.19E-01	1.00E+00	1.25E+00	4.52E-01	1.81E+00
Copper	6.43E-03	1.29E-04	1.86E+01	2.39E-03	2.26E-01	6.52E-04	1.47E-04	6.30E-03	6.56E-03	3.55E-01	6.60E+00	4.33E-02	1.00E+00	1.00E+00	2.35E-02	1.95E+00	2.30E+00	6.39E-01	1.19E+00	1.64E+00
Nickel	6.43E-03	1.29E-04	3.10E+01	3.99E-03	2.26E-01	7.28E-03	1.64E-03	6.30E-03	6.56E-03	4.94E-02	1.53E+00	1.01E-02	1.00E+00	1.00E+00	2.35E-02	6.68E-01	1.38E+00	6.14E-01	7.18E-01	9.30E-01
Selenium	6.43E-03	1.29E-04	1.88E+00	2.41E-04	2.26E-01	1.10E-02	2.49E-03	6.30E-03	6.56E-03	3.20E-01	6.01E-01	3.94E-03	1.00E+00	1.00E+00	2.35E-02	2.84E-01	2.30E-01	1.11E+00	1.06E-01	2.67E+00
Vanadium	6.43E-03	1.29E-04	5.81E+01	7.47E-03	2.26E-01	2.71E-03	6.11E-04	6.30E-03	6.56E-03	1.75E-02	1.02E+00	6.68E-03	1.00E+00	1.00E+00	2.35E-02	6.29E-01	1.14E+01	1.17E+00	5.22E+00	1.20E-01
Zinc	6.43E-03	1.29E-04	1.17E+02	1.50E-02	2.26E-01	4.00E-02	9.03E-03	6.30E-03	6.56E-03	3.86E-01	4.51E+01	2.96E-01	1.00E+00	1.00E+00	2.35E-02	1.36E+01	1.72E+01	9.55E-01	8.20E+00	1.66E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-24

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE MEADOW VOLE – BLACKFOOT WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate[1] (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	7.20E-03	1.73E-04	1.68E+00	2.91E-04	1.34E-01	3.37E-04	4.53E-05	7.03E-03	7.23E-03	4.71E-01	7.91E-01	5.72E-03	1.48E-04	5.92E+00	8.74E-04	1.00E+00	1.00E+00	3.73E-02	1.86E-01	6.00E-02
Copper	7.20E-03	1.73E-04	1.86E+01	3.22E-03	1.34E-01	6.52E-04	8.75E-05	7.03E-03	7.23E-03	3.55E-01	6.60E+00	4.77E-02	1.48E-04	1.42E+01	2.09E-03	1.00E+00	1.00E+00	3.73E-02	1.43E+00	2.67E+00
Nickel	7.20E-03	1.73E-04	3.10E+01	5.36E-03	1.34E-01	7.28E-03	9.77E-04	7.03E-03	7.23E-03	4.94E-02	1.53E+00	1.11E-02	1.48E-04	2.98E+00	4.40E-04	1.00E+00	1.00E+00	3.73E-02	4.79E-01	1.33E-01
Selenium	7.20E-03	1.73E-04	1.88E+00	3.25E-04	1.34E-01	1.10E-02	1.48E-03	7.03E-03	7.23E-03	3.20E-01	6.01E-01	4.34E-03	1.48E-04	2.05E+01	3.02E-03	1.00E+00	1.00E+00	3.73E-02	2.46E-01	5.00E-02
Vanadium	7.20E-03	1.73E-04	5.81E+01	1.00E-02	1.34E-01	2.71E-03	3.63E-04	7.03E-03	7.23E-03	1.75E-02	1.02E+00	7.36E-03	1.48E-04	1.46E+01	2.15E-03	1.00E+00	1.00E+00	3.73E-02	5.35E-01	2.10E-01
Zinc	7.20E-03	1.73E-04	1.17E+02	2.02E-02	1.34E-01	4.00E-02	5.37E-03	7.03E-03	7.23E-03	3.86E-01	4.51E+01	3.26E-01	1.48E-04	2.02E+02	2.98E-02	1.00E+00	1.00E+00	3.73E-02	1.02E+01	9.60E+00

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	5.95E-02	3.13E+00
Copper	3.00E-02	2.64E+00	5.41E-01
Nickel	2.48E-01	1.49E-01	3.22E+00
Selenium	2.46E-02	4.88E-02	5.05E+00
Vanadium	2.60E-01	2.36E-01	2.27E+00
Zinc	2.55E-02	9.38E+00	1.09E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-24

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE MEADOW VOLE – BLACKFOOT WATERSHED

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-25

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON – BLACKFOOT WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)
Cadmium	1.69E-01	7.92E-03	1.68E+00	1.33E-02	7.92E-03	2.17E+00	1.72E-02	8.30E-02	3.37E-04	2.80E-05	1.53E-01	4.93E-02	4.71E-01	7.91E-01	3.90E-02	4.93E-02	2.54E-01	5.50E-01	2.71E-02
Copper	1.69E-01	7.92E-03	1.86E+01	1.47E-01	7.92E-03	1.16E+01	9.19E-02	8.30E-02	6.52E-04	5.41E-05	1.53E-01	4.93E-02	3.55E-01	6.60E+00	3.25E-01	4.93E-02	4.41E-01	5.12E+00	2.52E-01
Nickel	1.69E-01	7.92E-03	3.10E+01	2.45E-01	7.92E-03	2.42E+01	1.92E-01	8.30E-02	7.28E-03	6.04E-04	1.53E-01	4.93E-02	4.94E-02	1.53E+00	7.56E-02	4.93E-02	3.05E-01	7.39E+00	3.64E-01
Selenium	1.69E-01	7.92E-03	1.88E+00	1.49E-02	7.92E-03	3.72E+00	2.95E-02	8.30E-02	1.10E-02	9.15E-04	1.53E-01	4.93E-02	3.20E-01	6.01E-01	2.96E-02	4.93E-02	8.17E-01	3.04E+00	1.50E-01
Vanadium	1.69E-01	7.92E-03	5.81E+01	4.60E-01	7.92E-03	3.62E+01	2.86E-01	8.30E-02	2.71E-03	2.24E-04	1.53E-01	4.93E-02	1.75E-02	1.02E+00	5.02E-02	4.93E-02	6.60E-02	2.39E+00	1.18E-01
Zinc	1.69E-01	7.92E-03	1.17E+02	9.27E-01	7.92E-03	1.06E+02	8.39E-01	8.30E-02	4.00E-02	3.32E-03	1.53E-01	4.93E-02	3.86E-01	4.51E+01	2.22E+00	4.93E-02	4.39E-01	4.65E+01	2.29E+00

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.51E-02	5.92E+00	3.86E-01	1.86E-02	2.75E-02	5.12E-04	3.72E-03	2.53E-01	9.42E-04	1.00E+00	1.00E+00	6.67E+00	0.0747237	6.00E-02	3.22E-02	4.36E-02	1.77E+00
Copper	6.51E-02	1.42E+01	9.24E-01	1.86E-02	1.19E+00	2.22E-02	3.72E-03	4.40E+00	1.64E-02	1.00E+00	1.00E+00	6.67E+00	2.64E-01	2.67E+00	3.00E-02	1.93E+00	1.57E-01
Nickel	6.51E-02	2.98E+00	1.94E-01	1.86E-02	1.64E-01	3.06E-03	3.72E-03	5.28E-01	1.96E-03	1.00E+00	1.00E+00	6.67E+00	1.64E-01	1.33E-01	2.48E-01	1.09E-01	2.08E+00
Selenium	6.51E-02	2.05E+01	1.33E+00	1.86E-02	4.16E-01	7.74E-03	3.72E-03	1.32E+01	4.91E-02	1.00E+00	1.00E+00	6.67E+00	2.55E-01	5.00E-02	2.46E-02	3.57E-02	6.97E+00
Vanadium	6.51E-02	1.46E+01	9.51E-01	1.86E-02	9.06E-02	1.68E-03	3.72E-03	2.34E-01	8.70E-04	1.00E+00	1.00E+00	6.67E+00	2.88E-01	2.10E-01	2.60E-01	1.73E-01	2.27E+00
Zinc	6.51E-02	2.02E+02	1.32E+01	1.86E-02	1.55E+01	2.89E-01	3.72E-03	8.57E+01	3.19E-01	1.00E+00	1.00E+00	6.67E+00	3.03E+00	9.60E+00	2.55E-02	6.87E+00	4.76E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-25

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON – BLACKFOOT WATERSHED

(Page 1 of 2)

Notes (continued):

1 The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-26

TIER 2 HAZARD OVERALL FOR THE COYOTE – BLACKFOOT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	2.29E-01	6.42E-03	2.66E+00	1.71E-02	7.83E-02	3.37E-04	2.64E-05	2.23E-01	2.36E-02	2.45E-01	6.51E-01	1.53E-02	2.12E-01	1.29E-01	2.73E-02	1.00E+00	1.00E+00	1.05E+01	5.69E-03	6.00E-02
Nickel	2.29E-01	6.42E-03	3.21E+01	2.06E-01	7.83E-02	7.28E-03	5.70E-04	2.23E-01	2.36E-02	3.98E-02	1.28E+00	3.01E-02	2.12E-01	1.71E-01	3.63E-02	1.00E+00	1.00E+00	1.05E+01	2.60E-02	1.33E-01
Selenium	2.29E-01	6.42E-03	2.62E+00	1.68E-02	7.83E-02	1.10E-02	8.64E-04	2.23E-01	2.36E-02	2.40E-01	6.28E-01	1.48E-02	2.12E-01	4.03E-01	8.56E-02	1.00E+00	1.00E+00	1.05E+01	1.12E-02	5.00E-02
Vanadium	2.29E-01	6.42E-03	6.07E+01	3.90E-01	7.83E-02	2.71E-03	2.12E-04	2.23E-01	2.36E-02	1.33E-02	8.05E-01	1.90E-02	2.12E-01	9.80E-02	2.08E-02	1.00E+00	1.00E+00	1.05E+01	4.09E-02	2.10E-01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	4.27E-02	1.33E-01
Nickel	2.48E-01	1.07E-01	2.43E-01
Selenium	2.46E-02	3.50E-02	3.22E-01
Vanadium	2.60E-01	1.69E-01	2.42E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.8 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.2 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-27

TIER 2 HAZARD OVERALL FOR THE NORTHERN HARRIER – BLACKFOOT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[5] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Chromium	4.09E-02	2.86E-04	6.69E+01	1.91E-02	3.81E-02	1.10E-03	7.07E+00	7.75E-03	4.27E-02	5.11E-01	2.18E-02	1.00E+00	1.00E+00	5.13E-01	9.50E-02	1.00E+00	1.25E+00	8.37E-01	1.14E-01
Selenium	4.09E-02	2.86E-04	2.62E+00	7.49E-04	3.81E-02	1.10E-03	1.21E+01	1.33E-02	4.27E-02	4.03E-01	1.72E-02	1.00E+00	1.00E+00	5.13E-01	6.09E-02	2.30E-01	1.11E+00	1.97E-01	3.09E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 0.7 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 99.3 percent of the total ingestion rate, based on the soil ingestion rate.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-28

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD – SALT WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	1.21E-02	2.41E-04	1.42E+00	3.42E-04	1.51E-01	3.36E-04	5.06E-05	1.18E-02	9.84E-03	4.71E-01	6.67E-01	6.56E-03	2.46E-03	5.81E+00	1.43E-02	1.00E+00	1.00E+00	5.90E-02	3.60E-01	8.00E-02
Chromium	1.21E-02	2.41E-04	5.83E+01	1.40E-02	1.51E-01	8.17E-04	1.23E-04	1.18E-02	9.84E-03	2.73E-02	1.59E+00	1.56E-02	2.46E-03	6.95E+00	1.71E-02	1.00E+00	1.00E+00	5.90E-02	7.95E-01	1.00E+00
Copper	1.21E-02	2.41E-04	1.84E+01	4.43E-03	1.51E-01	5.83E-04	8.80E-05	1.18E-02	9.84E-03	3.55E-01	6.53E+00	6.42E-02	2.46E-03	1.47E+01	3.62E-02	1.00E+00	1.00E+00	5.90E-02	1.78E+00	2.30E+00
Nickel	1.21E-02	2.41E-04	3.04E+01	7.34E-03	1.51E-01	6.31E-03	9.52E-04	1.18E-02	9.84E-03	4.94E-02	1.51E+00	1.48E-02	2.46E-03	3.09E+00	7.61E-03	1.00E+00	1.00E+00	5.90E-02	5.20E-01	1.38E+00
Selenium	1.21E-02	2.41E-04	1.12E+00	2.69E-04	1.51E-01	6.45E-03	9.73E-04	1.18E-02	9.84E-03	3.20E-01	3.57E-01	3.52E-03	2.46E-03	1.94E+01	4.77E-02	1.00E+00	1.00E+00	5.90E-02	8.90E-01	2.30E-01
Vanadium	1.21E-02	2.41E-04	5.60E+01	1.35E-02	1.51E-01	2.49E-03	3.76E-04	1.18E-02	9.84E-03	1.75E-02	9.83E-01	9.67E-03	2.46E-03	1.51E+01	3.72E-02	1.00E+00	1.00E+00	5.90E-02	1.03E+00	1.14E+01
Zinc	1.21E-02	2.41E-04	1.11E+02	2.68E-02	1.51E-01	3.71E-02	5.60E-03	1.18E-02	9.84E-03	3.86E-01	4.29E+01	4.22E-01	2.46E-03	1.99E+02	4.89E-01	1.00E+00	1.00E+00	5.90E-02	1.60E+01	1.72E+01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.99E-01	4.75E-02	7.58E+00
Chromium	1.25E+00	5.43E-01	1.46E+00
Copper	6.39E-01	1.43E+00	1.24E+00
Nickel	6.14E-01	8.64E-01	6.03E-01
Selenium	1.11E+00	1.28E-01	6.95E+00
Vanadium	1.17E+00	6.27E+00	1.64E-01
Zinc	9.55E-01	9.86E+00	1.62E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-28

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD – SALT WATERSHED

(Page 1 of 2)

1 The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-29

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE GREAT BLUE HERON – SALT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration in Dry Weight (mg/kg)	Fish Daily Dose[1] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[3] (mg/kg/day)	TRV[4] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[5] (mg/kg/day)	HQ (based on adjusted TRV)[6]
Selenium	1.18E-01	8.30E-04	3.38E+00	2.80E-03	4.64E-02	6.45E-03	2.99E-04	1.17E-01	1.19E-01	9.63E+00	1.15E+00	1.00E+00	1.00E+00	2.09E+00	5.50E-01	2.30E-01	1.11E+00	2.61E-01	2.11E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 99 percent of the total ingestion rate, based on the soil ingestion rate.

3 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

4 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

5 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

6 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-30

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE MALLARD DUCK – SALT WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[3] (mg/kg)	Aquatic Plant Daily Dose[1] (mg/kg)	Benthic Invertebrate Ingestion Rate (kg/day)	Benthic Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Benthic Invertebrate Daily Dose[1] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[4] (mg/kg/day)	TRV[5] (mg/kg/day)
Chromium	9.02E-02	2.98E-03	5.13E+01	1.53E-01	5.64E-02	8.17E-04	4.61E-05	8.72E-02	2.36E-02	3.46E-01	1.78E+01	4.20E-01	6.97E-02	2.61E-01	1.82E-02	1.00E+00	1.00E+00	1.13E+00	5.21E-01	1.00E+00
Nickel	9.02E-02	2.98E-03	2.55E+01	7.60E-02	5.64E-02	6.31E-03	3.56E-04	8.72E-02	2.36E-02	3.05E-01	7.76E+00	1.83E-01	6.97E-02	3.02E-01	2.10E-02	1.00E+00	1.00E+00	1.13E+00	2.47E-01	1.38E+00
Selenium	9.02E-02	2.98E-03	3.38E+00	1.01E-02	5.64E-02	6.45E-03	3.64E-04	8.72E-02	2.36E-02	8.17E-01	2.76E+00	6.51E-02	6.97E-02	1.73E+00	1.21E-01	1.00E+00	1.00E+00	1.13E+00	1.73E-01	2.30E-01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Chromium	1.25E+00	9.81E-01	5.31E-01
Nickel	6.14E-01	1.56E+00	1.59E-01
Selenium	1.11E+00	2.31E-01	7.50E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 96.7 percent of the total ingestion rate, based on the soil ingestion rate.

3 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-31

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK – SALT WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	4.18E-02	1.96E-03	1.42E+00	2.78E-03	1.96E-03	1.70E+00	3.33E-03	1.01E-01	3.36E-04	3.37E-05	3.79E-02	2.19E-03	2.54E-01	4.31E-01	9.45E-04	2.19E-03	4.71E-01	6.67E-01	1.46E-03
Copper	4.18E-02	1.96E-03	1.84E+01	3.61E-02	1.96E-03	1.20E+01	2.35E-02	1.01E-01	5.83E-04	5.87E-05	3.79E-02	2.19E-03	4.41E-01	5.29E+00	1.16E-02	2.19E-03	3.55E-01	6.53E+00	1.43E-02
Nickel	4.18E-02	1.96E-03	3.04E+01	5.97E-02	1.96E-03	2.55E+01	5.00E-02	1.01E-01	6.31E-03	6.35E-04	3.79E-02	2.19E-03	3.05E-01	7.76E+00	1.70E-02	2.19E-03	4.94E-02	1.51E+00	3.30E-03
Selenium	4.18E-02	1.96E-03	1.12E+00	2.19E-03	1.96E-03	3.38E+00	6.62E-03	1.01E-01	6.45E-03	6.49E-04	3.79E-02	2.19E-03	8.17E-01	2.76E+00	6.05E-03	2.19E-03	3.20E-01	3.57E-01	7.83E-04
Vanadium	4.18E-02	1.96E-03	5.60E+01	1.10E-01	1.96E-03	4.44E+01	8.70E-02	1.01E-01	2.49E-03	2.51E-04	3.79E-02	2.19E-03	6.60E-02	2.93E+00	6.42E-03	2.19E-03	1.75E-02	9.83E-01	2.15E-03
Zinc	4.18E-02	1.96E-03	1.11E+02	2.18E-01	1.96E-03	1.17E+02	2.29E-01	1.01E-01	3.71E-02	3.73E-03	3.79E-02	2.19E-03	4.39E-01	5.12E+01	1.12E-01	2.19E-03	3.86E-01	4.29E+01	9.39E-02

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.64E-03	5.81E+00	2.12E-02	2.68E-03	2.72E-02	7.28E-05	3.54E-02	1.61E-01	5.70E-03	1.00E+00	1.00E+00	8.52E-01	4.17E-02	6.00E-02	3.22E-02	4.93E-02	8.45E-01
Copper	3.64E-03	1.47E+01	5.36E-02	2.68E-03	1.18E+00	3.15E-03	3.54E-02	3.89E+00	1.38E-01	1.00E+00	1.00E+00	8.52E-01	3.29E-01	2.67E+00	3.00E-02	2.18E+00	1.50E-01
Nickel	3.64E-03	3.09E+00	1.13E-02	2.68E-03	1.52E-01	4.07E-04	3.54E-02	4.05E-01	1.44E-02	1.00E+00	1.00E+00	8.52E-01	1.84E-01	1.33E-01	2.48E-01	1.24E-01	1.49E+00
Selenium	3.64E-03	1.94E+01	7.07E-02	2.68E-03	4.21E-01	1.13E-03	3.54E-02	9.63E+00	3.41E-01	1.00E+00	1.00E+00	8.52E-01	5.04E-01	5.00E-02	2.46E-02	4.04E-02	1.25E+01
Vanadium	3.64E-03	1.51E+01	5.51E-02	2.68E-03	9.30E-02	2.49E-04	3.54E-02	2.27E-01	8.05E-03	1.00E+00	1.00E+00	8.52E-01	3.16E-01	2.10E-01	2.60E-01	1.96E-01	1.61E+00
Zinc	3.64E-03	1.99E+02	7.24E-01	2.68E-03	1.56E+01	4.16E-02	3.54E-02	7.81E+01	2.77E+00	1.00E+00	1.00E+00	8.52E-01	4.92E+00	9.60E+00	2.55E-02	7.78E+00	6.32E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-31

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK – SALT WATERSHED

(Page 1 of 2)

Notes (continued):

1 The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-32

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE NORTHERN BOBWHITE – SALT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	2.68E-02	5.40E-04	2.12E+00	1.14E-03	2.63E-02	2.34E-02	2.45E-01	5.17E-01	1.21E-02	3.94E-03	5.58E+00	2.20E-02	1.00E+00	1.00E+00	1.91E-01	1.85E-01	8.00E-02	7.99E-01	6.01E-02	3.07E+00
Chromium	2.68E-02	5.40E-04	5.73E+01	3.09E-02	2.63E-02	2.34E-02	2.64E-02	1.51E+00	3.54E-02	3.94E-03	7.08E+00	2.79E-02	1.00E+00	1.00E+00	1.91E-01	4.93E-01	1.00E+00	1.25E+00	6.87E-01	7.18E-01
Copper	2.68E-02	5.40E-04	1.86E+01	1.01E-02	2.63E-02	2.34E-02	3.24E-01	6.05E+00	1.42E-01	3.94E-03	1.55E+01	6.13E-02	1.00E+00	1.00E+00	1.91E-01	1.12E+00	2.30E+00	6.39E-01	1.81E+00	6.17E-01
Nickel	2.68E-02	5.40E-04	2.94E+01	1.59E-02	2.63E-02	2.34E-02	3.98E-02	1.17E+00	2.74E-02	3.94E-03	3.23E+00	1.27E-02	1.00E+00	1.00E+00	1.91E-01	2.93E-01	1.38E+00	6.14E-01	1.09E+00	2.68E-01
Selenium	2.68E-02	5.40E-04	1.16E+00	6.29E-04	2.63E-02	2.34E-02	2.40E-01	2.80E-01	6.55E-03	3.94E-03	1.20E+01	4.71E-02	1.00E+00	1.00E+00	1.91E-01	2.84E-01	2.30E-01	1.11E+00	1.62E-01	1.76E+00
Zinc	2.68E-02	5.40E-04	1.39E+02	7.52E-02	2.63E-02	2.34E-02	2.63E-01	3.66E+01	8.58E-01	3.94E-03	1.95E+02	7.67E-01	1.00E+00	1.00E+00	1.91E-01	8.90E+00	1.72E+01	9.55E-01	1.25E+01	7.14E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-33

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE EASTERN COTTONTAIL – SALT WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.87E-02	1.89E-03	2.12E+00	4.00E-03	7.68E-02	8.07E-02	2.45E-01	5.17E-01	4.17E-02	1.00E+00	1.00E+00	1.23E+00	3.72E-02	6.00E-02	3.22E-02	4.82E-02	7.71E-01
Copper	7.87E-02	1.89E-03	1.86E+01	3.52E-02	7.68E-02	8.07E-02	3.24E-01	6.05E+00	4.88E-01	1.00E+00	1.00E+00	1.23E+00	4.25E-01	2.67E+00	3.00E-02	2.14E+00	1.99E-01
Nickel	7.87E-02	1.89E-03	2.94E+01	5.55E-02	7.68E-02	8.07E-02	3.98E-02	1.17E+00	9.44E-02	1.00E+00	1.00E+00	1.23E+00	1.22E-01	1.33E-01	2.48E-01	1.21E-01	1.01E+00
Selenium	7.87E-02	1.89E-03	1.16E+00	2.20E-03	7.68E-02	8.07E-02	2.40E-01	2.80E-01	2.25E-02	1.00E+00	1.00E+00	1.23E+00	2.01E-02	5.00E-02	2.46E-02	3.95E-02	5.09E-01
Vanadium	7.87E-02	1.89E-03	5.54E+01	1.05E-01	7.68E-02	8.07E-02	1.33E-02	7.35E-01	5.93E-02	1.00E+00	1.00E+00	1.23E+00	1.33E-01	2.10E-01	2.60E-01	1.91E-01	6.96E-01
Zinc	7.87E-02	1.89E-03	1.39E+02	2.63E-01	7.68E-02	8.07E-02	2.63E-01	3.66E+01	2.95E+00	1.00E+00	1.00E+00	1.23E+00	2.61E+00	9.60E+00	2.55E-02	7.61E+00	3.43E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-34

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE AMERICAN ROBIN – SALT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	1.45E-02	2.90E-04	2.12E+00	6.13E-04	1.42E-02	7.39E-03	2.45E-01	5.17E-01	3.82E-03	7.39E-03	5.58E+00	4.13E-02	1.00E+00	1.00E+00	7.73E-02	5.91E-01	8.00E-02	7.99E-01	5.01E-02	1.18E+01
Chromium	1.45E-02	2.90E-04	5.73E+01	1.66E-02	1.42E-02	7.39E-03	2.64E-02	1.51E+00	1.11E-02	7.39E-03	7.08E+00	5.23E-02	1.00E+00	1.00E+00	7.73E-02	1.04E+00	1.00E+00	1.25E+00	5.73E-01	1.81E+00
Copper	1.45E-02	2.90E-04	1.86E+01	5.41E-03	1.42E-02	7.39E-03	3.24E-01	6.05E+00	4.47E-02	7.39E-03	1.55E+01	1.15E-01	1.00E+00	1.00E+00	7.73E-02	2.13E+00	2.30E+00	6.39E-01	1.51E+00	1.42E+00
Selenium	1.45E-02	2.90E-04	1.16E+00	3.38E-04	1.42E-02	7.39E-03	2.40E-01	2.80E-01	2.07E-03	7.39E-03	1.20E+01	8.83E-02	1.00E+00	1.00E+00	7.73E-02	1.17E+00	2.30E-01	1.11E+00	1.35E-01	8.69E+00
Zinc	1.45E-02	2.90E-04	1.39E+02	4.04E-02	1.42E-02	7.39E-03	2.63E-01	3.66E+01	2.70E-01	7.39E-03	1.95E+02	1.44E+00	1.00E+00	1.00E+00	7.73E-02	2.26E+01	1.72E+01	9.55E-01	1.04E+01	2.17E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-35

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE DEER MOUSE – SALT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.42E-03	7.00E-05	2.12E+00	1.48E-04	3.35E-03	1.90E-03	2.45E-01	5.17E-01	9.84E-04	1.59E-03	5.58E+00	8.87E-03	1.00E+00	1.00E+00	2.10E-02	4.76E-01	6.00E-02	3.22E-02	6.16E-02	7.73E+00
Copper	3.42E-03	7.00E-05	1.86E+01	1.30E-03	3.35E-03	1.90E-03	3.24E-01	6.05E+00	1.15E-02	1.59E-03	1.55E+01	2.47E-02	1.00E+00	1.00E+00	2.10E-02	1.78E+00	2.67E+00	3.00E-02	2.73E+00	6.54E-01
Nickel	3.42E-03	7.00E-05	2.94E+01	2.06E-03	3.35E-03	1.90E-03	3.98E-02	1.17E+00	2.23E-03	1.59E-03	3.23E+00	5.12E-03	1.00E+00	1.00E+00	2.10E-02	4.48E-01	1.33E-01	2.48E-01	1.54E-01	2.90E+00
Selenium	3.42E-03	7.00E-05	1.16E+00	8.15E-05	3.35E-03	1.90E-03	2.40E-01	2.80E-01	5.32E-04	1.59E-03	1.20E+01	1.90E-02	1.00E+00	1.00E+00	2.10E-02	9.33E-01	5.00E-02	2.46E-02	5.05E-02	1.85E+01
Vanadium	3.42E-03	7.00E-05	5.54E+01	3.88E-03	3.35E-03	1.90E-03	1.33E-02	7.35E-01	1.40E-03	1.59E-03	1.44E+01	2.28E-02	1.00E+00	1.00E+00	2.10E-02	1.34E+00	2.10E-01	2.60E-01	2.44E-01	5.48E+00
Zinc	3.42E-03	7.00E-05	1.39E+02	9.75E-03	3.35E-03	1.90E-03	2.63E-01	3.66E+01	6.96E-02	1.59E-03	1.95E+02	3.09E-01	1.00E+00	1.00E+00	2.10E-02	1.85E+01	9.60E+00	2.55E-02	9.71E+00	1.90E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-36

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE SONG SPARROW – SALT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.43E-03	1.29E-04	1.42E+00	1.82E-04	2.26E-01	3.36E-04	7.57E-05	6.30E-03	6.56E-03	4.71E-01	6.67E-01	4.38E-03	1.00E+00	1.00E+00	2.35E-02	1.97E-01	8.00E-02	7.99E-01	3.95E-02	5.00E+00
Chromium	6.43E-03	1.29E-04	5.83E+01	7.50E-03	2.26E-01	8.17E-04	1.84E-04	6.30E-03	6.56E-03	2.73E-02	1.59E+00	1.04E-02	1.00E+00	1.00E+00	2.35E-02	7.71E-01	1.00E+00	1.25E+00	4.52E-01	1.71E+00
Copper	6.43E-03	1.29E-04	1.84E+01	2.37E-03	2.26E-01	5.83E-04	1.32E-04	6.30E-03	6.56E-03	3.55E-01	6.53E+00	4.28E-02	1.00E+00	1.00E+00	2.35E-02	1.93E+00	2.30E+00	6.39E-01	1.19E+00	1.63E+00
Nickel	6.43E-03	1.29E-04	3.04E+01	3.92E-03	2.26E-01	6.31E-03	1.42E-03	6.30E-03	6.56E-03	4.94E-02	1.51E+00	9.88E-03	1.00E+00	1.00E+00	2.35E-02	6.48E-01	1.38E+00	6.14E-01	7.18E-01	9.02E-01
Selenium	6.43E-03	1.29E-04	1.12E+00	1.44E-04	2.26E-01	6.45E-03	1.46E-03	6.30E-03	6.56E-03	3.20E-01	3.57E-01	2.34E-03	1.00E+00	1.00E+00	2.35E-02	1.68E-01	2.30E-01	1.11E+00	1.06E-01	1.58E+00
Vanadium	6.43E-03	1.29E-04	5.60E+01	7.21E-03	2.26E-01	2.49E-03	5.63E-04	6.30E-03	6.56E-03	1.75E-02	9.83E-01	6.45E-03	1.00E+00	1.00E+00	2.35E-02	6.06E-01	1.14E+01	1.17E+00	5.22E+00	1.16E-01
Zinc	6.43E-03	1.29E-04	1.11E+02	1.43E-02	2.26E-01	3.71E-02	8.37E-03	6.30E-03	6.56E-03	3.86E-01	4.29E+01	2.81E-01	1.00E+00	1.00E+00	2.35E-02	1.29E+01	1.72E+01	9.55E-01	8.20E+00	1.58E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-37

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE MEADOW VOLE – SALT WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate[1] (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	7.20E-03	1.73E-04	1.42E+00	2.45E-04	1.34E-01	3.36E-04	4.50E-05	7.03E-03	7.23E-03	4.71E-01	6.67E-01	4.83E-03	1.48E-04	5.81E+00	8.58E-04	1.00E+00	1.00E+00	3.73E-02	1.60E-01	6.00E-02
Copper	7.20E-03	1.73E-04	1.84E+01	3.18E-03	1.34E-01	5.83E-04	7.83E-05	7.03E-03	7.23E-03	3.55E-01	6.53E+00	4.72E-02	1.48E-04	1.47E+01	2.17E-03	1.00E+00	1.00E+00	3.73E-02	1.41E+00	2.67E+00
Nickel	7.20E-03	1.73E-04	3.04E+01	5.27E-03	1.34E-01	6.31E-03	8.47E-04	7.03E-03	7.23E-03	4.94E-02	1.51E+00	1.09E-02	1.48E-04	3.09E+00	4.57E-04	1.00E+00	1.00E+00	3.73E-02	4.69E-01	1.33E-01
Selenium	7.20E-03	1.73E-04	1.12E+00	1.93E-04	1.34E-01	6.45E-03	8.66E-04	7.03E-03	7.23E-03	3.20E-01	3.57E-01	2.58E-03	1.48E-04	1.94E+01	2.86E-03	1.00E+00	1.00E+00	3.73E-02	1.75E-01	5.00E-02
Vanadium	7.20E-03	1.73E-04	5.60E+01	9.70E-03	1.34E-01	2.49E-03	3.35E-04	7.03E-03	7.23E-03	1.75E-02	9.83E-01	7.10E-03	1.48E-04	1.51E+01	2.23E-03	1.00E+00	1.00E+00	3.73E-02	5.20E-01	2.10E-01
Zinc	7.20E-03	1.73E-04	1.11E+02	1.92E-02	1.34E-01	3.71E-02	4.98E-03	7.03E-03	7.23E-03	3.86E-01	4.29E+01	3.10E-01	1.48E-04	1.99E+02	2.93E-02	1.00E+00	1.00E+00	3.73E-02	9.76E+00	9.60E+00

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	5.95E-02	2.70E+00
Copper	3.00E-02	2.64E+00	5.36E-01
Nickel	2.48E-01	1.49E-01	3.14E+00
Selenium	2.46E-02	4.88E-02	3.58E+00
Vanadium	2.60E-01	2.36E-01	2.20E+00
Zinc	2.55E-02	9.38E+00	1.04E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-37

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE MEADOW VOLE – SALT WATERSHED

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-38

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON – SALT WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	1.69E-01	7.92E-03	1.42E+00	1.12E-02	7.92E-03	1.70E+00	1.35E-02	8.30E-02	3.36E-04	2.78E-05	1.53E-01	4.93E-02	2.54E-01	4.31E-01	2.13E-02	4.93E-02	4.71E-01	6.67E-01	3.29E-02
Copper	1.69E-01	7.92E-03	1.84E+01	1.46E-01	7.92E-03	1.20E+01	9.51E-02	8.30E-02	5.83E-04	4.84E-05	1.53E-01	4.93E-02	4.41E-01	5.29E+00	2.61E-01	4.93E-02	3.55E-01	6.53E+00	3.22E-01
Nickel	1.69E-01	7.92E-03	3.04E+01	2.41E-01	7.92E-03	2.55E+01	2.02E-01	8.30E-02	6.31E-03	5.23E-04	1.53E-01	4.93E-02	3.05E-01	7.76E+00	3.83E-01	4.93E-02	4.94E-02	1.51E+00	7.42E-02
Selenium	1.69E-01	7.92E-03	1.12E+00	8.85E-03	7.92E-03	3.38E+00	2.68E-02	8.30E-02	6.45E-03	5.35E-04	1.53E-01	4.93E-02	8.17E-01	2.76E+00	1.36E-01	4.93E-02	3.20E-01	3.57E-01	1.76E-02
Vanadium	1.69E-01	7.92E-03	5.60E+01	4.44E-01	7.92E-03	4.44E+01	3.51E-01	8.30E-02	2.49E-03	2.07E-04	1.53E-01	4.93E-02	6.60E-02	2.93E+00	1.44E-01	4.93E-02	1.75E-02	9.83E-01	4.84E-02
Zinc	1.69E-01	7.92E-03	1.11E+02	8.81E-01	7.92E-03	1.17E+02	9.25E-01	8.30E-02	3.71E-02	3.08E-03	1.53E-01	4.93E-02	4.39E-01	5.12E+01	2.53E+00	4.93E-02	3.86E-01	4.29E+01	2.11E+00

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.51E-02	5.81E+00	3.79E-01	1.86E-02	2.72E-02	5.06E-04	3.72E-03	1.61E-01	5.99E-04	1.00E+00	1.00E+00	6.67E+00	6.82E-02	6.00E-02	3.22E-02	4.36E-02	1.56E+00
Copper	6.51E-02	1.47E+01	9.57E-01	1.86E-02	1.18E+00	2.19E-02	3.72E-03	3.89E+00	1.45E-02	1.00E+00	1.00E+00	6.67E+00	2.65E-01	2.67E+00	3.00E-02	1.93E+00	1.38E-01
Nickel	6.51E-02	3.09E+00	2.02E-01	1.86E-02	1.52E-01	2.83E-03	3.72E-03	4.05E-01	1.51E-03	1.00E+00	1.00E+00	6.67E+00	1.48E-01	1.33E-01	2.48E-01	1.09E-01	1.36E+00
Selenium	6.51E-02	1.94E+01	1.26E+00	1.86E-02	4.21E-01	7.83E-03	3.72E-03	9.63E+00	3.58E-02	1.00E+00	1.00E+00	6.67E+00	2.19E-01	5.00E-02	2.46E-02	3.57E-02	6.12E+00
Vanadium	6.51E-02	1.51E+01	9.85E-01	1.86E-02	9.30E-02	1.73E-03	3.72E-03	2.27E-01	8.46E-04	1.00E+00	1.00E+00	6.67E+00	2.88E-01	2.10E-01	2.60E-01	1.73E-01	1.66E+00
Zinc	6.51E-02	1.99E+02	1.29E+01	1.86E-02	1.56E+01	2.89E-01	3.72E-03	7.81E+01	2.90E-01	1.00E+00	1.00E+00	6.67E+00	2.94E+00	9.60E+00	2.55E-02	6.87E+00	4.27E-02

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-38

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON – SALT WATERSHED

(Page 1 of 2)

Notes (continued):

1 The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-39

TIER 2 HAZARD OVERALL FOR THE COYOTE – SALT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	2.29E-01	6.42E-03	2.12E+00	1.36E-02	7.83E-02	3.36E-04	2.63E-05	2.23E-01	2.36E-02	2.45E-01	5.17E-01	1.22E-02	2.12E-01	1.30E-01	2.75E-02	1.00E+00	1.00E+00	1.05E+01	5.08E-03	6.00E-02
Nickel	2.29E-01	6.42E-03	2.94E+01	1.89E-01	7.83E-02	6.31E-03	4.94E-04	2.23E-01	2.36E-02	3.98E-02	1.17E+00	2.76E-02	2.12E-01	1.68E-01	3.56E-02	1.00E+00	1.00E+00	1.05E+01	2.40E-02	1.33E-01
Selenium	2.29E-01	6.42E-03	1.16E+00	7.48E-03	7.83E-02	6.45E-03	5.05E-04	2.23E-01	2.36E-02	2.40E-01	2.80E-01	6.58E-03	2.12E-01	3.74E-01	7.94E-02	1.00E+00	1.00E+00	1.05E+01	8.95E-03	5.00E-02
Vanadium	2.29E-01	6.42E-03	5.54E+01	3.56E-01	7.83E-02	2.49E-03	1.95E-04	2.23E-01	2.36E-02	1.33E-02	7.35E-01	1.73E-02	2.12E-01	9.82E-02	2.09E-02	1.00E+00	1.00E+00	1.05E+01	3.75E-02	2.10E-01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	4.27E-02	1.19E-01
Nickel	2.48E-01	1.07E-01	2.25E-01
Selenium	2.46E-02	3.50E-02	2.56E-01
Vanadium	2.60E-01	1.69E-01	2.22E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.8 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.2 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-40

TIER 2 HAZARD OVERALL FOR THE NORTHERN HARRIER – SALT WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[5] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Chromium	4.09E-02	2.86E-04	5.73E+01	1.64E-02	3.81E-02	1.10E-03	7.08E+00	7.75E-03	4.27E-02	5.09E-01	2.18E-02	1.00E+00	1.00E+00	5.13E-01	8.94E-02	1.00E+00	1.25E+00	8.37E-01	1.07E-01
Selenium	4.09E-02	2.86E-04	1.16E+00	3.33E-04	3.81E-02	1.10E-03	1.20E+01	1.31E-02	4.27E-02	3.74E-01	1.60E-02	1.00E+00	1.00E+00	5.13E-01	5.73E-02	2.30E-01	1.11E+00	1.97E-01	2.91E-01

Notes:

BTF Biotransfer factor
COPEC Chemical of potential ecological concern
HQ Hazard quotient
kg Kilogram
kg/day Kilogram per day
mg/day Milligram per day
mg/kg Milligram per kilogram
mg/kg/day Milligram per kilogram per day
SUF Site use factor
TRV Toxicity reference value
TTC Trophic transfer coefficient

1 The soil ingestion rate is expressed as 0.7 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 99.3 percent of the total ingestion rate, based on the soil ingestion rate.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-41

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	1.21E-02	2.41E-04	1.95E+00	4.69E-04	1.51E-01	2.85E-04	4.29E-05	1.18E-02	9.84E-03	4.71E-01	9.16E-01	9.01E-03	2.46E-03	6.62E+00	1.63E-02	1.00E+00	1.00E+00	5.90E-02	4.37E-01	8.00E-02
Chromium	1.21E-02	2.41E-04	6.57E+01	1.58E-02	1.51E-01	7.37E-04	1.11E-04	1.18E-02	9.84E-03	2.73E-02	1.79E+00	1.76E-02	2.46E-03	7.05E+00	1.73E-02	1.00E+00	1.00E+00	5.90E-02	8.63E-01	1.00E+00
Copper	1.21E-02	2.41E-04	1.92E+01	4.62E-03	1.51E-01	2.64E-04	3.98E-05	1.18E-02	9.84E-03	3.55E-01	6.80E+00	6.69E-02	2.46E-03	1.45E+01	3.57E-02	1.00E+00	1.00E+00	5.90E-02	1.82E+00	2.30E+00
Nickel	1.21E-02	2.41E-04	3.23E+01	7.79E-03	1.51E-01	6.43E-03	9.70E-04	1.18E-02	9.84E-03	4.94E-02	1.60E+00	1.57E-02	2.46E-03	3.05E+00	7.50E-03	1.00E+00	1.00E+00	5.90E-02	5.42E-01	1.38E+00
Selenium	1.21E-02	2.41E-04	2.44E+00	5.87E-04	1.51E-01	6.84E-03	1.03E-03	1.18E-02	9.84E-03	3.20E-01	7.80E-01	7.67E-03	2.46E-03	2.23E+01	5.48E-02	1.00E+00	1.00E+00	5.90E-02	1.09E+00	2.30E-01
Vanadium	1.21E-02	2.41E-04	6.01E+01	1.45E-02	1.51E-01	2.73E-03	4.11E-04	1.18E-02	9.84E-03	1.75E-02	1.05E+00	1.04E-02	2.46E-03	1.51E+01	3.71E-02	1.00E+00	1.00E+00	5.90E-02	1.06E+00	1.14E+01
Zinc	1.21E-02	2.41E-04	1.23E+02	2.95E-02	1.51E-01	2.94E-02	4.43E-03	1.18E-02	9.84E-03	3.86E-01	4.73E+01	4.65E-01	2.46E-03	2.03E+02	4.99E-01	1.00E+00	1.00E+00	5.90E-02	1.69E+01	1.72E+01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.99E-01	4.75E-02	9.20E+00
Chromium	1.25E+00	5.43E-01	1.59E+00
Copper	6.39E-01	1.43E+00	1.27E+00
Nickel	6.14E-01	8.64E-01	6.27E-01
Selenium	1.11E+00	1.28E-01	8.49E+00
Vanadium	1.17E+00	6.27E+00	1.68E-01
Zinc	9.55E-01	9.86E+00	1.72E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-41

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-42

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE GREAT BLUE HERON – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration in Dry Weight (mg/kg)	Fish Daily Dose[1] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[3] (mg/kg/day)	TRV[4] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[5] (mg/kg/day)	HQ (based on adjusted TRV)[6]
Selenium	1.18E-01	8.30E-04	4.64E+00	3.85E-03	4.64E-02	6.84E-03	3.18E-04	1.17E-01	1.19E-01	1.07E+01	1.28E+00	1.00E+00	1.00E+00	2.09E+00	6.13E-01	2.30E-01	1.11E+00	2.61E-01	2.35E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 99 percent of the total ingestion rate, based on the soil ingestion rate.

3 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

4 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

5 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

6 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-43

TIER 2 HAZARD AQUATIC AND RIPARIAN FOR THE MALLARD DUCK – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[3] (mg/kg)	Aquatic Plant Daily Dose[1] (mg/kg)	Benthic Invertebrate Ingestion Rate (kg/day)	Benthic Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Benthic Invertebrate Daily Dose[1] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[4] (mg/kg/day)	TRV[5] (mg/kg/day)
Chromium	9.02E-02	2.98E-03	3.04E+01	9.06E-02	5.64E-02	7.37E-04	4.16E-05	8.72E-02	2.36E-02	3.46E-01	1.05E+01	2.49E-01	6.97E-02	3.19E-01	2.22E-02	1.00E+00	1.00E+00	1.13E+00	3.19E-01	1.00E+00
Nickel	9.02E-02	2.98E-03	1.56E+01	4.65E-02	5.64E-02	6.43E-03	3.63E-04	8.72E-02	2.36E-02	3.05E-01	4.75E+00	1.12E-01	6.97E-02	4.04E-01	2.81E-02	1.00E+00	1.00E+00	1.13E+00	1.65E-01	1.38E+00
Selenium	9.02E-02	2.98E-03	4.64E+00	1.38E-02	5.64E-02	6.84E-03	3.86E-04	8.72E-02	2.36E-02	8.17E-01	3.79E+00	8.96E-02	6.97E-02	2.31E+00	1.61E-01	1.00E+00	1.00E+00	1.13E+00	2.34E-01	2.30E-01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Chromium	1.25E+00	9.81E-01	3.25E-01
Nickel	6.14E-01	1.56E+00	1.06E-01
Selenium	1.11E+00	2.31E-01	1.01E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 96.7 percent of the total ingestion rate, based on the soil ingestion rate.

3 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-44

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	4.18E-02	1.96E-03	1.95E+00	3.81E-03	1.96E-03	2.93E+00	5.74E-03	1.01E-01	2.85E-04	2.86E-05	3.79E-02	2.19E-03	2.54E-01	7.44E-01	1.63E-03	2.19E-03	4.71E-01	9.16E-01	2.01E-03
Copper	4.18E-02	1.96E-03	1.92E+01	3.75E-02	1.96E-03	7.90E+00	1.55E-02	1.01E-01	2.64E-04	2.66E-05	3.79E-02	2.19E-03	4.41E-01	3.48E+00	7.63E-03	2.19E-03	3.55E-01	6.80E+00	1.49E-02
Nickel	4.18E-02	1.96E-03	3.23E+01	6.33E-02	1.96E-03	1.56E+01	3.06E-02	1.01E-01	6.43E-03	6.47E-04	3.79E-02	2.19E-03	3.05E-01	4.75E+00	1.04E-02	2.19E-03	4.94E-02	1.60E+00	3.50E-03
Selenium	4.18E-02	1.96E-03	2.44E+00	4.78E-03	1.96E-03	4.64E+00	9.10E-03	1.01E-01	6.84E-03	6.88E-04	3.79E-02	2.19E-03	8.17E-01	3.79E+00	8.31E-03	2.19E-03	3.20E-01	7.80E-01	1.71E-03
Vanadium	4.18E-02	1.96E-03	6.01E+01	1.18E-01	1.96E-03	3.55E+01	6.95E-02	1.01E-01	2.73E-03	2.74E-04	3.79E-02	2.19E-03	6.60E-02	2.34E+00	5.13E-03	2.19E-03	1.75E-02	1.05E+00	2.31E-03
Zinc	4.18E-02	1.96E-03	1.23E+02	2.40E-01	1.96E-03	9.53E+01	1.87E-01	1.01E-01	2.94E-02	2.95E-03	3.79E-02	2.19E-03	4.39E-01	4.18E+01	9.16E-02	2.19E-03	3.86E-01	4.73E+01	1.04E-01

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.64E-03	6.62E+00	2.41E-02	2.68E-03	2.71E-02	7.25E-05	3.54E-02	1.90E-01	6.72E-03	1.00E+00	1.00E+00	8.52E-01	5.18E-02	6.00E-02	3.22E-02	4.93E-02	1.05E+00
Copper	3.64E-03	1.45E+01	5.30E-02	2.68E-03	1.18E+00	3.16E-03	3.54E-02	4.05E+00	1.43E-01	1.00E+00	1.00E+00	8.52E-01	3.23E-01	2.67E+00	3.00E-02	2.18E+00	1.48E-01
Nickel	3.64E-03	3.05E+00	1.11E-02	2.68E-03	1.62E-01	4.33E-04	3.54E-02	4.43E-01	1.57E-02	1.00E+00	1.00E+00	8.52E-01	1.59E-01	1.33E-01	2.48E-01	1.24E-01	1.29E+00
Selenium	3.64E-03	2.23E+01	8.12E-02	2.68E-03	4.19E-01	1.12E-03	3.54E-02	1.07E+01	3.80E-01	1.00E+00	1.00E+00	8.52E-01	5.72E-01	5.00E-02	2.46E-02	4.04E-02	1.41E+01
Vanadium	3.64E-03	1.51E+01	5.49E-02	2.68E-03	9.09E-02	2.43E-04	3.54E-02	2.49E-01	8.81E-03	1.00E+00	1.00E+00	8.52E-01	3.04E-01	2.10E-01	2.60E-01	1.96E-01	1.55E+00
Zinc	3.64E-03	2.03E+02	7.39E-01	2.68E-03	1.54E+01	4.13E-02	3.54E-02	8.04E+01	2.85E+00	1.00E+00	1.00E+00	8.52E-01	4.99E+00	9.60E+00	2.55E-02	7.78E+00	6.42E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-44

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 2)

Notes (continued):

1 The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-45

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE NORTHERN BOBWHITE – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	2.68E-02	5.40E-04	2.25E+00	1.21E-03	2.63E-02	2.34E-02	2.45E-01	5.50E-01	1.29E-02	3.94E-03	5.61E+00	2.21E-02	1.00E+00	1.00E+00	1.91E-01	1.90E-01	8.00E-02	7.99E-01	6.01E-02	3.16E+00
Chromium	2.68E-02	5.40E-04	5.96E+01	3.22E-02	2.63E-02	2.34E-02	2.64E-02	1.57E+00	3.68E-02	3.94E-03	7.08E+00	2.79E-02	1.00E+00	1.00E+00	1.91E-01	5.07E-01	1.00E+00	1.25E+00	6.87E-01	7.38E-01
Copper	2.68E-02	5.40E-04	1.89E+01	1.02E-02	2.63E-02	2.34E-02	3.24E-01	6.13E+00	1.44E-01	3.94E-03	1.56E+01	6.13E-02	1.00E+00	1.00E+00	1.91E-01	1.13E+00	2.30E+00	6.39E-01	1.81E+00	6.24E-01
Nickel	2.68E-02	5.40E-04	3.00E+01	1.62E-02	2.63E-02	2.34E-02	3.98E-02	1.20E+00	2.80E-02	3.94E-03	3.23E+00	1.27E-02	1.00E+00	1.00E+00	1.91E-01	2.98E-01	1.38E+00	6.14E-01	1.09E+00	2.73E-01
Selenium	2.68E-02	5.40E-04	1.52E+00	8.18E-04	2.63E-02	2.34E-02	2.40E-01	3.64E-01	8.53E-03	3.94E-03	1.21E+01	4.77E-02	1.00E+00	1.00E+00	1.91E-01	2.99E-01	2.30E-01	1.11E+00	1.62E-01	1.85E+00
Zinc	2.68E-02	5.40E-04	1.42E+02	7.66E-02	2.63E-02	2.34E-02	2.63E-01	3.73E+01	8.73E-01	3.94E-03	1.95E+02	7.68E-01	1.00E+00	1.00E+00	1.91E-01	9.00E+00	1.72E+01	9.55E-01	1.25E+01	7.21E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-46

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE EASTERN COTTONTAIL – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.87E-02	1.89E-03	2.25E+00	4.25E-03	7.68E-02	8.07E-02	2.45E-01	5.50E-01	4.43E-02	1.00E+00	1.00E+00	1.23E+00	3.95E-02	6.00E-02	3.22E-02	4.82E-02	8.19E-01
Copper	7.87E-02	1.89E-03	1.89E+01	3.57E-02	7.68E-02	8.07E-02	3.24E-01	6.13E+00	4.95E-01	1.00E+00	1.00E+00	1.23E+00	4.31E-01	2.67E+00	3.00E-02	2.14E+00	2.02E-01
Nickel	7.87E-02	1.89E-03	3.00E+01	5.67E-02	7.68E-02	8.07E-02	3.98E-02	1.20E+00	9.64E-02	1.00E+00	1.00E+00	1.23E+00	1.24E-01	1.33E-01	2.48E-01	1.21E-01	1.03E+00
Selenium	7.87E-02	1.89E-03	1.52E+00	2.86E-03	7.68E-02	8.07E-02	2.40E-01	3.64E-01	2.93E-02	1.00E+00	1.00E+00	1.23E+00	2.62E-02	5.00E-02	2.46E-02	3.95E-02	6.62E-01
Vanadium	7.87E-02	1.89E-03	5.67E+01	1.07E-01	7.68E-02	8.07E-02	1.33E-02	7.52E-01	6.06E-02	1.00E+00	1.00E+00	1.23E+00	1.36E-01	2.10E-01	2.60E-01	1.91E-01	7.12E-01
Zinc	7.87E-02	1.89E-03	1.42E+02	2.68E-01	7.68E-02	8.07E-02	2.63E-01	3.73E+01	3.01E+00	1.00E+00	1.00E+00	1.23E+00	2.66E+00	9.60E+00	2.55E-02	7.61E+00	3.50E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-47

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE AMERICAN ROBIN – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	1.45E-02	2.90E-04	2.25E+00	6.52E-04	1.42E-02	7.39E-03	2.45E-01	5.50E-01	4.06E-03	7.39E-03	5.61E+00	4.15E-02	1.00E+00	1.00E+00	7.73E-02	5.97E-01	8.00E-02	7.99E-01	5.01E-02	1.19E+01
Chromium	1.45E-02	2.90E-04	5.96E+01	1.73E-02	1.42E-02	7.39E-03	2.64E-02	1.57E+00	1.16E-02	7.39E-03	7.08E+00	5.23E-02	1.00E+00	1.00E+00	7.73E-02	1.05E+00	1.00E+00	1.25E+00	5.73E-01	1.83E+00
Copper	1.45E-02	2.90E-04	1.89E+01	5.48E-03	1.42E-02	7.39E-03	3.24E-01	6.13E+00	4.53E-02	7.39E-03	1.56E+01	1.15E-01	1.00E+00	1.00E+00	7.73E-02	2.14E+00	2.30E+00	6.39E-01	1.51E+00	1.42E+00
Selenium	1.45E-02	2.90E-04	1.52E+00	4.40E-04	1.42E-02	7.39E-03	2.40E-01	3.64E-01	2.69E-03	7.39E-03	1.21E+01	8.94E-02	1.00E+00	1.00E+00	7.73E-02	1.20E+00	2.30E-01	1.11E+00	1.35E-01	8.86E+00
Zinc	1.45E-02	2.90E-04	1.42E+02	4.12E-02	1.42E-02	7.39E-03	2.63E-01	3.73E+01	2.75E-01	7.39E-03	1.95E+02	1.44E+00	1.00E+00	1.00E+00	7.73E-02	2.27E+01	1.72E+01	9.55E-01	1.04E+01	2.18E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-48

TIER 2 HAZARD QUOTIENTS OVERALL FOR THE DEER MOUSE – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.42E-03	7.00E-05	2.25E+00	1.57E-04	3.35E-03	1.90E-03	2.45E-01	5.50E-01	1.05E-03	1.59E-03	5.61E+00	8.91E-03	1.00E+00	1.00E+00	2.10E-02	4.82E-01	6.00E-02	3.22E-02	6.16E-02	7.82E+00
Copper	3.42E-03	7.00E-05	1.89E+01	1.32E-03	3.35E-03	1.90E-03	3.24E-01	6.13E+00	1.17E-02	1.59E-03	1.56E+01	2.47E-02	1.00E+00	1.00E+00	2.10E-02	1.79E+00	2.67E+00	3.00E-02	2.73E+00	6.58E-01
Nickel	3.42E-03	7.00E-05	3.00E+01	2.10E-03	3.35E-03	1.90E-03	3.98E-02	1.20E+00	2.27E-03	1.59E-03	3.23E+00	5.13E-03	1.00E+00	1.00E+00	2.10E-02	4.53E-01	1.33E-01	2.48E-01	1.54E-01	2.93E+00
Selenium	3.42E-03	7.00E-05	1.52E+00	1.06E-04	3.35E-03	1.90E-03	2.40E-01	3.64E-01	6.92E-04	1.59E-03	1.21E+01	1.92E-02	1.00E+00	1.00E+00	2.10E-02	9.53E-01	5.00E-02	2.46E-02	5.05E-02	1.89E+01
Vanadium	3.42E-03	7.00E-05	5.67E+01	3.97E-03	3.35E-03	1.90E-03	1.33E-02	7.52E-01	1.43E-03	1.59E-03	1.43E+01	2.28E-02	1.00E+00	1.00E+00	2.10E-02	1.34E+00	2.10E-01	2.60E-01	2.44E-01	5.49E+00
Zinc	3.42E-03	7.00E-05	1.42E+02	9.93E-03	3.35E-03	1.90E-03	2.63E-01	3.73E+01	7.09E-02	1.59E-03	1.95E+02	3.09E-01	1.00E+00	1.00E+00	2.10E-02	1.86E+01	9.60E+00	2.55E-02	9.71E+00	1.91E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

[1] The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-49

TIER 2 HAZARD QUOTIENT AQUATIC AND RIPARIAN FOR THE SONG SPARROW – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.43E-03	1.29E-04	1.95E+00	2.50E-04	2.26E-01	2.85E-04	6.42E-05	6.30E-03	6.56E-03	4.71E-01	9.16E-01	6.01E-03	1.00E+00	1.00E+00	2.35E-02	2.69E-01	8.00E-02	7.99E-01	3.95E-02	6.82E+00
Chromium	6.43E-03	1.29E-04	6.57E+01	8.45E-03	2.26E-01	7.37E-04	1.66E-04	6.30E-03	6.56E-03	2.73E-02	1.79E+00	1.18E-02	1.00E+00	1.00E+00	2.35E-02	8.67E-01	1.00E+00	1.25E+00	4.52E-01	1.92E+00
Copper	6.43E-03	1.29E-04	1.92E+01	2.46E-03	2.26E-01	2.64E-04	5.96E-05	6.30E-03	6.56E-03	3.55E-01	6.80E+00	4.46E-02	1.00E+00	1.00E+00	2.35E-02	2.01E+00	2.30E+00	6.39E-01	1.19E+00	1.69E+00
Nickel	6.43E-03	1.29E-04	3.23E+01	4.15E-03	2.26E-01	6.43E-03	1.45E-03	6.30E-03	6.56E-03	4.94E-02	1.60E+00	1.05E-02	1.00E+00	1.00E+00	2.35E-02	6.85E-01	1.38E+00	6.14E-01	7.18E-01	9.54E-01
Selenium	6.43E-03	1.29E-04	2.44E+00	3.13E-04	2.26E-01	6.84E-03	1.54E-03	6.30E-03	6.56E-03	3.20E-01	7.80E-01	5.12E-03	1.00E+00	1.00E+00	2.35E-02	2.97E-01	2.30E-01	1.11E+00	1.06E-01	2.79E+00
Vanadium	6.43E-03	1.29E-04	6.01E+01	7.73E-03	2.26E-01	2.73E-03	6.15E-04	6.30E-03	6.56E-03	1.75E-02	1.05E+00	6.92E-03	1.00E+00	1.00E+00	2.35E-02	6.50E-01	1.14E+01	1.17E+00	5.22E+00	1.25E-01
Zinc	6.43E-03	1.29E-04	1.23E+02	1.58E-02	2.26E-01	2.94E-02	6.63E-03	6.30E-03	6.56E-03	3.86E-01	4.73E+01	3.10E-01	1.00E+00	1.00E+00	2.35E-02	1.42E+01	1.72E+01	9.55E-01	8.20E+00	1.73E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-50

TIER 2 HAZARD AQUATIC QUOTIENT AND RIPARIAN FOR THE MEADOW VOLE – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate[1] (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	7.20E-03	1.73E-04	1.95E+00	3.37E-04	1.34E-01	2.85E-04	3.82E-05	7.03E-03	7.23E-03	4.71E-01	9.16E-01	6.62E-03	1.48E-04	6.62E+00	9.76E-04	1.00E+00	1.00E+00	3.73E-02	2.14E-01	6.00E-02
Copper	7.20E-03	1.73E-04	1.92E+01	3.31E-03	1.34E-01	2.64E-04	3.54E-05	7.03E-03	7.23E-03	3.55E-01	6.80E+00	4.91E-02	1.48E-04	1.45E+01	2.14E-03	1.00E+00	1.00E+00	3.73E-02	1.47E+00	2.67E+00
Nickel	7.20E-03	1.73E-04	3.23E+01	5.59E-03	1.34E-01	6.43E-03	8.63E-04	7.03E-03	7.23E-03	4.94E-02	1.60E+00	1.16E-02	1.48E-04	3.05E+00	4.50E-04	1.00E+00	1.00E+00	3.73E-02	4.95E-01	1.33E-01
Selenium	7.20E-03	1.73E-04	2.44E+00	4.22E-04	1.34E-01	6.84E-03	9.18E-04	7.03E-03	7.23E-03	3.20E-01	7.80E-01	5.64E-03	1.48E-04	2.23E+01	3.29E-03	1.00E+00	1.00E+00	3.73E-02	2.76E-01	5.00E-02
Vanadium	7.20E-03	1.73E-04	6.01E+01	1.04E-02	1.34E-01	2.73E-03	3.66E-04	7.03E-03	7.23E-03	1.75E-02	1.05E+00	7.62E-03	1.48E-04	1.51E+01	2.22E-03	1.00E+00	1.00E+00	3.73E-02	5.53E-01	2.10E-01
Zinc	7.20E-03	1.73E-04	1.23E+02	2.12E-02	1.34E-01	2.94E-02	3.94E-03	7.03E-03	7.23E-03	3.86E-01	4.73E+01	3.42E-01	1.48E-04	2.03E+02	2.99E-02	1.00E+00	1.00E+00	3.73E-02	1.07E+01	9.60E+00

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	5.95E-02	3.60E+00
Copper	3.00E-02	2.64E+00	5.56E-01
Nickel	2.48E-01	1.49E-01	3.32E+00
Selenium	2.46E-02	4.88E-02	5.65E+00
Vanadium	2.60E-01	2.36E-01	2.34E+00
Zinc	2.55E-02	9.38E+00	1.14E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-50

TIER 2 HAZARD AQUATIC QUOTIENT AND RIPARIAN FOR THE MEADOW VOLE – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-51

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	1.69E-01	7.92E-03	1.95E+00	1.54E-02	7.92E-03	2.93E+00	2.32E-02	8.30E-02	2.85E-04	2.36E-05	1.53E-01	4.93E-02	2.54E-01	7.44E-01	3.67E-02	4.93E-02	4.71E-01	9.16E-01	4.52E-02
Copper	1.69E-01	7.92E-03	1.92E+01	1.52E-01	7.92E-03	7.90E+00	6.26E-02	8.30E-02	2.64E-04	2.19E-05	1.53E-01	4.93E-02	4.41E-01	3.48E+00	1.72E-01	4.93E-02	3.55E-01	6.80E+00	3.35E-01
Nickel	1.69E-01	7.92E-03	3.23E+01	2.56E-01	7.92E-03	1.56E+01	1.23E-01	8.30E-02	6.43E-03	5.34E-04	1.53E-01	4.93E-02	3.05E-01	4.75E+00	2.34E-01	4.93E-02	4.94E-02	1.60E+00	7.88E-02
Selenium	1.69E-01	7.92E-03	2.44E+00	1.93E-02	7.92E-03	4.64E+00	3.68E-02	8.30E-02	6.84E-03	5.68E-04	1.53E-01	4.93E-02	8.17E-01	3.79E+00	1.87E-01	4.93E-02	3.20E-01	7.80E-01	3.85E-02
Vanadium	1.69E-01	7.92E-03	6.01E+01	4.76E-01	7.92E-03	3.55E+01	2.81E-01	8.30E-02	2.73E-03	2.26E-04	1.53E-01	4.93E-02	6.60E-02	2.34E+00	1.15E-01	4.93E-02	1.75E-02	1.05E+00	5.20E-02
Zinc	1.69E-01	7.92E-03	1.23E+02	9.71E-01	7.92E-03	9.53E+01	7.55E-01	8.30E-02	2.94E-02	2.44E-03	1.53E-01	4.93E-02	4.39E-01	4.18E+01	2.06E+00	4.93E-02	3.86E-01	4.73E+01	2.33E+00

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.51E-02	6.62E+00	4.31E-01	1.86E-02	2.71E-02	5.04E-04	3.72E-03	1.90E-01	7.06E-04	1.00E+00	1.00E+00	6.67E+00	8.11E-02	6.00E-02	3.22E-02	4.36E-02	1.86E+00
Copper	6.51E-02	1.45E+01	9.46E-01	1.86E-02	1.18E+00	2.20E-02	3.72E-03	4.05E+00	1.51E-02	1.00E+00	1.00E+00	6.67E+00	2.63E-01	2.67E+00	3.00E-02	1.93E+00	1.36E-01
Nickel	6.51E-02	3.05E+00	1.99E-01	1.86E-02	1.62E-01	3.01E-03	3.72E-03	4.43E-01	1.65E-03	1.00E+00	1.00E+00	6.67E+00	1.44E-01	1.33E-01	2.48E-01	1.09E-01	1.32E+00
Selenium	6.51E-02	2.23E+01	1.45E+00	1.86E-02	4.19E-01	7.80E-03	3.72E-03	1.07E+01	3.99E-02	1.00E+00	1.00E+00	6.67E+00	2.60E-01	5.00E-02	2.46E-02	3.57E-02	7.28E+00
Vanadium	6.51E-02	1.51E+01	9.81E-01	1.86E-02	9.09E-02	1.69E-03	3.72E-03	2.49E-01	9.26E-04	1.00E+00	1.00E+00	6.67E+00	2.86E-01	2.10E-01	2.60E-01	1.73E-01	1.65E+00
Zinc	6.51E-02	2.03E+02	1.32E+01	1.86E-02	1.54E+01	2.87E-01	3.72E-03	8.04E+01	2.99E-01	1.00E+00	1.00E+00	6.67E+00	3.01E+00	9.60E+00	2.55E-02	6.87E+00	4.38E-02

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-51

TIER 2 HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON – GEORGETOWN CREEK/BEAR RIVER WATERSHED

Notes (continued):

1 The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-52

TIER 2 HAZARD QUOTIENT OVERALL FOR THE COYOTE – GEORGETOWN CREEK/BEAR RIVER WATERSHED

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	2.29E-01	6.42E-03	2.25E+00	1.44E-02	7.83E-02	2.85E-04	2.23E-05	2.23E-01	2.36E-02	2.45E-01	5.50E-01	1.29E-02	2.12E-01	1.29E-01	2.74E-02	1.00E+00	1.00E+00	1.05E+01	5.22E-03	6.00E-02
Nickel	2.29E-01	6.42E-03	3.00E+01	1.93E-01	7.83E-02	6.43E-03	5.04E-04	2.23E-01	2.36E-02	3.98E-02	1.20E+00	2.81E-02	2.12E-01	1.69E-01	3.58E-02	1.00E+00	1.00E+00	1.05E+01	2.45E-02	1.33E-01
Selenium	2.29E-01	6.42E-03	1.52E+00	9.73E-03	7.83E-02	6.84E-03	5.36E-04	2.23E-01	2.36E-02	2.40E-01	3.64E-01	8.57E-03	2.12E-01	3.80E-01	8.07E-02	1.00E+00	1.00E+00	1.05E+01	9.48E-03	5.00E-02
Vanadium	2.29E-01	6.42E-03	5.67E+01	3.64E-01	7.83E-02	2.73E-03	2.13E-04	2.23E-01	2.36E-02	1.33E-02	7.52E-01	1.77E-02	2.12E-01	9.81E-02	2.08E-02	1.00E+00	1.00E+00	1.05E+01	3.83E-02	2.10E-01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	4.27E-02	1.22E-01
Nickel	2.48E-01	1.07E-01	2.29E-01
Selenium	2.46E-02	3.50E-02	2.71E-01
Vanadium	2.60E-01	1.69E-01	2.27E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.8 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.2 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-53

TIER 2 HAZARD OVERALL FOR THE NORTHERN HARRIER – GEORGETOWN CREEK/BEAR RIVER WATERSHED

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[5] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Chromium	4.09E-02	2.86E-04	5.96E+01	1.70E-02	3.81E-02	1.10E-03	6.61E-01	7.24E-04	4.27E-02	5.10E-01	2.18E-02	1.00E+00	1.00E+00	5.13E-01	7.71E-02	1.00E+00	1.25E+00	8.37E-01	9.21E-02
Selenium	4.09E-02	2.86E-04	1.52E+00	4.33E-04	3.81E-02	1.10E-03	1.57E+01	1.72E-02	4.27E-02	3.80E-01	1.62E-02	1.00E+00	1.00E+00	5.13E-01	6.61E-02	2.30E-01	1.11E+00	1.97E-01	3.35E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 0.7 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 99.3 percent of the total ingestion rate, based on the soil ingestion rate.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-54

TIER 2 BACKGROUND HAZARD AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	1.21E-02	2.41E-04	1.37E+00	3.31E-04	1.51E-01	1.16E-04	1.74E-05	1.18E-02	9.84E-03	4.71E-01	6.47E-01	6.37E-03	2.46E-03	5.75E+00	1.41E-02	1.00E+00	1.00E+00	5.90E-02	3.53E-01	8.00E-02
Chromium	1.21E-02	2.41E-04	5.77E+01	1.39E-02	1.51E-01	4.94E-04	7.46E-05	1.18E-02	9.84E-03	2.73E-02	1.57E+00	1.55E-02	2.46E-03	6.94E+00	1.71E-02	1.00E+00	1.00E+00	5.90E-02	7.88E-01	1.00E+00
Copper	1.21E-02	2.41E-04	1.83E+01	4.42E-03	1.51E-01	5.48E-04	8.26E-05	1.18E-02	9.84E-03	3.55E-01	6.51E+00	6.40E-02	2.46E-03	1.47E+01	3.62E-02	1.00E+00	1.00E+00	5.90E-02	1.77E+00	2.30E+00
Nickel	1.21E-02	2.41E-04	3.03E+01	7.30E-03	1.51E-01	1.90E-03	2.87E-04	1.18E-02	9.84E-03	4.94E-02	1.50E+00	1.47E-02	2.46E-03	3.10E+00	7.62E-03	1.00E+00	1.00E+00	5.90E-02	5.08E-01	1.38E+00
Selenium	1.21E-02	2.41E-04	1.01E+00	2.43E-04	1.51E-01	9.81E-04	1.48E-04	1.18E-02	9.84E-03	3.20E-01	3.23E-01	3.18E-03	2.46E-03	1.92E+01	4.72E-02	1.00E+00	1.00E+00	5.90E-02	8.60E-01	2.30E-01
Vanadium	1.21E-02	2.41E-04	5.57E+01	1.34E-02	1.51E-01	1.13E-03	1.70E-04	1.18E-02	9.84E-03	1.75E-02	9.77E-01	9.61E-03	2.46E-03	1.51E+01	3.72E-02	1.00E+00	1.00E+00	5.90E-02	1.02E+00	1.14E+01
Zinc	1.21E-02	2.41E-04	1.10E+02	2.66E-02	1.51E-01	2.17E-02	3.27E-03	1.18E-02	9.84E-03	3.86E-01	4.25E+01	4.18E-01	2.46E-03	1.98E+02	4.88E-01	1.00E+00	1.00E+00	5.90E-02	1.59E+01	1.72E+01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.99E-01	4.75E-02	7.44E+00
Chromium	1.25E+00	5.43E-01	1.45E+00
Copper	6.39E-01	1.43E+00	1.24E+00
Nickel	6.14E-01	8.64E-01	5.88E-01
Selenium	1.11E+00	1.28E-01	6.72E+00
Vanadium	1.17E+00	6.27E+00	1.63E-01
Zinc	9.55E-01	9.86E+00	1.61E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-54

TIER 2 BACKGROUND HAZARD AQUATIC AND RIPARIAN FOR THE RED-WINGED BLACKBIRD

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-55

TIER 2 BACKGROUND HAZARD AQUATIC AND RIPARIAN FOR THE GREAT BLUE HERON

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration in Dry Weight (mg/kg)	Fish Daily Dose[1] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[3] (mg/kg/day)	TRV[4] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[5] (mg/kg/day)	HQ (based on adjusted TRV)[6]
Selenium	1.18E-01	8.30E-04	1.48E+00	1.23E-03	4.64E-02	9.81E-04	4.55E-05	1.17E-01	1.19E-01	8.30E+00	9.88E-01	1.00E+00	1.00E+00	2.09E+00	4.73E-01	2.30E-01	1.11E+00	2.61E-01	1.81E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 99 percent of the total ingestion rate, based on the soil ingestion rate.

3 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

4 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

5 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

6 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-56

TIER 2 BACKGROUND HAZARD AQUATIC AND RIPARIAN FOR THE MALLARD DUCK

COPEC	Total Ingestion Rate (kg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[1] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[1] (mg/day)	Total Prey Ingestion Rate[2] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[3] (mg/kg)	Aquatic Plant Daily Dose[1] (mg/kg)	Benthic Invertebrate Ingestion Rate (kg/day)	Benthic Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Benthic Invertebrate Daily Dose[1] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[4] (mg/kg/day)	TRV[5] (mg/kg/day)
Chromium	9.02E-02	2.98E-03	4.77E+01	1.42E-01	5.64E-02	4.94E-04	2.79E-05	8.72E-02	2.36E-02	3.46E-01	1.65E+01	3.90E-01	6.97E-02	1.91E-01	1.33E-02	1.00E+00	1.00E+00	1.13E+00	4.81E-01	1.00E+00
Nickel	9.02E-02	2.98E-03	2.23E+01	6.65E-02	5.64E-02	1.90E-03	1.07E-04	8.72E-02	2.36E-02	3.05E-01	6.79E+00	1.60E-01	6.97E-02	1.81E-01	1.26E-02	1.00E+00	1.00E+00	1.13E+00	2.11E-01	1.38E+00
Selenium	9.02E-02	2.98E-03	1.48E+00	4.41E-03	5.64E-02	9.81E-04	5.54E-05	8.72E-02	2.36E-02	8.17E-01	1.21E+00	2.85E-02	6.97E-02	1.05E+00	7.32E-02	1.00E+00	1.00E+00	1.13E+00	9.36E-02	2.30E-01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Chromium	1.25E+00	9.81E-01	4.90E-01
Nickel	6.14E-01	1.56E+00	1.35E-01
Selenium	1.11E+00	2.31E-01	4.05E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

2 Total prey ingestion rate was 96.7 percent of the total ingestion rate, based on the soil ingestion rate.

3 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-57

TIER 2 BACKGROUND HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	4.18E-02	1.96E-03	1.37E+00	2.69E-03	1.96E-03	2.25E+00	4.40E-03	1.01E-01	1.16E-04	1.16E-05	3.79E-02	2.19E-03	2.54E-01	5.70E-01	1.25E-03	2.19E-03	4.71E-01	6.47E-01	1.42E-03
Copper	4.18E-02	1.96E-03	1.83E+01	3.59E-02	1.96E-03	1.30E+01	2.54E-02	1.01E-01	5.48E-04	5.51E-05	3.79E-02	2.19E-03	4.41E-01	5.72E+00	1.25E-02	2.19E-03	3.55E-01	6.51E+00	1.43E-02
Nickel	4.18E-02	1.96E-03	3.03E+01	5.94E-02	1.96E-03	2.23E+01	4.37E-02	1.01E-01	1.90E-03	1.91E-04	3.79E-02	2.19E-03	3.05E-01	6.79E+00	1.49E-02	2.19E-03	4.94E-02	1.50E+00	3.28E-03
Selenium	4.18E-02	1.96E-03	1.01E+00	1.98E-03	1.96E-03	1.48E+00	2.90E-03	1.01E-01	9.81E-04	9.87E-05	3.79E-02	2.19E-03	8.17E-01	1.21E+00	2.65E-03	2.19E-03	3.20E-01	3.23E-01	7.08E-04
Vanadium	4.18E-02	1.96E-03	5.57E+01	1.09E-01	1.96E-03	3.91E+01	7.66E-02	1.01E-01	1.13E-03	1.13E-04	3.79E-02	2.19E-03	6.60E-02	2.58E+00	5.65E-03	2.19E-03	1.75E-02	9.77E-01	2.14E-03
Zinc	4.18E-02	1.96E-03	1.10E+02	2.16E-01	1.96E-03	1.10E+02	2.16E-01	1.01E-01	2.17E-02	2.18E-03	3.79E-02	2.19E-03	4.39E-01	4.84E+01	1.06E-01	2.19E-03	3.86E-01	4.25E+01	9.32E-02

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.64E-03	5.75E+00	2.10E-02	2.68E-03	2.72E-02	7.29E-05	3.54E-02	1.28E-01	4.52E-03	1.00E+00	1.00E+00	8.52E-01	4.15E-02	6.00E-02	3.22E-02	4.93E-02	8.41E-01
Copper	3.64E-03	1.47E+01	5.36E-02	2.68E-03	1.18E+00	3.15E-03	3.54E-02	3.70E+00	1.31E-01	1.00E+00	1.00E+00	8.52E-01	3.24E-01	2.67E+00	3.00E-02	2.18E+00	1.48E-01
Nickel	3.64E-03	3.10E+00	1.13E-02	2.68E-03	1.51E-01	4.05E-04	3.54E-02	3.59E-01	1.27E-02	1.00E+00	1.00E+00	8.52E-01	1.71E-01	1.33E-01	2.48E-01	1.24E-01	1.39E+00
Selenium	3.64E-03	1.92E+01	6.99E-02	2.68E-03	4.16E-01	1.11E-03	3.54E-02	8.30E+00	2.94E-01	1.00E+00	1.00E+00	8.52E-01	4.38E-01	5.00E-02	2.46E-02	4.04E-02	1.08E+01
Vanadium	3.64E-03	1.51E+01	5.51E-02	2.68E-03	9.06E-02	2.42E-04	3.54E-02	2.25E-01	7.97E-03	1.00E+00	1.00E+00	8.52E-01	3.02E-01	2.10E-01	2.60E-01	1.96E-01	1.54E+00
Zinc	3.64E-03	1.98E+02	7.23E-01	2.68E-03	1.55E+01	4.16E-02	3.54E-02	7.52E+01	2.66E+00	1.00E+00	1.00E+00	8.52E-01	4.77E+00	9.60E+00	2.55E-02	7.78E+00	6.13E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-57

TIER 2 BACKGROUND HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE MINK

Notes (continued):

[1] The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-58

TIER 2 BACKGROUND HAZARD QUOTIENTS OVERALL FOR THE NORTHERN BOBWHITE

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	2.68E-02	5.40E-04	2.05E+00	1.11E-03	2.63E-02	2.34E-02	2.45E-01	5.58E+00	1.31E-01	3.94E-03	5.58E+00	2.20E-02	1.00E+00	1.00E+00	1.91E-01	1.83E-01	8.00E-02	7.99E-01	6.01E-02	3.04E+00
Chromium	2.68E-02	5.40E-04	5.62E+01	3.03E-02	2.63E-02	2.34E-02	2.64E-02	7.08E+00	1.66E-01	3.94E-03	7.08E+00	2.79E-02	1.00E+00	1.00E+00	1.91E-01	4.86E-01	1.00E+00	1.25E+00	6.87E-01	7.08E-01
Copper	2.68E-02	5.40E-04	1.85E+01	1.00E-02	2.63E-02	2.34E-02	3.24E-01	1.55E+01	3.64E-01	3.94E-03	1.55E+01	6.12E-02	1.00E+00	1.00E+00	1.91E-01	1.11E+00	2.30E+00	6.39E-01	1.81E+00	6.14E-01
Nickel	2.68E-02	5.40E-04	2.91E+01	1.57E-02	2.63E-02	2.34E-02	3.98E-02	3.22E+00	7.55E-02	3.94E-03	3.22E+00	1.27E-02	1.00E+00	1.00E+00	1.91E-01	2.91E-01	1.38E+00	6.14E-01	1.09E+00	2.66E-01
Selenium	2.68E-02	5.40E-04	1.00E+00	5.40E-04	2.63E-02	2.34E-02	2.40E-01	1.19E+01	2.80E-01	3.94E-03	1.19E+01	4.70E-02	1.00E+00	1.00E+00	1.91E-01	2.79E-01	2.30E-01	1.11E+00	1.62E-01	1.72E+00
Zinc	2.68E-02	5.40E-04	1.38E+02	7.46E-02	2.63E-02	2.34E-02	2.63E-01	1.95E+02	4.56E+00	3.94E-03	1.95E+02	7.67E-01	1.00E+00	1.00E+00	1.91E-01	8.86E+00	1.72E+01	9.55E-01	1.25E+01	7.10E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-59

TIER 2 BACKGROUND HAZARD QUOTIENTS OVERALL FOR THE EASTERN COTTONTAIL

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	7.87E-02	1.89E-03	2.05E+00	3.88E-03	7.68E-02	8.07E-02	2.45E-01	5.02E-01	4.05E-02	1.00E+00	1.00E+00	1.23E+00	3.61E-02	6.00E-02	3.22E-02	4.82E-02	7.48E-01
Copper	7.87E-02	1.89E-03	1.85E+01	3.50E-02	7.68E-02	8.07E-02	3.24E-01	6.00E+00	4.84E-01	1.00E+00	1.00E+00	1.23E+00	4.22E-01	2.67E+00	3.00E-02	2.14E+00	1.97E-01
Nickel	7.87E-02	1.89E-03	2.91E+01	5.49E-02	7.68E-02	8.07E-02	3.98E-02	1.16E+00	9.34E-02	1.00E+00	1.00E+00	1.23E+00	1.21E-01	1.33E-01	2.48E-01	1.21E-01	9.97E-01
Selenium	7.87E-02	1.89E-03	1.00E+00	1.89E-03	7.68E-02	8.07E-02	2.40E-01	2.40E-01	1.94E-02	1.00E+00	1.00E+00	1.23E+00	1.73E-02	5.00E-02	2.46E-02	3.95E-02	4.37E-01
Vanadium	7.87E-02	1.89E-03	5.48E+01	1.04E-01	7.68E-02	8.07E-02	1.33E-02	7.27E-01	5.86E-02	1.00E+00	1.00E+00	1.23E+00	1.32E-01	2.10E-01	2.60E-01	1.91E-01	6.89E-01
Zinc	7.87E-02	1.89E-03	1.38E+02	2.61E-01	7.68E-02	8.07E-02	2.63E-01	3.63E+01	2.93E+00	1.00E+00	1.00E+00	1.23E+00	2.59E+00	9.60E+00	2.55E-02	7.61E+00	3.40E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-60

TIER 2 BACKGROUND HAZARD QUOTIENTS OVERALL FOR THE AMERICAN ROBIN

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	1.45E-02	2.90E-04	2.05E+00	5.95E-04	1.42E-02	7.39E-03	2.45E-01	5.02E-01	3.71E-03	7.39E-03	5.58E+00	4.12E-02	1.00E+00	1.00E+00	7.73E-02	5.89E-01	8.00E-02	7.99E-01	5.01E-02	1.17E+01
Chromium	1.45E-02	2.90E-04	5.62E+01	1.63E-02	1.42E-02	7.39E-03	2.64E-02	1.48E+00	1.09E-02	7.39E-03	7.08E+00	5.23E-02	1.00E+00	1.00E+00	7.73E-02	1.03E+00	1.00E+00	1.25E+00	5.73E-01	1.79E+00
Copper	1.45E-02	2.90E-04	1.85E+01	5.37E-03	1.42E-02	7.39E-03	3.24E-01	6.00E+00	4.44E-02	7.39E-03	1.55E+01	1.15E-01	1.00E+00	1.00E+00	7.73E-02	2.13E+00	2.30E+00	6.39E-01	1.51E+00	1.41E+00
Selenium	1.45E-02	2.90E-04	1.00E+00	2.90E-04	1.42E-02	7.39E-03	2.40E-01	2.40E-01	1.77E-03	7.39E-03	1.19E+01	8.82E-02	1.00E+00	1.00E+00	7.73E-02	1.17E+00	2.30E-01	1.11E+00	1.35E-01	8.64E+00
Zinc	1.45E-02	2.90E-04	1.38E+02	4.01E-02	1.42E-02	7.39E-03	2.63E-01	3.63E+01	2.68E-01	7.39E-03	1.95E+02	1.44E+00	1.00E+00	1.00E+00	7.73E-02	2.26E+01	1.72E+01	9.55E-01	1.04E+01	2.17E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-61

TIER 2 BACKGROUND HAZARD QUOTIENTS OVERALL FOR THE DEER MOUSE

(Page 1 of 1)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.42E-03	7.00E-05	2.05E+00	1.44E-04	3.35E-03	1.90E-03	2.45E-01	5.02E-01	9.55E-04	1.59E-03	5.58E+00	8.86E-03	1.00E+00	1.00E+00	2.10E-02	4.74E-01	6.00E-02	3.22E-02	6.16E-02	7.71E+00
Copper	3.42E-03	7.00E-05	1.85E+01	1.30E-03	3.35E-03	1.90E-03	3.24E-01	6.00E+00	1.14E-02	1.59E-03	1.55E+01	2.47E-02	1.00E+00	1.00E+00	2.10E-02	1.78E+00	2.67E+00	3.00E-02	2.73E+00	6.52E-01
Nickel	3.42E-03	7.00E-05	2.91E+01	2.03E-03	3.35E-03	1.90E-03	3.98E-02	1.16E+00	2.20E-03	1.59E-03	3.22E+00	5.12E-03	1.00E+00	1.00E+00	2.10E-02	4.45E-01	1.33E-01	2.48E-01	1.54E-01	2.89E+00
Selenium	3.42E-03	7.00E-05	1.00E+00	7.00E-05	3.35E-03	1.90E-03	2.40E-01	2.40E-01	4.57E-04	1.59E-03	1.19E+01	1.89E-02	1.00E+00	1.00E+00	2.10E-02	9.27E-01	5.00E-02	2.46E-02	5.05E-02	1.84E+01
Vanadium	3.42E-03	7.00E-05	5.48E+01	3.84E-03	3.35E-03	1.90E-03	1.33E-02	7.27E-01	1.38E-03	1.59E-03	1.44E+01	2.28E-02	1.00E+00	1.00E+00	2.10E-02	1.34E+00	2.10E-01	2.60E-01	2.44E-01	5.47E+00
Zinc	3.42E-03	7.00E-05	1.38E+02	9.67E-03	3.35E-03	1.90E-03	2.63E-01	3.63E+01	6.90E-02	1.59E-03	1.95E+02	3.09E-01	1.00E+00	1.00E+00	2.10E-02	1.85E+01	9.60E+00	2.55E-02	9.71E+00	1.90E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-62

TIER 2 BACKGROUND HAZARD QUOTIENT AQUATIC AND RIPARIAN FOR THE SONG SPARROW

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.43E-03	1.29E-04	1.37E+00	1.77E-04	2.26E-01	1.16E-04	2.61E-05	6.30E-03	6.56E-03	4.71E-01	6.47E-01	4.25E-03	1.00E+00	1.00E+00	2.35E-02	1.90E-01	8.00E-02	7.99E-01	3.95E-02	4.80E+00
Chromium	6.43E-03	1.29E-04	5.77E+01	7.42E-03	2.26E-01	4.94E-04	1.12E-04	6.30E-03	6.56E-03	2.73E-02	1.57E+00	1.03E-02	1.00E+00	1.00E+00	2.35E-02	7.60E-01	1.00E+00	1.25E+00	4.52E-01	1.68E+00
Copper	6.43E-03	1.29E-04	1.83E+01	2.36E-03	2.26E-01	5.48E-04	1.24E-04	6.30E-03	6.56E-03	3.55E-01	6.51E+00	4.27E-02	1.00E+00	1.00E+00	2.35E-02	1.92E+00	2.30E+00	6.39E-01	1.19E+00	1.62E+00
Nickel	6.43E-03	1.29E-04	3.03E+01	3.90E-03	2.26E-01	1.90E-03	4.29E-04	6.30E-03	6.56E-03	4.94E-02	1.50E+00	9.83E-03	1.00E+00	1.00E+00	2.35E-02	6.03E-01	1.38E+00	6.14E-01	7.18E-01	8.39E-01
Selenium	6.43E-03	1.29E-04	1.01E+00	1.30E-04	2.26E-01	9.81E-04	2.21E-04	6.30E-03	6.56E-03	3.20E-01	3.23E-01	2.12E-03	1.00E+00	1.00E+00	2.35E-02	1.05E-01	2.30E-01	1.11E+00	1.06E-01	9.89E-01
Vanadium	6.43E-03	1.29E-04	5.57E+01	7.17E-03	2.26E-01	1.13E-03	2.54E-04	6.30E-03	6.56E-03	1.75E-02	9.77E-01	6.41E-03	1.00E+00	1.00E+00	2.35E-02	5.89E-01	1.14E+01	1.17E+00	5.22E+00	1.13E-01
Zinc	6.43E-03	1.29E-04	1.10E+02	1.42E-02	2.26E-01	2.17E-02	4.89E-03	6.30E-03	6.56E-03	3.86E-01	4.25E+01	2.79E-01	1.00E+00	1.00E+00	2.35E-02	1.27E+01	1.72E+01	9.55E-01	8.20E+00	1.55E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

[1] The soil ingestion rate is expressed as 2 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 98 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-63

TIER 2 BACKGROUND HAZARD QUOTIENT AQUATIC AND RIPARIAN FOR THE MEADOW VOLE

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate[1] (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	7.20E-03	1.73E-04	1.37E+00	2.38E-04	1.34E-01	1.16E-04	1.55E-05	7.03E-03	7.23E-03	4.71E-01	6.47E-01	4.68E-03	1.48E-04	5.75E+00	8.48E-04	1.00E+00	1.00E+00	3.73E-02	1.55E-01	6.00E-02
Copper	7.20E-03	1.73E-04	1.83E+01	3.17E-03	1.34E-01	5.48E-04	7.35E-05	7.03E-03	7.23E-03	3.55E-01	6.51E+00	4.71E-02	1.48E-04	1.47E+01	2.17E-03	1.00E+00	1.00E+00	3.73E-02	1.41E+00	2.67E+00
Nickel	7.20E-03	1.73E-04	3.03E+01	5.24E-03	1.34E-01	1.90E-03	2.55E-04	7.03E-03	7.23E-03	4.94E-02	1.50E+00	1.08E-02	1.48E-04	3.10E+00	4.57E-04	1.00E+00	1.00E+00	3.73E-02	4.51E-01	1.33E-01
Selenium	7.20E-03	1.73E-04	1.01E+00	1.75E-04	1.34E-01	9.81E-04	1.32E-04	7.03E-03	7.23E-03	3.20E-01	3.23E-01	2.34E-03	1.48E-04	1.92E+01	2.83E-03	1.00E+00	1.00E+00	3.73E-02	1.47E-01	5.00E-02
Vanadium	7.20E-03	1.73E-04	5.57E+01	9.64E-03	1.34E-01	1.13E-03	1.51E-04	7.03E-03	7.23E-03	1.75E-02	9.77E-01	7.06E-03	1.48E-04	1.51E+01	2.23E-03	1.00E+00	1.00E+00	3.73E-02	5.12E-01	2.10E-01
Zinc	7.20E-03	1.73E-04	1.10E+02	1.91E-02	1.34E-01	2.17E-02	2.91E-03	7.03E-03	7.23E-03	3.86E-01	4.25E+01	3.07E-01	1.48E-04	1.98E+02	2.93E-02	1.00E+00	1.00E+00	3.73E-02	9.63E+00	9.60E+00

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	5.95E-02	2.61E+00
Copper	3.00E-02	2.64E+00	5.35E-01
Nickel	2.48E-01	1.49E-01	3.02E+00
Selenium	2.46E-02	4.88E-02	3.01E+00
Vanadium	2.60E-01	2.36E-01	2.17E+00
Zinc	2.55E-02	9.38E+00	1.03E+00

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-63

TIER 2 BACKGROUND HAZARD QUOTIENT AQUATIC AND RIPARIAN FOR THE MEADOW VOLE

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 2.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 97.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-64

TIER 2 BACKGROUND HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON

(Page 1 of 2)

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Aquatic Plant Ingestion Rate (kg/day)	Aquatic Plant BTF (unitless)	Aquatic Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Aquatic Plant Daily Dose[2] (mg/kg)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)
Cadmium	1.69E-01	7.92E-03	1.37E+00	1.09E-02	7.92E-03	2.25E+00	1.78E-02	8.30E-02	1.16E-04	9.58E-06	1.53E-01	4.93E-02	2.54E-01	5.70E-01	2.81E-02	4.93E-02	4.71E-01	6.47E-01	3.19E-02
Copper	1.69E-01	7.92E-03	1.83E+01	1.45E-01	7.92E-03	1.30E+01	1.03E-01	8.30E-02	5.48E-04	4.54E-05	1.53E-01	4.93E-02	4.41E-01	5.72E+00	2.82E-01	4.93E-02	3.55E-01	6.51E+00	3.21E-01
Nickel	1.69E-01	7.92E-03	3.03E+01	2.40E-01	7.92E-03	2.23E+01	1.77E-01	8.30E-02	1.90E-03	1.58E-04	1.53E-01	4.93E-02	3.05E-01	6.79E+00	3.35E-01	4.93E-02	4.94E-02	1.50E+00	7.39E-02
Selenium	1.69E-01	7.92E-03	1.01E+00	8.00E-03	7.92E-03	1.48E+00	1.17E-02	8.30E-02	9.81E-04	8.14E-05	1.53E-01	4.93E-02	8.17E-01	1.21E+00	5.96E-02	4.93E-02	3.20E-01	3.23E-01	1.59E-02
Vanadium	1.69E-01	7.92E-03	5.57E+01	4.41E-01	7.92E-03	3.91E+01	3.09E-01	8.30E-02	1.13E-03	9.35E-05	1.53E-01	4.93E-02	6.60E-02	2.58E+00	1.27E-01	4.93E-02	1.75E-02	9.77E-01	4.82E-02
Zinc	1.69E-01	7.92E-03	1.10E+02	8.73E-01	7.92E-03	1.10E+02	8.74E-01	8.30E-02	2.17E-02	1.80E-03	1.53E-01	4.93E-02	4.39E-01	4.84E+01	2.38E+00	4.93E-02	3.86E-01	4.25E+01	2.10E+00

COPEC	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration (mg/kg)	Mammal Daily Dose[2] (mg/day)	Fish Ingestion Rate (kg/day)	Fish Tissue Concentration (mg/kg)	Fish Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	6.51E-02	5.75E+00	3.74E-01	1.86E-02	2.72E-02	5.07E-04	3.72E-03	1.28E-01	4.74E-04	1.00E+00	1.00E+00	6.67E+00	6.66E-02	6.00E-02	3.22E-02	4.36E-02	1.53E+00
Copper	6.51E-02	1.47E+01	9.58E-01	1.86E-02	1.18E+00	2.19E-02	3.72E-03	3.70E+00	1.38E-02	1.00E+00	1.00E+00	6.67E+00	2.66E-01	2.67E+00	3.00E-02	1.93E+00	1.38E-01
Nickel	6.51E-02	3.10E+00	2.02E-01	1.86E-02	1.51E-01	2.82E-03	3.72E-03	3.59E-01	1.33E-03	1.00E+00	1.00E+00	6.67E+00	1.38E-01	1.33E-01	2.48E-01	1.09E-01	1.26E+00
Selenium	6.51E-02	1.92E+01	1.25E+00	1.86E-02	4.16E-01	7.74E-03	3.72E-03	8.30E+00	3.09E-02	1.00E+00	1.00E+00	6.67E+00	2.05E-01	5.00E-02	2.46E-02	3.57E-02	5.75E+00
Vanadium	6.51E-02	1.51E+01	9.85E-01	1.86E-02	9.06E-02	1.68E-03	3.72E-03	2.25E-01	8.37E-04	1.00E+00	1.00E+00	6.67E+00	2.76E-01	2.10E-01	2.60E-01	1.73E-01	1.60E+00
Zinc	6.51E-02	1.98E+02	1.29E+01	1.86E-02	1.55E+01	2.89E-01	3.72E-03	7.52E+01	2.80E-01	1.00E+00	1.00E+00	6.67E+00	2.90E+00	9.60E+00	2.55E-02	6.87E+00	4.22E-02

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

TABLE G-64

TIER 2 BACKGROUND HAZARD QUOTIENTS AQUATIC AND RIPARIAN FOR THE RACCOON

(Page 1 of 2)

Notes (continued):

[1] The soil ingestion rate is expressed as 9.4 percent of the total ingestion rate.

[2] Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

[3] Total prey ingestion rate was 90.6 percent of the total ingestion rate, based on the soil ingestion rate.

[4] Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

[5] Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

[6] The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

[7] Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

[8] The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-65

TIER 2 BACKGROUND HAZARD QUOTIENT OVERALL FOR THE COYOTE

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Water Ingestion Rate (kg/day)	Water Concentration (mg/kg)	Water Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Plant Ingestion Rate (kg/day)	Plant BTF (unitless)	Plant Tissue Concentration in Dry Weight[4] (mg/kg)	Plant Daily Dose[2] (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration in Dry Weight (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[6] (mg/kg/day)
Cadmium	2.29E-01	6.42E-03	2.05E+00	1.32E-02	7.83E-02	1.16E-04	9.04E-06	2.23E-01	2.36E-02	2.45E-01	5.02E-01	1.18E-02	2.12E-01	1.30E-01	2.76E-02	1.00E+00	1.00E+00	1.05E+01	5.01E-03	6.00E-02
Nickel	2.29E-01	6.42E-03	2.91E+01	1.87E-01	7.83E-02	1.90E-03	1.49E-04	2.23E-01	2.36E-02	3.98E-02	1.16E+00	2.73E-02	2.12E-01	1.68E-01	3.56E-02	1.00E+00	1.00E+00	1.05E+01	2.38E-02	1.33E-01
Selenium	2.29E-01	6.42E-03	1.00E+00	6.42E-03	7.83E-02	9.81E-04	7.68E-05	2.23E-01	2.36E-02	2.40E-01	2.40E-01	5.66E-03	2.12E-01	3.70E-01	7.86E-02	1.00E+00	1.00E+00	1.05E+01	8.65E-03	5.00E-02
Vanadium	2.29E-01	6.42E-03	5.48E+01	3.52E-01	7.83E-02	1.13E-03	8.82E-05	2.23E-01	2.36E-02	1.33E-02	7.27E-01	1.71E-02	2.12E-01	9.82E-02	2.09E-02	1.00E+00	1.00E+00	1.05E+01	3.71E-02	2.10E-01

COPEC	Test Species Body Weight (kg)	Allometrically Adjusted TRV[7] (mg/kg/day)	HQ (based on adjusted TRV)[8]
Cadmium	3.22E-02	4.27E-02	1.17E-01
Nickel	2.48E-01	1.07E-01	2.22E-01
Selenium	2.46E-02	3.50E-02	2.47E-01
Vanadium	2.60E-01	1.69E-01	2.19E-01

Notes:

BTF	Biotransfer factor
COPEC	Chemical of potential ecological concern
HQ	Hazard quotient
kg	Kilogram
kg/day	Kilogram per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
SUF	Site use factor
TRV	Toxicity reference value
TTC	Trophic transfer coefficient

1 The soil ingestion rate is expressed as 2.8 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 97.2 percent of the total ingestion rate, based on the soil ingestion rate.

4 Prey tissue concentration was calculated by multiplying the appropriate media concentration by the appropriate BTF where applicable. Concentrations are presented in dry weight.

5 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

6 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

7 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

8 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-66

TIER 2 BACKGROUND HAZARD QUOTIENT OVERALL FOR THE NORTHERN HARRIER

COPEC	Total Ingestion Rate (kg/day)	Soil Ingestion Rate[1] (kg/day)	Soil Concentration (mg/kg)	Soil Daily Dose[2] (mg/day)	Total Prey Ingestion Rate[3] (kg/day)	Invertebrate Ingestion Rate (kg/day)	Invertebrate Tissue Concentration (mg/kg)	Invertebrate Daily Dose[2] (mg/day)	Mammal Ingestion Rate (kg/day)	Mammal Tissue Concentration in Dry Weight (mg/kg)	Mammal Daily Dose[2] (mg/kg)	SUF	TTC	Body Weight (kg)	Total Daily Dose[5] (mg/kg/day)	TRV[5] (mg/kg/day)	Test Species Body Weight (kg)	Allometrically Adjusted TRV[6] (mg/kg/day)	HQ (based on adjusted TRV)[7]
Chromium	4.09E-02	2.86E-04	5.62E+01	1.61E-02	3.81E-02	1.10E-03	7.08E+00	7.75E-03	4.27E-02	5.09E-01	2.17E-02	1.00E+00	1.00E+00	5.13E-01	8.88E-02	1.00E+00	1.25E+00	8.37E-01	1.06E-01
Selenium	4.09E-02	2.86E-04	1.00E+00	2.86E-04	3.81E-02	1.10E-03	1.19E+01	1.31E-02	4.27E-02	3.70E-01	1.58E-02	1.00E+00	1.00E+00	5.13E-01	5.69E-02	2.30E-01	1.11E+00	1.97E-01	2.88E-01

Notes:

BTF Biotransfer factor
COPEC Chemical of potential ecological concern
HQ Hazard quotient
kg Kilogram
kg/day Kilogram per day
mg/day Milligram per day
mg/kg Milligram per kilogram
mg/kg/day Milligram per kilogram per day
SUF Site use factor
TRV Toxicity reference value
TTC Trophic transfer coefficient

1 The soil ingestion rate is expressed as 0.7 percent of the total ingestion rate.

2 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.

3 Total prey ingestion rate was 99.3 percent of the total ingestion rate, based on the soil ingestion rate.

4 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose) x SUF)/receptor species body weight.

5 The derivation of TRVs is described in Engineering Field Activity West (1998). These TRVs are adjusted to incorporate uncertainty factors.

6 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2 \text{ for birds})(1-0.94 \text{ for mammals})}$.

7 The HQ was calculated using total daily dose / allometrically adjusted TRV.

TABLE G-67

TIER 3 SUMMARY OF HAZARD QUOTIENTS
AQUATIC AND RIPARIAN RECEPTORS

(Page 1 of 1)

COPEC	Red-winged Blackbird	Song Sparrow	Meadow Vole	Great Blue Herron	Mallard Duck	Mink	Raccoon
Blackfoot River							
Cadmium	8.20E+00	6.19E+00	3.20E+00	1.58E-01	7.15E-01	1.16E+00	1.77E+00
Chromium	1.51E+00	1.80E+00	2.06E-04	1.19E-01	4.78E-01	2.50E-04	1.96E-04
Copper	1.24E+00	1.64E+00	5.41E-01	8.76E-02	1.10E-01	1.91E-01	1.57E-01
Nickel	6.02E-01	9.05E-01	3.17E+00	2.26E-02	1.65E-01	2.53E+00	2.08E+00
Selenium	7.68E+00	2.39E+00	4.82E+00	2.88E+00	1.29E+00	1.67E+01	6.97E+00
Vanadium	1.63E-01	1.19E-01	2.25E+00	2.16E-03	1.64E-02	2.63E+00	2.27E+00
Zinc	1.67E+00	1.64E+00	1.08E+00	2.45E-01	1.94E-01	7.38E-01	4.76E-01
Georgetown River							
Cadmium	9.25E+00	7.02E+00	3.65E+00	1.24E-01	5.73E-01	1.28E+00	2.04E+00
Chromium	1.59E+00	1.91E+00	2.18E-04	1.03E-01	3.25E-01	2.24E-04	1.70E-04
Copper	1.27E+00	1.69E+00	5.56E-01	8.02E-02	8.40E-02	1.76E-01	1.49E-01
Nickel	6.24E-01	9.41E-01	3.30E+00	1.79E-02	1.06E-01	2.18E+00	1.75E+00
Selenium	8.48E+00	2.75E+00	5.62E+00	2.35E+00	1.01E+00	1.45E+01	7.72E+00
Vanadium	1.68E-01	1.23E-01	2.33E+00	2.21E-03	1.54E-02	2.68E+00	2.31E+00
Zinc	1.71E+00	1.72E+00	1.13E+00	2.30E-01	1.68E-01	7.06E-01	4.72E-01
Salt River							
Cadmium	7.64E+00	5.24E+00	2.76E+00	1.02E-01	3.67E-01	9.93E-01	8.78E-01
Chromium	1.46E+00	1.70E+00	1.94E-04	1.06E-01	5.31E-01	2.53E-04	1.45E-04
Copper	1.24E+00	1.62E+00	5.36E-01	7.76E-02	9.90E-02	1.83E-01	8.36E-02
Nickel	6.00E-01	8.91E-01	3.12E+00	1.89E-02	1.59E-01	2.53E+00	1.43E+00
Selenium	6.95E+00	1.56E+00	3.57E+00	2.11E+00	7.50E-01	1.27E+01	3.29E+00
Vanadium	1.64E-01	1.15E-01	2.19E+00	2.39E-03	1.82E-02	2.80E+00	1.63E+00
Zinc	1.62E+00	1.56E+00	1.03E+00	2.23E-01	1.74E-01	6.99E-01	2.44E-01

Note:

COPEC Chemical of potential ecological concern

TABLE G-68

TIER 3 SUMMARY OF HAZARD QUOTIENTS
OVERALL RECEPTORS

(Page 1 of 1)

COPEC	Northern Bobwhite	Eastern Cottontail	American Robin	Deer Mouse	Coyote	Northern Harrier
Cadmium	3.37E+00	9.69E-01	1.21E+01	7.96E+00	1.34E-01	3.29E-01
Chromium	8.03E-01	8.60E-05	1.91E+00	2.83E-04	2.46E-05	1.14E-01
Copper	6.45E-01	2.11E-01	1.45E+00	6.70E-01	2.92E-02	7.37E-02
Nickel	2.88E-01	1.10E+00	6.06E-01	3.04E+00	2.43E-01	2.93E-02
Selenium	2.07E+00	1.14E+00	9.08E+00	1.94E+01	3.21E-01	3.09E-01
Vanadium	7.10E-02	7.63E-01	2.51E-01	5.53E+00	2.42E-01	7.48E-03
Zinc	7.45E-01	3.69E-01	2.21E+00	1.94E+00	9.13E-02	1.51E-01
Cadmium	3.16E+00	8.19E-01	1.19E+01	7.82E+00	1.23E-01	3.28E-01
Chromium	7.38E-01	7.65E-05	1.83E+00	2.70E-04	2.24E-05	1.09E-01
Copper	6.24E-01	2.02E-01	1.42E+00	6.58E-01	2.85E-02	7.35E-02
Nickel	2.73E-01	1.03E+00	5.87E-01	2.93E+00	2.29E-01	2.83E-02
Selenium	1.85E+00	6.62E-01	8.86E+00	1.89E+01	2.71E-01	2.96E-01
Vanadium	6.91E-02	7.12E-01	2.50E-01	5.49E+00	2.26E-01	7.28E-03
Zinc	7.21E-01	3.50E-01	2.18E+00	1.91E+00	9.00E-02	1.51E-01
Cadmium	3.07E+00	7.71E-01	1.18E+01	7.73E+00	1.19E-01	3.26E-01
Chromium	7.18E-01	7.36E-05	1.81E+00	2.66E-04	2.17E-05	1.07E-01
Copper	6.17E-01	1.99E-01	1.42E+00	6.54E-01	2.84E-02	7.34E-02
Nickel	2.68E-01	1.01E+00	5.82E-01	2.90E+00	2.25E-01	2.80E-02
Selenium	1.76E+00	5.09E-01	8.69E+00	1.85E+01	2.56E-01	2.91E-01
Vanadium	6.85E-02	6.96E-01	2.49E-01	5.48E+00	2.22E-01	7.21E-03
Zinc	7.14E-01	3.43E-01	2.17E+00	1.90E+00	8.97E-02	1.51E-01

Note:

COPEC Chemical of potential ecological concern

APPENDIX H

2001 DATA SUMMARY REPORT

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1.0 INTRODUCTION

This report presents data collected by Tetra Tech EM Inc. (TtEMI) and Montgomery Watson (MW) in 2001 as part of the Selenium Project Area Wide Investigation. TtEMI used the data to assist the Idaho Department of Environmental Quality (IDEQ) in the development of area wide human health and ecological risk assessments for the Southeastern Idaho Phosphate Mining Resource Area (Resource Area).

1.1 PURPOSE OF REPORT

This report supplements findings of the area wide ecological and human health risk assessments performed by TtEMI for IDEQ and presented in TtEMI's "Draft Area Wide Human Health and Ecological Risk Assessment" (TtEMI 2002a). TtEMI and MW data presented in this report represents uncensored, laboratory-reported data for all media sampled by both firms in 2001. MW's "Draft Spring 2001 Area Wide Investigation Data Summary" (MW 2001) presents results of MW's Spring 2001 sampling of mine surface water features and waste rock dump soil; however, the data presented in MW (2001) is data that was censored as part of MW's laboratory data validation procedures. Additionally, MW (2001) does not include data from other media sampled by MW during Summer 2001.

1.2 PROJECT BACKGROUND

Phosphate mining has been conducted in the Resource Area since 1907. In 1996, isolated livestock losses associated with excessive selenium uptake prompted concerns about potential ecological and human health impacts from past mining operations in the Resource Area (MW 1999). In response to these concerns, five companies operating mines in the region formed an *ad hoc* Selenium Committee of the Idaho Mining Association (IMA) to characterize the environmental risks and identify mitigative measures associated with phosphate mining. The IMA Selenium Committee contracted MW to investigate the occurrence and potential release of metals and prepare preliminary ecological and human health risk assessments associated with phosphate mining activities in the Resource Area (MW 1999).

In 2001, under contract with IDEQ, TtEMI reviewed existing data and preliminary risk assessment work and performed a data gaps analysis as part of an area wide Scope of Work referenced in July 2000 Memorandum of Understanding (MOU) concerning contamination from phosphate mining operations in southeastern Idaho (U.S. Department of Agriculture and Others 2000). The MOU was negotiated among

IDEQ and the tribal and federal agencies with jurisdictional responsibilities in the region. The MOU specified IDEQ as the lead agency for coordinating future activities of the Area Wide Investigation and for establishing regional cleanup guidance to assist lead agencies in implementing future site-specific remedial efforts. The Area Wide Investigation is incorporated as part of an Administrative Order of Consent (AOC) negotiated with the responsible mining companies. Findings of TtEMI's review and the resulting data gaps analysis are presented in two TtEMI reports, "Final Existing Data and Risk Assessment Review" (TtEMI 2001a) and "Final Data Gap Technical Memorandum" (TtEMI 2001b).

1.3 SUMMARY OF 2001 AREA WIDE INVESTIGATION SAMPLING ACTIVITIES

TtEMI and MW conducted extensive sampling in 2001 to support development of area wide human health and ecological risk assessments for the Resource Area. Representing the IMA Selenium Committee, MW followed a sampling design developed by TtEMI for IDEQ to fill data gaps identified in TtEMI (2001b). Under this scope of work, MW collected samples from the following media: mine surface water features; mine waste rock soil; and plant, insect, worm, and small mammal tissue. Concurrent with this work, TtEMI collected additional data consisting of samples from the following media: stream surface water; stream sediment; riparian soil and plant tissue; and aquatic plant, benthic invertebrate, and fish tissue.

TtEMI's surface water sampling program was developed to (1) support the area wide risk assessments and (2) assist IDEQ's Total Maximum Daily Load (TMDL) program in evaluating surface water quality in the Resource Area for compliance with regulatory requirements. The upper Blackfoot River and some respective tributaries in southeastern Idaho are listed on the State's 303(d) list for nutrients, sediment, organic compounds, and unknown pollutants. IDEQ performed loading analyses for nutrients and sediment and, in 2001, submitted the "Blackfoot River Waterbody Assessment and Total Maximum Daily Load" (IDEQ 2001) report for approval by the U.S. Environmental Protection Agency (EPA). Because previous investigations (A.A Rich and Associates 1999; MW 1999, 2000) have demonstrated that selenium and other toxic constituents are present in streams within the upper Blackfoot River watershed as well as streams in the upper Salt and Bear River watersheds, IDEQ contracted TtEMI to characterize baseline levels of selenium and other toxic constituents in the three watersheds and evaluate surface water quality data for exceedances of water quality criteria for the protection of aquatic life. The results of TtEMI's 2001 surface water sampling program are presented in TtEMI's "Final 2001 TMDL Baseline Monitoring Report" (TtEMI 2002b).

2.0 SCOPE OF 2001 TETRA TECH EM INC. SAMPLING ACTIVITIES

TtEMI performed sampling in 2001 to fulfill data needs of concurrent ecological and human health risk assessments and IDEQ's TMDL program. This section discusses the sampling events, monitoring stations, media sampled, field and laboratory methods, and data quality assessments implemented by TtEMI in 2001.

2.1 SAMPLING EVENT DESCRIPTIONS

TtEMI implemented four sampling events in 2001. Over the course of the four events, the following media were sampled:

- Stream surface water
- Stream sediment
- Riparian soil and plant tissue
- Aquatic plant, insect, and fish tissue

Table H-1 summarizes the four TtEMI 2001 sampling events.

2.2 SAMPLING LOCATIONS

To fulfill data needs of the risk assessments and IDEQ's TMDL program, TtEMI identified and incorporated sampling stations that were located downstream from current or historic mining activity as well as background (reference) stations located upstream or away from mining activities. Table H-2 lists the TtEMI 2001 sampling locations and indicates the media collected from each location by event. TtEMI 2001 sampling locations are shown on Figure 1.

2.3 FIELD AND LABORATORY METHODS

This section discusses the field and laboratory procedures followed for TtEMI's 2001 sampling program.

2.3.1 Surface Water

TtEMI followed the methods, described in TtEMI's "Final Sampling and Analysis Plan (SAP) – Selenium Project Baseline Water Quality Assessment" (TtEMI 2001c), for surface water sample collection during all four TtEMI sampling events in 2001. One exception was that TtEMI collected unfiltered samples only during Event 4. During Events 1, 2, and 3, TtEMI collected both filtered and unfiltered surface water samples. During all four events, TtEMI measured field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation reduction potential) at all monitoring stations where surface water samples were collected. During Events 1, 2, and 3, TtEMI measured flow at all stations where surface water samples were collected. TtEMI's SAP (2001c) describes methods followed by TtEMI for measurement of field parameters and flow. During Events 1, 2, and 3, TtEMI collected the following types of field quality control (QC) surface water samples: field duplicates, equipment rinsates, and source water blanks. Split samples were collected during Events 1, 3, and 4. TtEMI also collected field duplicates during Event 4.

Table H-3 lists the laboratory analyses and methods used for surface water samples collected by TtEMI in 2001. TtEMI contracted with two analytical laboratories for analysis of the surface water samples. The University of Idaho Analytical Sciences Laboratory (U of I) in Moscow, Idaho, performed the majority of Event 1, 2, and 3 surface water analyses. ACZ Laboratories, Inc. (ACZ) in Steamboat Springs, Colorado performed analyses on Event 1, 2, and 3 samples that U of I was unable to perform. Such analyses included total organic carbon (all events), gross alpha and gross beta radionuclides (Event 1 only), and low-level mercury (Events 1 and 3). ACZ analyzed all Event 4 original and field duplicate surface water samples. ACZ analyzed Event 1 and 3 split samples that were prepared by U of I or collected in the field. U of I analyzed Event 4 split samples prepared by ACZ. Laboratory QC analyses performed as part of TtEMI's surface water sampling program included check standards, blanks, matrix spikes, laboratory control samples, laboratory duplicates, and standard reference materials. Analytical results reported by the laboratories for these QC samples were used to evaluate the quality of laboratory data. Further information describing TtEMI's data quality program is presented in the Quality Assurance Project Plan (QAPP) included with TtEMI's SAP (2001c).

2.3.2 Sediment

TtEMI followed the same field methods for sediment sample collection during all 2001 events in which sediment samples were collected. The methods are described in Addendum 1 to TtEMI's SAP (2001c).

Field parameter measurement included measurement of oxidation-reduction potential at the stream and sediment interface. Field QC sampling involved collection of field duplicate samples. Laboratory QC analyses performed as part of TtEMI's sediment sampling program included check standards, blanks, matrix spikes, laboratory control samples, laboratory duplicates, and standard reference materials. Table H-4 lists laboratory analyses and methods used for sediment samples collected by TtEMI in 2001. U of I analyzed Event 2 and 3 sediment samples and split samples collected in the field by TtEMI during Event 4. ACZ analyzed Event 4 original and field duplicate sediment samples. U of I analyzed Event 4 split samples prepared by ACZ.

2.3.3 Riparian Soil and Plant Tissue

Methods for collection of riparian soil samples are described by TtEMI in Addendum 2 to the SAP (TtEMI 2001c). U of I performed all laboratory analyses of Event 2 riparian soil samples. The same analytical suite U of I performed on Event 2 and 3 sediment samples presented in Table H-4 was used for analysis of all Event 2 soil samples. Laboratory QC analyses included blanks, check standards, and standard reference materials.

Locations for TtEMI 2001 riparian plant tissue samples were collocated with riparian soil sample sites. Methods for collection of riparian plant tissue samples are described by TtEMI in Addendum 2 to the SAP (TtEMI 2001c). U of I performed all laboratory analyses of Event 2 riparian plant tissue samples. Table H-5 presents laboratory methods for all riparian plant tissue analyses performed by U of I. Laboratory QC analyses included blanks, check standards, and standard reference materials.

2.3.4 Aquatic Plant, Benthic Invertebrate, and Fish Tissue

Methods for collection of aquatic plant, benthic invertebrate, and fish tissue samples are described by TtEMI in Addendum 3 to the SAP (TtEMI 2001c). Laboratory analytical methods used for analysis of aquatic plant, insect, and fish tissue samples are presented in Table H-6. Severn Trent Laboratories (STL) in Burlington, Vermont analyzed all aquatic plant, insect, and fish tissue samples. ACZ analyzed aquatic plant tissue split samples collected by TtEMI. Other field QC samples collected by TtEMI included field duplicates for insect and plant tissue samples. Laboratory QC analyses included blanks, laboratory control samples, matrix spikes, and matrix spike duplicates.

2.4 EVALUATION OF LABORATORY DATA QUALITY

Laboratory data were evaluated to assess data quality following procedures outlined in the QAPP (TtEMI 2001c). As noted earlier, the QAPP describes procedures to ensure that the data generated during field activities were accurate, complete, and representative of actual field conditions. The data evaluation included a review of the QC information in the raw data package, analytical methods, and discussions with laboratory staff. In particular, the following data from 2001 TtEMI sampling events were evaluated:

- Check standards
- Blanks
- Matrix spike and matrix duplicate spike samples
- Laboratory control samples
- Standard reference material

For all events, surface water analyses performed by U of I, the laboratory quality assessment was restricted to the results for selenium analyzed by hydride generation and boron, mercury, and metals analyzed by EPA Methods 200.7 and 200.8.

3.0 RESULTS OF 2001 SAMPLING ACTIVITIES BY TETRA TECH EM INC.

This section references results of all sampling activities performed by TtEMI in 2001.

3.1 SURFACE WATER

Laboratory analytical results, field parameter, and flow data from TtEMI 2001 Events 1 through 4 surface water sampling are summarized in Tables H-7 through H-10. The TtEMI 2001 stream surface water analytical and are provided in Appendix A.

3.2 SEDIMENT

Laboratory analytical results and field parameter data from TtEMI 2001 Event 2, 3, and 4 sediment sampling are summarized in Table H-11. The TtEMI 2001 stream sediment analytical data are provided in Appendix B and the TtEMI 2001 field data are provided in Appendix C.

3.3 RIPARIAN SOIL AND PLANT TISSUE

Laboratory analytical results from TtEMI 2001 Event 2 riparian soil and plant tissue sampling are summarized in Tables H-12 and H-13, respectively. The TtEMI 2001 riparian soil and plant tissue analytical data are provided in Appendices D and E, respectively.

3.4 AQUATIC PLANT, BENTHIC INVERTEBRATE, AND FISH TISSUE

Laboratory analytical results from TtEMI 2001 Event 4 aquatic plant, benthic invertebrate, and fish tissue sampling are summarized in Tables H-14, H-15, and H-16, respectively. The TtEMI aquatic plant tissue, benthic invertebrate tissue, and fish tissue analytical data are provided in Appendices F, G, and H, respectively.

3.5 LABORATORY DATA QUALITY

This section discusses the quality of laboratory data reported to TtEMI by laboratories subcontracted by TtEMI for analysis of surface water and tissue samples collected in 2001 by TtEMI. The laboratory analyses were performed according to EPA accepted methods, as described in the SAP (TtEMI 2001c). Results from sampling events were evaluated to assess quality of the laboratory data. This evaluation

included a review of QC information in the raw data package, analytical methods, and discussions with the current U of I and ACZ laboratory staff. In particular, the following data were evaluated:

- Check standards
- Blanks
- Matrix spike and matrix duplicate spike samples
- Laboratory control samples
- Standard reference material

3.5.1 Surface Water Data

The assessment of surface water laboratory data quality was restricted to selenium, boron, and other constituents analyzed using EPA Methods 200.7 and 200.8.

Check Standards

Check standards were consistently reported for all constituents. The check standard recoveries were generally within 95 to 100 percent. The recoveries were never outside of the QC guidance limits of 85 and 115 percent. The recoveries for check samples indicate that the instruments maintained calibration throughout the analytical runs.

Blanks

The method blank results were generally below method detection limits (MDL). With the exception of aluminum and boron, occurrences of blank samples with detectable concentrations of constituents were rare. In such cases, concentrations of the detected constituents only slightly exceeded the respective MDL. These exceedances are probably related to normal analytical variability, rather than significant laboratory contamination. Normal analytical variability is exacerbated by the very low detection limits that were selected for the project. Aluminum and boron tended to occur in the blanks more regularly than the other elements and at somewhat higher concentrations. The source of aluminum and boron is problematic. However, dust could be the source for aluminum in the blanks, whereas glassware was the probable source for boron. Thus, the blank results suggest that laboratory contamination was minimal.

Matrix Spikes

Matrix spikes were determined only for selenium and cadmium. Matrix spike recoveries for cadmium were always within the QC guidance limits of 75 to 125 percent. The recoveries for selenium were

generally within the desired range but were low in some cases. Thus, the selenium analysis may be affected by matrix interference in some instances.

Laboratory Control Samples

Blank spikes were reported for selenium and cadmium, but not for other constituents. Laboratory control sample (blank spike) recoveries for these were generally within the QC guidance of 80 to 120 percent. These data indicate that analytical precision was reasonable and generally within acceptable analytical bounds.

Standard Reference Materials

Standard reference materials were included with the analytical runs for all elements, except uranium. The standard reference materials are prepared by external sources and provide a measure of laboratory accuracy. Recoveries for the external standards were generally good. Analytical methods used in the source laboratory that developed the standard reference materials may vary from those used in the reporting laboratory, so it is not uncommon for recoveries to deviate from the true values. The recoveries were almost always within acceptable limits, indicating good precision and high accuracy.

Sensitivity

The detection limits were below proposed regulatory benchmarks, and the data are adequate from this perspective. Notably, the reported detection limits are generally lower than previous investigations in the Resource Area (TtEMI 2001a). The relatively high sensitivity associated with the low detection limits resulted in low magnitude, but high proportional variation.

Overall Assessment of Quality of Surface Water Laboratory Data

Overall, only minor and isolated problems were noted with calibrations, blanks, matrix spikes, laboratory control samples, and standard reference materials. No apparent and consistent bias was detected in the analysis. The primary limitation of the data from a quality perspective is that matrix spikes, duplicates, and laboratory control samples were not consistently analyzed for all elements. Nonetheless, the data are considered both accurate and precise based on check standard, blank, and standard reference material analyses. The detection limits are much improved from previous investigations and are appropriate for the proposed regulatory comparisons.

In particular cases, the reported values for filtered samples were greater than those reported for the corresponding unfiltered samples. These results are contrary to conditions normally expected when

comparing total chemical concentrations in filtered and unfiltered data. Because particulate matter removed by filtering will decompose under acid treatment to release metal into solution, the unfiltered sample split generally has higher total metal concentrations than filtered samples. The incongruous results occurred in samples from all sampling events without any discernible pattern associated with particular analyses or sample teams. It is important to note that this pattern occurred in almost all laboratory analyses for which unfiltered and filtered samples were collected.

In the majority of cases where filtered sample results were higher than unfiltered results, concentrations were near the detection limit for the constituent. Because sample concentrations were near the detection limit (such as, generally less than 5 times the detection limit), the incongruous results are likely attributed to normal analytical variability, rather than gross field or laboratory errors. As indicated above, the low detection limits used in this study accentuate the potential for low absolute magnitude, but high proportional variability. The low flow regime of 2001 further aggravated variability for the filtered and unfiltered samples because the sediment load was minimal during sampling. In a few isolated instances, the filtered sample results were significantly higher than unfiltered samples from an absolute concentration perspective, suggesting some sort of error in the sampling, processing, or analytical processes. Low frequency errors of this nature are inherent in large-scale projects. Samples with obvious errors occur at low frequency (less than 5 percent) in the data and are easily identified. Interpretatively, these data should be used with caution.

3.5.2 Sediment and Soil Data

The assessment of sediment and soil laboratory data quality is described below.

Check Standards

Check standards were consistently reported for all constituents. The check standard recoveries were generally within 95 to 100 percent. The recoveries were never outside of the QC guidance limits of 85 and 115 percent. The recoveries for check samples indicate that the instruments maintained calibration throughout the analytical runs.

Blanks

The method blank results were below MDLs, with the exception of aluminum; occurrences of blank samples with detectable concentrations of constituents were rare. These occurrences are probably related to normal analytical variability, rather than significant laboratory contamination. Normal analytical

variability is exacerbated by the very low detection limits that were selected for the project. The source of aluminum is problematic; however, dust could be the source of aluminum detected in the blanks. For all other constituents, the blank results suggest that laboratory contamination was minimal.

Matrix Spikes

Matrix spike recoveries were generally within the QC guidance limits of 75 to 125 percent, with a few exceptions. The recovery for aluminum greatly exceeded the control limits and may have been affected by matrix interference. The recoveries for antimony and manganese were lower than the QC guidance limits, while recoveries for barium and boron slightly exceeded the QC guidance limits.

Laboratory Control Samples

Laboratory control sample (blank spike) recoveries were generally within the QC guidance limits of 80 to 120 percent with the exception of aluminum, mercury, and silver. The recovery for aluminum was higher than the guidance limits, while the recoveries for mercury and silver were slightly lower than the guidance limits. Overall, the data indicate that analytical precision was reasonable and generally within acceptable analytical bounds.

Standard Reference Materials

Standard reference materials were included with the analytical runs for all elements. The standard reference materials are prepared by external sources and provide a measure of laboratory accuracy. Recoveries for the external standards were generally good. Analytical methods used in the source laboratory that developed the standard reference materials may vary from those used in the reporting laboratory, so it is not uncommon for recoveries to deviate from the true values. The recoveries were almost always within acceptable limits, indicating good precision and high accuracy.

Sensitivity

The detection limits were below proposed regulatory benchmarks, and the data are adequate from this perspective. Notably, the reported detection limits are generally lower than previous investigations in the Resource Area (TtEMI 2001a). The relatively high sensitivity associated with the low detection limits resulted in low magnitude, but high proportional variation.

Overall Assessment of Sediment and Soil Laboratory Data

Overall, only minor and isolated problems were noted with calibrations, blanks, matrix spikes, laboratory control samples, and standard reference materials. No apparent and consistent bias was detected in the

analysis. The data are considered both accurate and precise based on check standard, blank, and standard reference material analyses. The detection limits are much improved from previous investigations and are appropriate for the proposed regulatory comparisons.

3.5.3 Tissue Data

The assessment of tissue laboratory data quality is described below.

Check Standards

Check standards were consistently reported for all constituents. The check standard recoveries were generally within 91 to 104 percent. The recoveries were never outside of the QC guidance limits of 85 and 115 percent. The recoveries for check samples indicate that the instruments maintained calibration throughout the analytical runs.

Blanks

The method blank results were generally below MDLs. Trace concentrations of lead, molybdenum, thallium, and zinc were observed in the blank analyses for aquatic macrophytes. For fish tissue analyses, trace concentrations of cadmium, lead, molybdenum, and selenium were detected in the blank analyses. In all cases, concentrations of the detected constituents in the blank only slightly exceeded the MDL. These exceedances are probably related to normal analytical variability, rather than significant laboratory contamination. Normal analytical variability is exacerbated by the very low detection limits that were selected for the project.

Matrix Spikes and Matrix Spike Duplicates

Matrix spike recoveries were generally within the QC guidance limits of 75 to 125 percent. The recoveries for thallium were low for all media at about 41 percent indicating matrix interference for thallium. The recoveries for selenium were generally within the desired range but in the case of fish tissue were high at 217 percent. However, the spike concentration was very small compared to the actual tissue concentrations. The replicate analyses that were performed yielded results with good correlation in the interanalysis comparison. Therefore, the high matrix spike recovery is believed to be due to the low concentration in the spike versus the actual tissue concentration and natural analytical variation.

Minimal tissue volumes of benthic macroinvertebrates limited the laboratory'a ability to perform additional analyses. Therefore, no matrix spikes or matrix spike duplicates were performed on benthic macroinvertebrate samples.

Blank Spikes

Laboratory control sample (blank spike) recoveries were generally within the QC guidance of 80 to 120 percent. These data indicate that analytical precision was reasonable and generally within acceptable analytical bounds.

Standard Reference Materials

Standard reference materials were included with the analytical runs for all elements. The standard reference materials are prepared by external sources and provide a measure of laboratory accuracy. Recoveries for the external standards were generally good. The recoveries were within acceptable limits, indicating good precision and high accuracy.

Sensitivity

The detection limits were based on tissue concentrations required to detect potential effects based on conservative food chain modeling. The required detection limits are generally lower than previous investigations in the Resource Area (TtEMI 2001a). The relatively high sensitivity associated with the low detection limits resulted in low magnitude, but high proportional variation. All analyses met the required detection limits.

Overall Assessment of Quality of Tissue Laboratory Data

Overall, only minor and isolated problems were noted with calibrations, blanks, matrix spikes, laboratory control samples, and standard reference materials. No apparent and consistent bias was detected in the analysis. The data are considered both accurate and precise based on check standard, blank, and standard reference material analyses. The detection limits are appropriate for the proposed regulatory comparisons.

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4.0 SCOPE OF 2001 SAMPLING ACTIVITIES BY MONTGOMERY WATSON

MW performed sampling in 2001 as part of the Area Wide Investigation on behalf of the IMA. The scope of MW's Spring 2001 sampling is described in the "Spring 2001 Area Wide Investigation Data Summary" (MW 2001). MW's Spring 2001 sampling consisted of sample collection from mine surface water features and waste rock soil. During Summer 2001, MW continued sampling as part of the Area Wide Investigation data collection program. Methods for sample collection and laboratory analyses followed recommendations by TtEMI (2001b). The following types of sample locations and media were sampled as part of MW's Summer 2001 sampling activities:

- Mine waste rock, upland, and riparian soil
- Mine waste rock, upland, and riparian plant tissue
- Mine waste rock, upland, and riparian small mammal tissue
- Mine waste rock, upland, and riparian insect tissue
- Riparian worm tissue

MW sample locations in 2001 consisted of both mining-impacted and background locations. MW Spring 2001 sample locations are described in MW (2001) and shown on Figure 1. Table H-17 lists MW Summer 2001 sample locations and indicates the location type and whether the location is mining-impacted or background. Table H-17 also indicates the types of media collected from each location. MW Summer 2001 sampling locations are also shown on Figure 1.

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5.0 RESULTS OF 2001 SAMPLING ACTIVITIES BY MONTGOMERY WATSON

Data provided by MW (2001) represents corrected laboratory results and does not include results of sampling performed by MW in Summer 2001. Data provided here represents data as directly reported by U of I and includes all media sampled by MW in Spring and Summer 2001.

5.1 SURFACE WATER

Laboratory analytical results of MW Spring 2001 mine surface water sampling are summarized in Table H-18 and the analytical data are provided in Appendix I.

5.2 SOIL

Laboratory analytical results of MW Spring and Summer 2001 soil sampling are summarized in Table H-19 and the analytical data are provided in Appendix J.

5.3 PLANT TISSUE

Laboratory analytical results of MW Summer 2001 plant tissue sampling are summarized in Table H-20 and the analytical data are provided in Appendix K.

5.4 SMALL MAMMAL TISSUE

Laboratory analytical results of MW Summer 2001 small mammal tissue sampling are summarized in Table H-21 and the analytical data are provided in Appendix L.

5.5 INSECT TISSUE

Laboratory analytical results of MW Summer 2001 insect tissue sampling are summarized in Table H-22 and the analytical data are provided in Appendix M.

5.6 WORM TISSUE

Laboratory analytical results of MW Summer 2001 worm tissue sampling are summarized in Table H-23 and the analytical data are provided in Appendix N.

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6.0 REFERENCES

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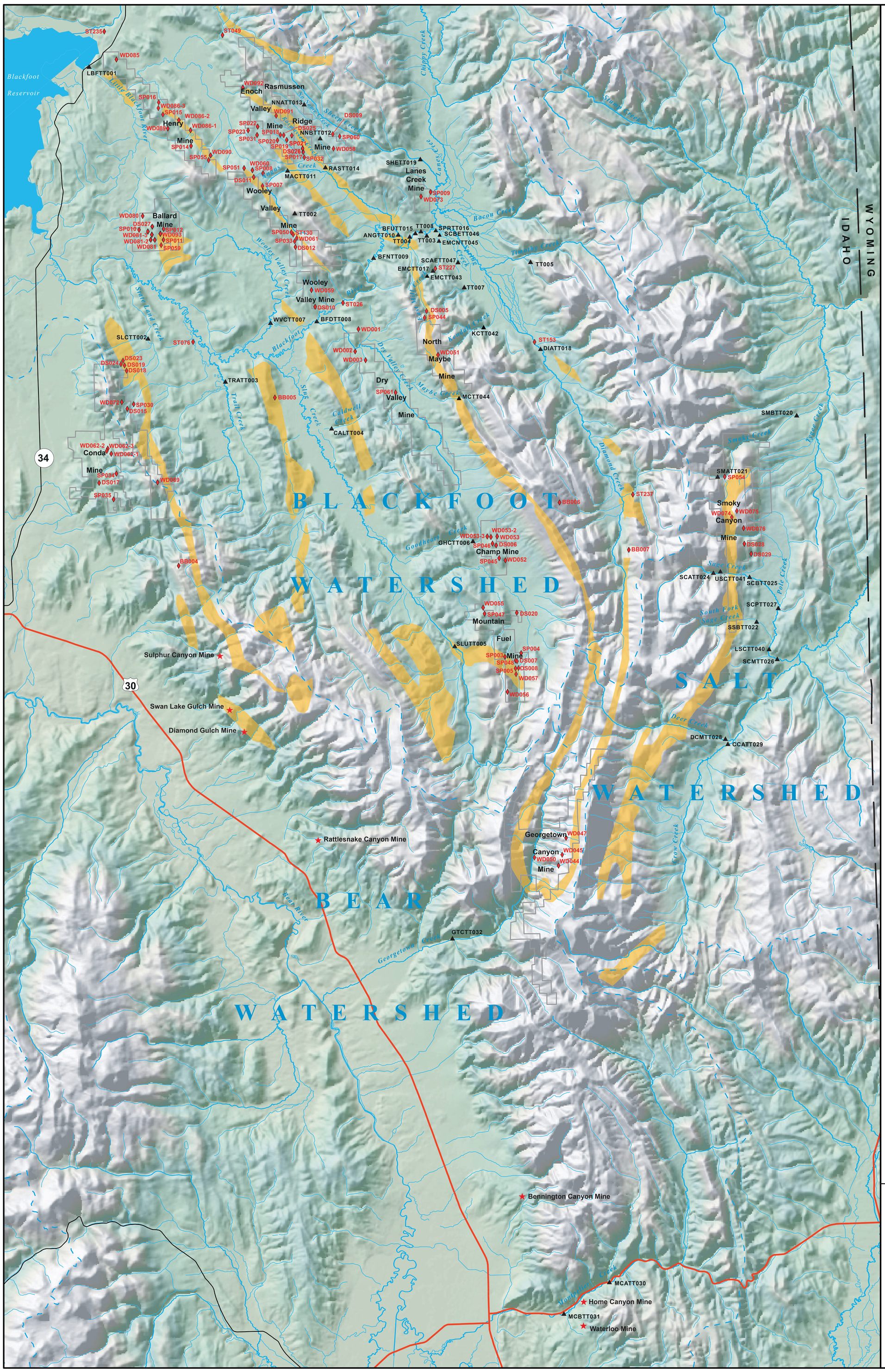
FIGURES



Legend

- Tetra Tech EM Inc. Sample Stations
- MW Sample Stations
- U.S. Highway
- State Highway
- Streams
- Lakes
- Watershed Boundaries
- Orphan Mine Sites
- Mine Areas
- Phosphoria Outcrops (from USGS Open File Report 95-681)

N

0 1 2 3 4 Miles

GIS map by Ed Madej 06/27/02
ID_figure1_datasum067202.ai
Idaho_figure1_datasum062702.mxd

Figure 1

2001 Tetra Tech EM Inc. and Montgomery Watson Area Wide Sampling Locations

Tetra Tech EM Inc.
106 North 6th Street
Suite 202
Boise, Idaho 83702
(208) 343-4085
Fax 343-4756

TABLES

TABLE H-1

SUMMARY OF 2001 TETRA TECH EM INC. SAMPLING EVENTS

Event	Event Dates	Media Sampled			
		Stream Surface Water	Stream Sediment	Riparian Soil and Plant Tissue	Aquatic Plant, Insect, and Fish Tissue
Event 1	5/15 – 5/18/01	X			
Event 2	6/12 – 6/16/01	X	X	X	
Event 3	9/18 – 9/21/01	X	X		
Event 4	7/24 –7/26/01	X	X		X

TABLE H-2

SUMMARY OF 2001 TETRA TECH EM INC. SAMPLING LOCATIONS

Station Identification	Station Name	Watershed	Status	Event 1	Event 2				Event 3		Event 4				
				Surface Water	Surface Water	Sediment	Riparian Plant Tissue	Riparian Soil	Surface Water	Sediment	Surface Water	Sediment	Aquatic Plant Tissue	Aquatic Insect Tissue	Fish Tissue
001	Rasmussen Mine Unit 4 Site (001)	Blackfoot	IMP				X	X							
002	Rasmussen Mine Unit 4 Site (002)	Blackfoot	IMP				X	X							
003	Blackfoot River Wildlife Management Area (003)	Blackfoot	IMP				X	X							
004	Blackfoot River Wildlife Management Area (004)	Blackfoot	IMP				X	X							
005	Lower Mill Creek Canyon	Blackfoot	IMP				X	X							
006	Mill Creek (East)	Blackfoot	IMP				X	X							
007	Diamond Creek	Blackfoot	BG				X	X							
008	Blackfoot River Wildlife Management Area (008)	Blackfoot	IMP				X	X							
009	No Name Creek above mining (009)	Blackfoot	BG				X	X							
010	No Name Creek above mining (010)	Blackfoot	BG				X	X							
011	No Name Creek above mining (011)	Blackfoot	BG				X	X							
LBFTT001	Little Blackfoot River	Blackfoot	IMP	X	X				X						
SLCTT002	Stateland Creek	Blackfoot	IMP	X	X	X			X						
TRATT003	Trail Creek near mouth	Blackfoot	IMP	X	X				X						
CALTT004	Caldwell Creek	Blackfoot	BG	X	X	X			X						
SLUTT005	Slug Creek at U.S. Forest Service boundary	Blackfoot	BG	X	X	X			X						
GHCTT006	Goodheart Creek	Blackfoot	IMP	X	X	X									
WVCTT007	Wooley Valley Creek at Blackfoot River Road	Blackfoot	IMP	X	X				X						
BFDTT008	Blackfoot River above Dry Valley Creek	Blackfoot	IMP	X	X	X			X						
BFNTT009	Blackfoot River above Narrows	Blackfoot	IMP	X	X	X			X						
ANGTT010	Angus Creek (mouth)	Blackfoot	IMP	X	X										
MACTT011	Middle Angus Creek	Blackfoot	IMP	X	X				X						
NNBTT012	No Name Creek below mining	Blackfoot	IMP	X						X					
NNATT013	No Name Creek above mining	Blackfoot	BG	X	X	X									
RASTT014	Rasmussen Creek above Angus Creek	Blackfoot	IMP	X	X				X						
BFUTT015	Blackfoot River at upper bridge	Blackfoot	IMP	X	X	X			X						
SPRTT016	Spring Creek (mouth)	Blackfoot	IMP	X	X	X			X						
EMCTT017	East Mill Creek above split	Blackfoot	IMP	X	X	X			X						
DIATT018	Diamond Creek at U.S. Forest Service boundary	Blackfoot	BG	X	X	X			X						
SHETT019	Sheep Creek	Blackfoot	BG	X	X	X			X						
SMBTT020	Smoky Creek below mining	Salt	IMP	X	X				X						
SMATT021	Smoky Creek above mining	Salt	BG	X	X	X			X						
SSBTT022	South Fork Sage Creek below mining	Salt	IMP	X	X	X			X						
SCATT024	Sage Creek above mining	Salt	BG	X	X	X			X						
SCBTT025	Sage Creek below mining	Salt	IMP	X	X				X						
SCMTT026	Sage Creek near mouth	Salt	IMP	X	X	X			X						

TABLE H-2 (continued)

SUMMARY OF 2001 TETRA TECH EM INC. SAMPLING LOCATIONS

Station Identification	Station Name	Watershed	Status	Event 1	Event 2				Event 3		Event 4				
				Surface Water	Surface Water	Sediment	Riparian Plant Tissue	Riparian Soil	Surface Water	Sediment	Surface Water	Sediment	Aquatic Plant Tissue	Aquatic Insect Tissue	Fish Tissue
SCPTT027	Sage Creek below Pole Creek	Salt	IMP		X	X			X						
DCMTT028	Deer Creek (mouth)	Salt	IMP	X	X				X	X					
CCATT029	Crow Creek above Deer Creek	Salt	BG	X	X	X			X						
MCATT030	Montpelier Creek above mining	Bear	BG	X	X	X			X						
MCBTT031	Montpelier Creek below mining	Bear	IMP	X	X	X			X						
GTCTT032	Georgetown Creek	Bear	IMP	X	X	X			X						
LSCTT040	Lower Sage Creek	Salt	IMP							X	X	X	X	X	X
USCTT041	Upper Sage Creek	Salt	BG							X	X	X	X	X	X
KCTT042	Kendall Creek	Blackfoot	BG							X	X	X	X	X	X
EMCTT043	East Mill Creek	Blackfoot	IMP							X	X	X	X	X	X
MCTT044	Maybe Creek	Blackfoot	IMP							X	X	X		X	
EMCNTT045	East Mill Creek North	Blackfoot	IMP							X	X	X	X		
SCBETT046	Spring Creek below East Mill Creek	Blackfoot	IMP							X	X	X	X	X	X
SCAETT047	Spring Creek above East Mill Creek	Blackfoot	BG							X	X	X	X	X	X

Notes:

IMP Mining-impacted
BG Background

TABLE H-3

LABORATORY ANALYTICAL METHODS FOR 2001 TETRA TECH EM INC. SURFACE WATER SAMPLES

Analyte	University of Idaho Analytical Sciences Laboratory Method	ACZ Laboratories, Inc. Method
Aluminum	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Antimony	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Arsenic	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Barium	EPA 200.7 ICP	EPA 200.7 ICP
Beryllium	EPA 200.7 ICP	EPA 200.8 ICP-MS
Bicarbonate alkalinity	EPA 310.1	SM 2320B
Boron	ICP-Na-Fusion	EPA 200.7 ICP
Cadmium	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Calcium	EPA 200.7 ICP	EPA 200.7 ICP
Carbonate alkalinity	EPA 310.1	SM 2320B
Chloride	EPA 300.0	NA
Chromium	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Copper	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Fluoride	EPA 300.0	NA
Gross alpha	NA	EPA 9310
Gross beta	NA	EPA 9310
Hardness	EPA 130.2	SM 2340B-Calculation
Hydroxide alkalinity	EPA 310.1	NA
Iron	EPA 200.7 ICP	NA
Lead	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Magnesium	EPA 200.7 ICP	EPA 200.7 ICP
Manganese	EPA 200.7 ICP	EPA 200.7 ICP
Mercury	EPA 245.7	EPA 1631 AF
Molybdenum	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Nickel	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Nitrate-N+Nitrite-N	EPA 353.2	NA
pH	EPA 310.1	NA
Potassium	EPA 200.7 ICP	EPA 200.7 ICP
Selenium	ICP-HG	SM 3500-Se C, AA-Hydride
Silver	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Sodium	EPA 200.7 ICP	EPA 200.7 ICP
Sulfate	EPA 300.0	NA
Thallium	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Total alkalinity	EPA 310.1	SM 2320B
Total dissolved solids	EPA 160.1	NA

TABLE H-3 (continued)

LABORATORY ANALYTICAL METHODS FOR 2001 TETRA TECH EM INC. SURFACE WATER SAMPLES

Analyte	University of Idaho Analytical Sciences Laboratory Method	ACZ Laboratories, Inc. Method
Total organic carbon	NA	EPA 415.1 Oxidation/IR
Total phosphorus	EPA 365.4	NA
Total suspended solids	EPA 160.2	NA
Uranium	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Vanadium	EPA 200.8 ICP-MS	EPA 200.8 ICP-MS
Zinc	EPA 200.7 ICP	EPA 200.7 ICP

Notes:

AA	Atomic adsorption
AF	Atomic fluorescence
EPA	U.S. Environmental Protection Agency
ICP	Inductively coupled plasma atomic emission spectrometry
ICP-HG	Inductively coupled plasma-hydride generation
ICP-MS	Inductively coupled plasma-mass spectrometry
IR	Infrared spectrometer
MDL	Method detection limit
Na	Sodium
NA	Not applicable
Se	Selenium
SM	Standard method

TABLE H-4

LABORATORY ANALYTICAL METHODS FOR 2001 TETRA TECH EM INC. SEDIMENT AND RIPARIAN SOIL SAMPLES

Analyte	University of Idaho Analytical Sciences Laboratory Method	ACZ Laboratories, Inc. Method
Aluminum	NA	EPA 3050B/6010B
Antimony	EPA 3050B/6010B	EPA 3050B/6020
Arsenic	EPA 3050B/6010B	EPA 3050B/6020
Barium	EPA 3050B/6010B	EPA 3050B/6010B
Beryllium	EPA 3050B/6010B	EPA 3050B/6020
Boron	Na-Fusion-ICP	EPA 3050B/6010B
Cadmium	EPA 3050B/6010B	EPA 3050B/6020
Chromium	EPA 3050B/6010B	EPA 3050B/6010B
Copper	EPA 3050B/6010B	EPA 3050B/6010B
Fluoride	Na-Fusion-IC	NA
Lead	EPA 3050B/6010B	EPA 3050B/6020
Manganese	EPA 3050B/6010B	EPA 3050B/6010B
Mercury	EPA 245.7	EPA 3051/6020
Molybdenum	EPA 3050B/6010B	EPA 3050B/6010B
Nickel	EPA 3050B/6010B	EPA 3050B/6020
Selenium	ICP-HG	EPA 3050/SM 7742 Modified, AA-Hydride
Silver	EPA 3050B/6010B	EPA 3050B/6020
Sodium	EPA 3050B/6010B	NA
Thallium	EPA 3050B/6010B	EPA 3050B/6020
Uranium	EPA 3050B/6010B	EPA 3050B/6020
Vanadium	EPA 3050B/6010B	EPA 3050B/6010B
Zinc	EPA 3050B/6010B	EPA 3050B/6010B
Paste pH	USDA #60-24	USDA #60-21A
Organic Carbon	Walkley/Black Titrimetric	ASA No.9 29-2.2.4
Particle size distribution	ASA #9 15-4.4.4 Hydrometer	ASTM D 422 Hydrometer

Notes:

AA	Atomic adsorption
ASA	American Society of Agronomy
ASTM	American Society for Testing and Materials
EPA	U.S. Environmental Protection Agency
IC	Ion chromatography
ICP-HG	Inductively coupled plasma-hydride generation
ICP-MS	Inductively coupled plasma-mass spectrometer
Na	Sodium
NA	Not applicable
Se	Selenium
SM	Standard method
USDA	U.S. Department of Agriculture

TABLE H-5

LABORATORY ANALYTICAL METHODS FOR 2001 TETRA TECH EM INC. RIPARIAN PLANT TISSUE SAMPLES

Analyte	University of Idaho Analytical Sciences Laboratory Method
Aluminum	ICP - AES
Antimony	ICP - AES
Arsenic	ICP – AES
Beryllium	ICP – AES
Boron	ICP – AES
Cadmium	ICP – AES
Chromium	ICP – AES
Cobalt	ICP – AES
Copper	ICP – AES
Iron	ICP – AES
Lead	ICP – AES
Manganese	ICP – AES
Mercury	EPA 245.7
Molybdenum	ICP – AES
Nickel	ICP – AES
Selenium	ICP-HG
Silver	ICP – AES
Thallium	ICP – AES
Uranium	ICP – AES
Vanadium	ICP – AES
Zinc	ICP - AES

Notes:

EPA	U.S. Environmental Protection Agency
ICP-AES	Inductively couple plasma-atomic emission spectrometry
ICP-HG	Inductively coupled plasma-hydride generation

TABLE H-6

LABORATORY ANALYTICAL METHODS FOR 2001 TETRA TECH EM INC. AQUATIC PLANT, BENTHIC INVERTEBRATE, AND FISH TISSUE SAMPLES

Analyte	Severn Trent Laboratories, Inc. Method
Aluminum	EPA 3050B/6010B
Antimony	EPA 3050B/6010B
Arsenic	EPA 3050B/6010B
Beryllium	EPA 3050B/6010B
Boron	EPA 3050B/6010B
Cadmium	EPA 3050B/6010B
Chromium	EPA 3050B/6010B
Cobalt	EPA 3050B/6010B
Copper	EPA 3050B/6010B
Iron	EPA 3050B/6010B
Lead	EPA 3050B/6010B
Manganese	EPA 3050B/6010B
Mercury	EPA 7471A[1], ILM04.1[2]
Molybdenum	EPA 3050B/6010B
Nickel	EPA 3050B/6010B
Selenium	EPA 3050B/6010B
Silver	EPA 3050B/6010B
Thallium	EPA 3050B/6010B
Uranium	EPA 3050B/6010B
Vanadium	EPA 3050B/6010B
Zinc	EPA 3050B/6010B
Percent moisture	OLM 03.1

Notes:

EPA U.S. Environmental Protection Agency

[1] EPA Method 7471A used for aquatic plant and fish tissue mercury analyses

[2] Method ILM04.1 used for benthic invertebrate mercury analyses

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
ANGTT010	Angus Creek (mouth)	UNF	130		BDL	U (2.5)	BDL	U (0.5)	23		BDL	U (5)	50		BDL	U (0.13)	5300		BDL	U (0.5)
ANGTT010	Angus Creek (mouth)	F	44		BDL	U (2.5)	BDL	U (0.5)	29		BDL	U (5)	55		BDL	U (0.13)			BDL	U (0.5)
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	490		BDL	U (2.5)	BDL	U (0.5)	68		BDL	U (5)	77		BDL	U (0.13)	2300		BDL	U (0.5)
BFDTT008	Blackfoot River above Dry Valley Creek	F	14		BDL	U (2.5)	BDL	U (0.5)	55		BDL	U (5)	110		BDL	U (0.13)			BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	UNF	190		BDL	U (2.5)	BDL	U (0.5)	69		BDL	U (5)	53		BDL	U (0.13)	1900		BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	F	34		BDL	U (2.5)	BDL	U (0.5)	74		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
BFUTT015	Blackfoot River at upper bridge	UNF	170		BDL	U (2.5)	BDL	U (0.5)	82		BDL	U (5)	96		BDL	U (0.13)	1700		BDL	U (0.5)
BFUTT015	Blackfoot River at upper bridge	F	11		BDL	U (2.5)	BDL	U (0.5)	67		BDL	U (5)	64		BDL	U (0.13)			BDL	U (0.5)
CALTT004	Caldwell Creek	UNF	8100		BDL	U (2.5)	BDL	U (0.5)	180		BDL	U (5)	85		0.65		8100		3.6	
CALTT004	Caldwell Creek	F	20		BDL	U (2.5)	BDL	U (0.5)	84		BDL	U (5)	100		BDL	U (0.13)			BDL	U (0.5)
CALTT004	Caldwell Creek	UNF/S																		
CCATT029	Crow Creek above Deer Creek	UNF	200		BDL	U (2.5)	BDL	U (0.5)	68		BDL	U (5)	95		0.16		160000		BDL	U (0.5)
CCATT029	Crow Creek above Deer Creek	F	22		BDL	U (2.5)	BDL	U (0.5)	58		BDL	U (5)	150		BDL	U (0.13)			BDL	U (0.5)
DCMTT028	Deer Creek (mouth)	UNF	100		BDL	U (2.5)	BDL	U (0.5)	30		BDL	U (5)	72		BDL	U (0.13)	2100		BDL	U (0.5)
DCMTT028	Deer Creek (mouth)	F	37		BDL	U (2.5)	BDL	U (0.5)	22		BDL	U (5)	140		BDL	U (0.13)			BDL	U (0.5)
DIATT018	Diamond Creek at USFS boundary	UNF	45		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	68		0.24		1500		BDL	U (0.5)
DIATT018	Diamond Creek at USFS boundary	F	14		BDL	U (2.5)	BDL	U (0.5)	20		BDL	U (5)	160		BDL	U (0.13)			BDL	U (0.5)
DIATT018	Diamond Creek at USFS boundary	UNF/S																		
EMCTT017	East Mill Creek above split	UNF	140		BDL	U (2.5)	BDL	U (0.5)	25		BDL	U (5)	100		2.3		2100		1.2	
EMCTT017	East Mill Creek above split	F	48		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	51		BDL	U (0.13)			BDL	U (0.5)
EMCTT017	East Mill Creek above split	UNF/DUP	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	120		0.19		2100		BDL	U (0.5)
EMCTT017	East Mill Creek above split	F/DUP	84		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	98		0.24				BDL	U (0.5)
EMCTT017	East Mill Creek above split	UNF/S																		
GHCTT006	Goodheart Creek	UNF	54		BDL	U (2.5)	BDL	U (0.5)	38		BDL	U (5)	74		0.32		3800		BDL	U (0.5)
GHCTT006	Goodheart Creek	F	23		BDL	U (2.5)	BDL	U (0.5)	45		BDL	U (5)	70		0.31				BDL	U (0.5)
GHCTT006	Goodheart Creek	UNF/S																		
GTCTT032	Georgetown Creek	UNF	47		BDL	U (2.5)	BDL	U (0.5)	37		BDL	U (5)	110		BDL	U (0.13)	1300		BDL	U (0.5)
GTCTT032	Georgetown Creek	F	24		BDL	U (2.5)	BDL	U (0.5)	29		BDL	U (5)	100		BDL	U (0.13)			1	
LBFTT001	Little Blackfoot River	UNF	51		BDL	U (2.5)	BDL	U (0.5)	50		BDL	U (5)	65		BDL	U (0.13)	25000		BDL	U (0.5)
LBFTT001	Little Blackfoot River	F	39		BDL	U (2.5)	BDL	U (0.5)	56		BDL	U (5)	140		BDL	U (0.13)			BDL	U (0.5)

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
LBFTT001	Little Blackfoot River	UNF/DUP	40		BDL	U (2.5)	BDL	U (0.5)	50		BDL	U (5)	71		BDL	U (0.13)	20000		BDL	U (0.5)
LBFTT001	Little Blackfoot River	F/DUP	27		BDL	U (2.5)	BDL	U (0.5)	55		BDL	U (5)	71		BDL	U (0.13)			BDL	U (0.5)
MACTT011	Middle Angus Creek	UNF	1600		BDL	U (2.5)	BDL	U (0.5)	38		BDL	U (5)	180		0.17		5900		BDL	U (0.5)
MACTT011	Middle Angus Creek	F	39		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
MACTT011	Middle Angus Creek	UNF/S																		
MCATT030	Montpelier Creek above mining	UNF	76		BDL	U (2.5)	BDL	U (0.5)	56		BDL	U (5)	99		BDL	U (0.13)	6300		BDL	U (0.5)
MCATT030	Montpelier Creek above mining	F	9.8		BDL	U (2.5)	BDL	U (0.5)	46		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
MCATT030	Montpelier Creek above mining	UNF/S																		
MCBTT031	Montpelier Creek below mining	UNF	62		BDL	U (2.5)	BDL	U (0.5)	53		BDL	U (5)	89		BDL	U (0.13)	7200		BDL	U (0.5)
MCBTT031	Montpelier Creek below mining	F	15		BDL	U (2.5)	BDL	U (0.5)	46		BDL	U (5)	180		BDL	U (0.13)			BDL	U (0.5)
NNATT013	No Name Creek above mining	UNF	1800		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	49		0.31		1500		5.8	
NNATT013	No Name Creek above mining	F	950		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	120		0.64				15	
NNATT013	No Name Creek above mining	UNF/S																		
NNBTT012	No Name Creek below mining	UNF	200		BDL	U (2.5)	BDL	U (0.5)	31		BDL	U (5)	98		0.2		15000		BDL	U (0.5)
NNBTT012	No Name Creek below mining	F	27		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	130		BDL	U (0.13)			BDL	U (0.5)
RASTT014	Rasmussen Creek above Angus Creek	UNF	670		BDL	U (2.5)	BDL	U (0.5)	42		BDL	U (5)	58		BDL	U (0.13)	7300		1.4	
RASTT014	Rasmussen Creek above Angus Creek	F	38		BDL	U (2.5)	BDL	U (0.5)	39		BDL	U (5)	85		BDL	U (0.13)			BDL	U (0.5)
SCATT024	Sage Creek above mining	UNF	40		BDL	U (2.5)	BDL	U (0.5)	25		BDL	U (5)	100		BDL	U (0.13)	900		BDL	U (0.5)
SCATT024	Sage Creek above mining	F	16		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	52		BDL	U (0.13)			BDL	U (0.5)
SCATT024	Sage Creek above mining	UNF/S																		
SCBTT025	Sage Creek below mining	UNF	70		BDL	U (2.5)	BDL	U (0.5)	26		BDL	U (5)	120		0.23		920		BDL	U (0.5)
SCBTT025	Sage Creek below mining	F	22		BDL	U (2.5)	BDL	U (0.5)	30		BDL	U (5)	48		0.16				BDL	U (0.5)
SCMTT026	Sage Creek (mouth)	UNF	100		BDL	U (2.5)	BDL	U (0.5)	36		BDL	U (5)	90		BDL	U (0.13)	6700		BDL	U (0.5)
SCMTT026	Sage Creek (mouth)	F	31		BDL	U (2.5)	BDL	U (0.5)	42		BDL	U (5)	96		BDL	U (0.13)			BDL	U (0.5)
SHETT019	Sheep Creek	UNF	440		BDL	U (2.5)	BDL	U (0.5)	62		BDL	U (5)	79		BDL	U (0.13)	1800		0.57	
SHETT019	Sheep Creek	F	45		BDL	U (2.5)	BDL	U (0.5)	67		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
SHETT019	Sheep Creek	UNF/S																		
SLCTT002	Stateland Creek	UNF	250		BDL	U (2.5)	BDL	U (0.5)	29		BDL	U (5)	49		BDL	U (0.13)	4700		1.2	
SLCTT002	Stateland Creek	F	41		BDL	U (2.5)	BDL	U (0.5)	36		BDL	U (5)	72		BDL	U (0.13)			BDL	U (0.5)
SLUTT005	Slug Creek at USFS boundary	UNF	490		BDL	U (2.5)	BDL	U (0.5)	89		BDL	U (5)	60		0.13		4100		BDL	U (0.5)

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SLUTT005	Slug Creek at USFS boundary	F	15		BDL	U (2.5)	BDL	U (0.5)	74		BDL	U (5)	130		BDL	U (0.13)			BDL	U (0.5)
SLUTT005	Slug Creek at USFS boundary	UNF/S																		
SMATT021	Smoky Creek above mining	UNF	71		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	57		BDL	U (0.13)	1300		BDL	U (0.5)
SMATT021	Smoky Creek above mining	F	12		BDL	U (2.5)	BDL	U (0.5)	20		BDL	U (5)	110		0.16				BDL	U (0.5)
SMATT021	Smoky Creek above mining	UNF/S																		
SMBTT020	Smoky Creek below mining	UNF	1500		BDL	U (2.5)	BDL	U (0.5)	42		BDL	U (5)	110		0.27		9300		1.1	
SMBTT020	Smoky Creek below mining	F	17		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	UNF	260		BDL	U (2.5)	BDL	U (0.5)	34		BDL	U (5)	110		BDL	U (0.13)	1600		1.9	
SPRTT016	Spring Creek (mouth)	F	13		BDL	U (2.5)	BDL	U (0.5)	35		BDL	U (5)	35		BDL	U (0.13)			BDL	U (0.5)
SSBTT022	South Fork Sage Creek below mining	UNF	17		BDL	U (2.5)	BDL	U (0.5)	38		BDL	U (5)	110		BDL	U (0.13)	4200		BDL	U (0.5)
SSBTT022	South Fork Sage Creek below mining	F	39		BDL	U (2.5)	BDL	U (0.5)	48		BDL	U (5)	88		BDL	U (0.13)			BDL	U (0.5)
SSBTT022	South Fork Sage Creek below mining	UNF/DUP	14		BDL	U (2.5)	BDL	U (0.5)	38		BDL	U (5)	110		BDL	U (0.13)	4200		0.94	
SSBTT022	South Fork Sage Creek below mining	F/DUP	18		BDL	U (2.5)	BDL	U (0.5)	45		BDL	U (5)	48		BDL	U (0.13)			BDL	U (0.5)
TRATT003	Trail Creek near mouth	UNF	87		BDL	U (2.5)	BDL	U (0.5)	62		BDL	U (5)	48		BDL	U (0.13)	7900		BDL	U (0.5)
TRATT003	Trail Creek near mouth	F	15		BDL	U (2.5)	BDL	U (0.5)	53		BDL	U (5)	100		BDL	U (0.13)			BDL	U (0.5)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	51		BDL	U (2.5)	BDL	U (0.5)	41		BDL	U (5)	120		BDL	U (0.13)	4100		BDL	U (0.5)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	16		BDL	U (2.5)	BDL	U (0.5)	33		BDL	U (5)	75		BDL	U (0.13)			1.6	

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
ANGTT010	Angus Creek (mouth)	UNF	0.97		120		280		0.29		9100		50		BDL	U (0.5)	BDL	U (2.5)	0.99	
ANGTT010	Angus Creek (mouth)	F	0.92				55		BDL	U (0.25)	10000		38				BDL	U (2.5)	0.15	
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	0.46		100		360		0.39		11000		68		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
BFDTT008	Blackfoot River above Dry Valley Creek	F	0.6				19		BDL	U (0.25)	10000		27				BDL	U (2.5)	0.43	
BFNTT009	Blackfoot River above Narrows	UNF	0.63		BDL	U (100)	240		0.31		10000		39		BDL	U (0.5)	BDL	U (2.5)	1.7	

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
BFNTT009	Blackfoot River above Narrows	F	0.45				24		BDL	U (0.25)	11000		37				BDL	U (2.5)	BDL	U (0.13)
BFUTT015	Blackfoot River at upper bridge	UNF	0.26		BDL	U (100)	220		BDL	U (0.25)	12000		40		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
BFUTT015	Blackfoot River at upper bridge	F	0.51				BDL	U (10)	BDL	U (0.25)	10000		24				BDL	U (2.5)	1.2	
CALTT004	Caldwell Creek	UNF	2.7		140		6300		4.2		15000		310		BDL	U (0.5)	BDL	U (2.5)	4	
CALTT004	Caldwell Creek	F	0.75				BDL	U (10)	BDL	U (0.25)	12000		31				BDL	U (2.5)	0.93	
CALTT004	Caldwell Creek	UNF/S													0.0086					
CCATT029	Crow Creek above Deer Creek	UNF	1.2		130		320		0.66		16000		39		BDL	U (0.5)	BDL	U (2.5)	1.5	
CCATT029	Crow Creek above Deer Creek	F	0.53				38		BDL	U (0.25)	16000		18				BDL	U (2.5)	0.37	
DCMTT028	Deer Creek (mouth)	UNF	0.68		110		200		BDL	U (0.25)	17000		38		BDL	U (0.5)	BDL	U (2.5)	0.41	
DCMTT028	Deer Creek (mouth)	F	0.54				50		0.43		16000		16				BDL	U (2.5)	0.65	
DIATT018	Diamond Creek at USFS boundary	UNF	BDL	U (0.13)	BDL	U (100)	67		BDL	U (0.25)	13000		14		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
DIATT018	Diamond Creek at USFS boundary	F	0.29				15		BDL	U (0.25)	12000		6.8				BDL	U (2.5)	0.26	
DIATT018	Diamond Creek at USFS boundary	UNF/S													0.0015					
EMCTT017	East Mill Creek above split	UNF	0.74		BDL	U (100)	240		26		14000		19		BDL	U (0.5)	BDL	U (2.5)	1.3	
EMCTT017	East Mill Creek above split	F	0.15				BDL	U (10)	BDL	U (0.25)	15000		4.9				BDL	U (2.5)	BDL	U (0.13)
EMCTT017	East Mill Creek above split	UNF/DUP	BDL	U (0.13)	BDL	U (100)	190		0.33		14000		18		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
EMCTT017	East Mill Creek above split	F/DUP	0.27				BDL	U (10)	0.41		14000		4.4				BDL	U (2.5)	BDL	U (0.13)
EMCTT017	East Mill Creek above split	UNF/S													0.0034					
GHCTT006	Goodheart Creek	UNF	1.1		200		480		0.51		23000		200		BDL	U (0.5)	4		9	
GHCTT006	Goodheart Creek	F	0.92				77		0.45		25000		200				3.1		10	
GHCTT006	Goodheart Creek	UNF/S													0.0029					
GTCTT032	Georgetown Creek	UNF	BDL	U (0.13)	160		28		BDL	U (0.25)	17000		4.5		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
GTCTT032	Georgetown Creek	F	1.1				BDL	U (10)	BDL	U (0.25)	15000		BDL	U (2)			BDL	U (2.5)	2	
LBFTT001	Little Blackfoot River	UNF	0.92		480		52		BDL	U (0.25)	32000		BDL	U (2)	BDL	U (0.5)	BDL	U (2.5)	1.5	
LBFTT001	Little Blackfoot River	F	0.25				BDL	U (10)	BDL	U (0.25)	33000		5.7				BDL	U (2.5)	2.2	
LBFTT001	Little Blackfoot River	UNF/DUP	0.66		490		58		BDL	U (0.25)	28000		BDL	U (2)	BDL	U (0.5)	BDL	U (2.5)	1.7	
LBFTT001	Little Blackfoot River	F/DUP	0.21				BDL	U (10)	BDL	U (0.25)	35000		6.6				BDL	U (2.5)	0.74	
MACTT011	Middle Angus Creek	UNF	1.7		130		1200		1.2		12000		220		BDL	U (0.5)	BDL	U (2.5)	1.4	
MACTT011	Middle Angus Creek	F	0.71				BDL	U (10)	BDL	U (0.25)	16000		35				BDL	U (2.5)	0.78	
MACTT011	Middle Angus Creek	UNF/S													0.0045					

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
MCATT030	Montpelier Creek above mining	UNF	0.21		120		96		BDL	U (0.25)	19000		13		BDL	U (0.5)	BDL	U (2.5)	2.2	
MCATT030	Montpelier Creek above mining	F	0.5				17		BDL	U (0.25)	18000		2.7				BDL	U (2.5)	0.33	
MCATT030	Montpelier Creek above mining	UNF/S													0.0018					
MCBTT031	Montpelier Creek below mining	UNF	0.32		200		82		1.1		24000		14		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
MCBTT031	Montpelier Creek below mining	F	0.85				48		BDL	U (0.25)	22000		4.6				BDL	U (2.5)	0.58	
NNATT013	No Name Creek above mining	UNF	1.2		120		1000		0.6		3400		33		BDL	U (0.5)	BDL	U (2.5)	1.4	
NNATT013	No Name Creek above mining	F	73				1600		5.3		3100		31				BDL	U (2.5)	5.6	
NNATT013	No Name Creek above mining	UNF/S													0.0072					
NNBTT012	No Name Creek below mining	UNF	1.5		120		59		0.54		11000		32		BDL	U (0.5)	BDL	U (2.5)	1.6	
NNBTT012	No Name Creek below mining	F	0.84				24		BDL	U (0.25)	10000		16				BDL	U (2.5)	1.8	
RASTT014	Rasmussen Creek above Angus Creek	UNF	0.77		BDL	U (100)	860		0.73		10000		71		BDL	U (0.5)	BDL	U (2.5)	1.3	
RASTT014	Rasmussen Creek above Angus Creek	F	BDL	U (0.13)			27		BDL	U (0.25)	11000		38				BDL	U (2.5)	0.43	
SCATT024	Sage Creek above mining	UNF	0.25		BDL	U (100)	64		BDL	U (0.25)	11000		44		BDL	U (0.5)	BDL	U (2.5)	0.32	
SCATT024	Sage Creek above mining	F	BDL	U (0.13)			18		BDL	U (0.25)	13000		2.9				BDL	U (2.5)	BDL	U (0.13)
SCATT024	Sage Creek above mining	UNF/S													0.0018					
SCBTT025	Sage Creek below mining	UNF	1.4		BDL	U (100)	98		0.29		12000		25		BDL	U (0.5)	BDL	U (2.5)	1.1	
SCBTT025	Sage Creek below mining	F	1.1				12		0.45		13000		16				BDL	U (2.5)	0.41	
SCMTT026	Sage Creek (mouth)	UNF	0.47		310		160		BDL	U (0.25)	20000		16		BDL	U (0.5)	BDL	U (2.5)	0.44	
SCMTT026	Sage Creek (mouth)	F	BDL	U (0.13)			16		BDL	U (0.25)	20000		10				BDL	U (2.5)	BDL	U (0.13)
SHETT019	Sheep Creek	UNF	0.82		BDL	U (100)	540		0.43		12000		22		BDL	U (0.5)	BDL	U (2.5)	2.8	
SHETT019	Sheep Creek	F	5.9				17		BDL	U (0.25)	13000		12				BDL	U (2.5)	1	
SHETT019	Sheep Creek	UNF/S													0.0028					
SLCTT002	Stateland Creek	UNF	0.9		160		320		0.65		10000		19		BDL	U (0.5)	BDL	U (2.5)	1.6	
SLCTT002	Stateland Creek	F	BDL	U (0.13)			19		0.34		11000		18				BDL	U (2.5)	BDL	U (0.13)
SLUTT005	Slug Creek at USFS boundary	UNF	0.26		280		430		BDL	U (0.25)	14000		50		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
SLUTT005	Slug Creek at USFS boundary	F	0.5				15		BDL	U (0.25)	13000		21				BDL	U (2.5)	0.65	
SLUTT005	Slug Creek at USFS boundary	UNF/S													0.0027					
SMATT021	Smoky Creek above mining	UNF	0.22		100		80		BDL	U (0.25)	17000		13		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
SMATT021	Smoky Creek above mining	F	0.69				BDL	U (10)	0.38		16000		BDL	U (2)			BDL	U (2.5)	0.42	
SMATT021	Smoky Creek above mining	UNF/S													0.0013					

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SMBTT020	Smoky Creek below mining	UNF	1.2		130		1900		0.96		16000		200		BDL	U (0.5)	BDL	U (2.5)	0.89	
SMBTT020	Smoky Creek below mining	F	0.46				28		BDL	U (0.25)	15000		46				BDL	U (2.5)	0.41	
SPRTT016	Spring Creek (mouth)	UNF	15		BDL	U (100)	410		0.54		11000		29		BDL	U (0.5)	BDL	U (2.5)	1.2	
SPRTT016	Spring Creek (mouth)	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	11000		17				BDL	U (2.5)	BDL	U (0.13)
SSBTT022	South Fork Sage Creek below mining	UNF	0.26		300		BDL	U (10)	BDL	U (0.25)	20000		BDL	U (2)	BDL	U (0.5)	BDL	U (2.5)	0.51	
SSBTT022	South Fork Sage Creek below mining	F	0.29				BDL	U (10)	BDL	U (0.25)	20000		3.4				BDL	U (2.5)	BDL	U (0.13)
SSBTT022	South Fork Sage Creek below mining	UNF/DUP	0.37		290		130		BDL	U (0.25)	20000		BDL	U (2)	BDL	U (0.5)	BDL	U (2.5)	2.2	
SSBTT022	South Fork Sage Creek below mining	F/DUP	BDL	U (0.13)			BDL	U (10)	0.66		20000		3.8				BDL	U (2.5)	BDL	U (0.13)
TRATT003	Trail Creek near mouth	UNF	0.37		140		210		0.26		12000		62		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
TRATT003	Trail Creek near mouth	F	0.65				40		BDL	U (0.25)	11000		49				BDL	U (2.5)	0.59	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	0.15		170		290		BDL	U (0.25)	16000		210		BDL	U (0.5)	BDL	U (2.5)	BDL	U (0.13)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	0.47				44		BDL	U (0.25)	14000		200				BDL	U (2.5)	1.7	

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Nitrate		Potassium		Selenium		Silver		Sodium		Sulfate		Thallium		Uranium		Vanadium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
ANGTT010	Angus Creek (mouth)	UNF	BDL	U (100)	1200		BDL	U (1)	BDL	U (0.25)	4800		23000		BDL	U (2.5)	0.48		1	
ANGTT010	Angus Creek (mouth)	F			1300		BDL	U (1)	BDL	U (0.25)	5800				BDL	U (2.5)	0.45		1.2	
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	BDL	U (100)	920		2.1		BDL	U (0.25)	3400		11000		BDL	U (2.5)	0.46		BDL	U (0.25)
BFDTT008	Blackfoot River above Dry Valley Creek	F			680		2.6		BDL	U (0.25)	3800				BDL	U (2.5)	0.47		0.49	
BFNTT009	Blackfoot River above Narrows	UNF	BDL	U (100)	760		1.6		BDL	U (0.25)	3900		10000		BDL	U (2.5)	0.56		1.5	
BFNTT009	Blackfoot River above Narrows	F			820		1.6		BDL	U (0.25)	4600				BDL	U (2.5)	0.5		1.4	
BFUTT015	Blackfoot River at upper bridge	UNF	BDL	U (100)	720		2.5		BDL	U (0.25)	5100		10000		BDL	U (2.5)	0.51		0.56	
BFUTT015	Blackfoot River at upper bridge	F			610		2.4		BDL	U (0.25)	3700				BDL	U (2.5)	0.5		0.74	
CALTT004	Caldwell Creek	UNF	BDL	U (100)	3300		BDL	U (1)	BDL	U (0.25)	6800		20000		BDL	U (2.5)	1.1		8.1	
CALTT004	Caldwell Creek	F			1500		BDL	U (1)	BDL	U (0.25)	7600				BDL	U (2.5)	0.93		1.2	

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Nitrate		Potassium		Selenium		Silver		Sodium		Sulfate		Thallium		Uranium		Vanadium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
CALTT004	Caldwell Creek	UNF/S																		
CCATT029	Crow Creek above Deer Creek	UNF	BDL	U (100)	940		BDL	U (1)	BDL	U (0.25)	100000		24000		BDL	U (2.5)	0.96		2.3	
CCATT029	Crow Creek above Deer Creek	F			850		BDL	U (1)	BDL	U (0.25)	100000				BDL	U (2.5)	1		2.5	
DCMTT028	Deer Creek (mouth)	UNF	BDL	U (100)	800		1.2		BDL	U (0.25)	BDL	U (2000)	6800		BDL	U (2.5)	1		2.9	
DCMTT028	Deer Creek (mouth)	F			670		BDL	U (1)	BDL	U (0.25)	2900				BDL	U (2.5)	1.1		2.2	
DIATT018	Diamond Creek at USFS boundary	UNF	BDL	U (100)	530		BDL	U (1)	BDL	U (0.25)	3400		11000		BDL	U (2.5)	0.79		1.3	
DIATT018	Diamond Creek at USFS boundary	F			BDL	U (500)	BDL	U (1)	BDL	U (0.25)	3200				BDL	U (2.5)	0.61		0.59	
DIATT018	Diamond Creek at USFS boundary	UNF/S																		
EMCTT017	East Mill Creek above split	UNF	490		580		130		BDL	U (0.25)	4300		34000		BDL	U (2.5)	0.55		1.8	
EMCTT017	East Mill Creek above split	F			560		170		BDL	U (0.25)	4300				BDL	U (2.5)	0.45		0.86	
EMCTT017	East Mill Creek above split	UNF/DUP	570		600		160		BDL	U (0.25)	4300		33000		BDL	U (2.5)	0.24		0.4	
EMCTT017	East Mill Creek above split	F/DUP			BDL	U (500)	190		BDL	U (0.25)	4600				BDL	U (2.5)	0.7		1	
EMCTT017	East Mill Creek above split	UNF/S																		
GHCTT006	Goodheart Creek	UNF	BDL	U (100)	1200		3.2		BDL	U (0.25)	8600		92000		BDL	U (2.5)	2.2		1.7	
GHCTT006	Goodheart Creek	F			1400		2.4		0.45		10000				BDL	U (2.5)	2.2		2.4	
GHCTT006	Goodheart Creek	UNF/S																		
GTCTT032	Georgetown Creek	UNF	190		600		1.9		BDL	U (0.25)	2500		29000		BDL	U (2.5)	1.1		1	
GTCTT032	Georgetown Creek	F			530		2		BDL	U (0.25)	2800				BDL	U (2.5)	1.1		1	
LBFTT001	Little Blackfoot River	UNF	BDL	U (100)	2200		BDL	U (1)	BDL	U (0.25)	20000		53000		BDL	U (2.5)	1.9		1.3	
LBFTT001	Little Blackfoot River	F			2300		BDL	U (1)	BDL	U (0.25)	20000				BDL	U (2.5)	1.7		1.4	
LBFTT001	Little Blackfoot River	UNF/DUP	BDL	U (100)	2200		BDL	U (1)	BDL	U (0.25)	21000		45000		BDL	U (2.5)	1.8		0.86	
LBFTT001	Little Blackfoot River	F/DUP			2300		BDL	U (1)	BDL	U (0.25)	21000				BDL	U (2.5)	1.7		1.4	
MACTT011	Middle Angus Creek	UNF	BDL	U (100)	1100		BDL	U (1)	BDL	U (0.25)	6400		73000		3.1		0.79		2	
MACTT011	Middle Angus Creek	F			1100		BDL	U (1)	BDL	U (0.25)	5500				BDL	U (2.5)	0.89		0.66	
MACTT011	Middle Angus Creek	UNF/S																		
MCATT030	Montpelier Creek above mining	UNF	BDL	U (100)	1100		BDL	U (1)	BDL	U (0.25)	8200		56000		BDL	U (2.5)	0.56		2.4	
MCATT030	Montpelier Creek above mining	F			1000		BDL	U (1)	BDL	U (0.25)	7600				BDL	U (2.5)	0.61		1.2	
MCATT030	Montpelier Creek above mining	UNF/S																		
MCBTT031	Montpelier Creek below mining	UNF	BDL	U (100)	1100		1.3		BDL	U (0.25)	8800		92000		BDL	U (2.5)	0.7		1.5	

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Nitrate		Potassium		Selenium		Silver		Sodium		Sulfate		Thallium		Uranium		Vanadium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
MCBTT031	Montpelier Creek below mining	F			1000		1.3		BDL	U (0.25)	8300				BDL	U (2.5)	0.71		0.88	
NNATT013	No Name Creek above mining	UNF	BDL	U (100)	1000		BDL	U (1)	BDL	U (0.25)	3300		4500		BDL	U (2.5)	0.26		4	
NNATT013	No Name Creek above mining	F			740		BDL	U (1)	BDL	U (0.25)	3300				BDL	U (2.5)	0.31		3.8	
NNATT013	No Name Creek above mining	UNF/S																		
NNBTT012	No Name Creek below mining	UNF	BDL	U (100)	1200		1.7		1.1		7000		82000		BDL	U (2.5)	0.21		1.4	
NNBTT012	No Name Creek below mining	F			1100		2.3		BDL	U (0.25)	7200				BDL	U (2.5)	0.2		0.79	
RASTT014	Rasmussen Creek above Angus Creek	UNF	110		800		BDL	U (1)	BDL	U (0.25)	5000		14000		BDL	U (2.5)	0.55		2.3	
RASTT014	Rasmussen Creek above Angus Creek	F			590		1		BDL	U (0.25)	5400				BDL	U (2.5)	0.46		0.92	
SCATT024	Sage Creek above mining	UNF	BDL	U (100)	BDL	U (500)	BDL	U (1)	BDL	U (0.25)	3100		13000		BDL	U (2.5)	0.44		1.1	
SCATT024	Sage Creek above mining	F			540		BDL	U (1)	BDL	U (0.25)	2200				BDL	U (2.5)	0.43		BDL	U (0.25)
SCATT024	Sage Creek above mining	UNF/S																		
SCBTT025	Sage Creek below mining	UNF	BDL	U (100)	530		BDL	U (1)	BDL	U (0.25)	2800		19000		BDL	U (2.5)	0.5		0.57	
SCBTT025	Sage Creek below mining	F			580		BDL	U (1)	BDL	U (0.25)	BDL	U (2000)			BDL	U (2.5)	0.44		0.38	
SCMTT026	Sage Creek (mouth)	UNF	BDL	U (100)	600		3.2		BDL	U (0.25)	7200		30000		BDL	U (2.5)	1.6		2	
SCMTT026	Sage Creek (mouth)	F			650		2.5		BDL	U (0.25)	7500				BDL	U (2.5)	1.5		2.9	
SHETT019	Sheep Creek	UNF	BDL	U (100)	720		BDL	U (1)	BDL	U (0.25)	3700		24000		BDL	U (2.5)	0.49		1.4	
SHETT019	Sheep Creek	F			660		BDL	U (1)	BDL	U (0.25)	3800				BDL	U (2.5)	0.41		0.53	
SHETT019	Sheep Creek	UNF/S																		
SLCTT002	Stateland Creek	UNF	BDL	U (100)	770		2.5		BDL	U (0.25)	5800		16000		BDL	U (2.5)	0.85		3.6	
SLCTT002	Stateland Creek	F			770		2.2		BDL	U (0.25)	6200				BDL	U (2.5)	0.73		3.9	
SLUTT005	Slug Creek at USFS boundary	UNF	BDL	U (100)	2800		BDL	U (1)	BDL	U (0.25)	5700		4700		BDL	U (2.5)	1.1		3	
SLUTT005	Slug Creek at USFS boundary	F			2700		BDL	U (1)	BDL	U (0.25)	5800				BDL	U (2.5)	1.2		2.1	
SLUTT005	Slug Creek at USFS boundary	UNF/S																		
SMATT021	Smoky Creek above mining	UNF	BDL	U (100)	640		BDL	U (1)	BDL	U (0.25)	4000		16000		BDL	U (2.5)	0.33		BDL	U (0.25)
SMATT021	Smoky Creek above mining	F			750		BDL	U (1)	BDL	U (0.25)	3800				BDL	U (2.5)	0.45		0.71	
SMATT021	Smoky Creek above mining	UNF/S																		
SMBTT020	Smoky Creek below mining	UNF	BDL	U (100)	1400		BDL	U (1)	BDL	U (0.25)	6200		16000		BDL	U (2.5)	0.67		4.6	
SMBTT020	Smoky Creek below mining	F			910		BDL	U (1)	BDL	U (0.25)	6000				BDL	U (2.5)	0.55		1	
SPRTT016	Spring Creek (mouth)	UNF	BDL	U (100)	BDL	U (500)	13		BDL	U (0.25)	3900		10000		BDL	U (2.5)	0.46		1.1	

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Nitrate		Potassium		Selenium		Silver		Sodium		Sulfate		Thallium		Uranium		Vanadium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SPRTT016	Spring Creek (mouth)	F			BDL	U (500)	13		BDL	U (0.25)	4200				BDL	U (2.5)	0.39		BDL	U (0.25)
SSBTT022	South Fork Sage Creek below mining	UNF	110		650		BDL	U (1)	BDL	U (0.25)	4900		13000		BDL	U (2.5)	1.9		0.84	
SSBTT022	South Fork Sage Creek below mining	F			720		1.4		BDL	U (0.25)	5700				BDL	U (2.5)	1.9		1.9	
SSBTT022	South Fork Sage Creek below mining	UNF/DUP	110		630		BDL	U (1)	BDL	U (0.25)	4600		13000		BDL	U (2.5)	1.9		1.1	
SSBTT022	South Fork Sage Creek below mining	F/DUP			630		1.2		0.56		4100				BDL	U (2.5)	1.9		1.2	
TRATT003	Trail Creek near mouth	UNF	BDL	U (100)	790		BDL	U (1)	BDL	U (0.25)	6300		13000		BDL	U (2.5)	0.48		1.3	
TRATT003	Trail Creek near mouth	F			730		BDL	U (1)	BDL	U (0.25)	6100				BDL	U (2.5)	0.51		1	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	BDL	U (100)	880		BDL	U (1)	0.35		6600		10000		BDL	U (2.5)	1.4		1.2	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F			840		BDL	U (1)	BDL	U (0.25)	6800				BDL	U (2.5)	1.4		1.3	

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Total Alkalinity		Total Organic Carbon		Gross Alpha Radiation		Gross Beta Radiation		Total Dissolved Solids	
			(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
ANGTT010	Angus Creek (mouth)	UNF	63		150						150		10		0 +/- 1.9		4.4 +/- 3.1		230	
ANGTT010	Angus Creek (mouth)	F	BDL	U (10)					176											
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	12		170		9				180		2	BS	4.1 +/- 2.9		5.9 +/- 3.2		190	
BFDTT008	Blackfoot River above Dry Valley Creek	F	87						166											
BFNTT009	Blackfoot River above Narrows	UNF	54		170		14				180		3	BS	0.17 +/- 2		0.24 +/- 3.2		230	
BFNTT009	Blackfoot River above Narrows	F	BDL	U (10)					190											
BFUTT015	Blackfoot River at upper bridge	UNF	BDL	U (10)	190						190		5	B	5 +/- 3.2		8.4 +/- 3.6		220	
BFUTT015	Blackfoot River at upper bridge	F	130						174											
CALTT004	Caldwell Creek	UNF	54		170		13				180		3	BS	2.6 +/- 3.2		3 +/- 2.8		240	

TABLE H-7

TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Total Alkalinity		Total Organic Carbon		Gross Alpha Radiation		Gross Beta Radiation		Total Dissolved Solids	
			(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
CALTT004	Caldwell Creek	F	110						197											
CALTT004	Caldwell Creek	UNF/S																		
CCATT029	Crow Creek above Deer Creek	UNF	BDL	U (10)	190		9				200		4	B	3.7 +/- 3.3		4.6 +/- 3.3		520	
CCATT029	Crow Creek above Deer Creek	F	66						218											
DCMTT028	Deer Creek (mouth)	UNF	11		200		BDL	U (3)			200		5		2.7 +/- 3		1.6 +/- 3.3		210	
DCMTT028	Deer Creek (mouth)	F	94						191											
DIATT018	Diamond Creek at USFS boundary	UNF	12		190						190		BDL	US (1)	1.2 +/- 2.3		0.88 +/- 3.2		230	
DIATT018	Diamond Creek at USFS boundary	F	46						182											
DIATT018	Diamond Creek at USFS boundary	UNF/S																		
EMCTT017	East Mill Creek above split	UNF	69		170		5				180		3	B	2.1 +/- 2.7		0 +/- 2.9		250	
EMCTT017	East Mill Creek above split	F	BDL	U (10)					217											
EMCTT017	East Mill Creek above split	UNF/DUP	76		180		6				190		BDL	US (1)	0 +/- 1.9		1.9 +/- 3		260	
EMCTT017	East Mill Creek above split	F/DUP	BDL	U (10)					212											
EMCTT017	East Mill Creek above split	UNF/S																		
GHCTT006	Goodheart Creek	UNF	94		250						250		9	S	2.2 +/- 3		2.4 +/- 3.1		450	
GHCTT006	Goodheart Creek	F	12						353											
GHCTT006	Goodheart Creek	UNF/S																		
GTCTT032	Georgetown Creek	UNF	10		190						190		1	B	0 +/- 2.3		2.2 +/- 2.7		230	
GTCTT032	Georgetown Creek	F	89						194											
LBFTT001	Little Blackfoot River	UNF	120		400						400		1	B	1.4 +/- 3.2		0 +/- 3.4		520	
LBFTT001	Little Blackfoot River	F	15						436											
LBFTT001	Little Blackfoot River	UNF/DUP	71		400						400		2	B	0.11 +/- 2.9		6.6 +/- 3.6		520	
LBFTT001	Little Blackfoot River	F/DUP	14						444											
MACTT011	Middle Angus Creek	UNF	10		160		4				170		3	BS	4.4 +/- 3.1		3.1 +/- 2.9		290	
MACTT011	Middle Angus Creek	F	BDL	U (10)					201											

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TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Total Alkalinity		Total Organic Carbon		Gross Alpha Radiation		Gross Beta Radiation		Total Dissolved Solids	
			(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
MACTT011	Middle Angus Creek	UNF/S																		
MCATT030	Montpelier Creek above mining	UNF	BDL	U (10)	160		9				170		BDL	US (1)	2.1 +/- 2.6		0.18 +/- 2.9		290	
MCATT030	Montpelier Creek above mining	F	66						206											
MCATT030	Montpelier Creek above mining	UNF/S																		
MCBTT031	Montpelier Creek below mining	UNF	11		180		9				190		3	B	4.1 +/- 3.3		2.4 +/- 2.9		380	
MCBTT031	Montpelier Creek below mining	F	67						265											
NNATT013	No Name Creek above mining	UNF	17		63						63		5	BS	1.2 +/- 1.7		2 +/- 2.9		140	
NNATT013	No Name Creek above mining	F	160						58											
NNATT013	No Name Creek above mining	UNF/S																		
NNBTT012	No Name Creek below mining	UNF	16		82						82		3	BS	0 +/- 2.2		0.54 +/- 2.6		310	
NNBTT012	No Name Creek below mining	F	82						166											
RASTT014	Rasmussen Creek above Angus Creek	UNF	83		170						170		3	B	0.84 +/- 2.2		0 +/- 3.1		220	
RASTT014	Rasmussen Creek above Angus Creek	F	BDL	U (10)					180											
SCATT024	Sage Creek above mining	UNF	59		170		4				180		1	B	0 +/- 2.2		4 +/- 3.4		200	
SCATT024	Sage Creek above mining	F	BDL	U (10)					191											
SCATT024	Sage Creek above mining	UNF/S																		
SCBTT025	Sage Creek below mining	UNF	82		170		6				180		2	B	1.9 +/- 2.6		0.26 +/- 2.7		220	
SCBTT025	Sage Creek below mining	F	BDL	U (10)					188											
SCMTT026	Sage Creek (mouth)	UNF	54		180		14				190		BDL	US (1)	5.7 +/- 3.4		0 +/- 2.9		240	
SCMTT026	Sage Creek (mouth)	F	BDL	U (10)					217											
SHETT019	Sheep Creek	UNF	53		170						170		1	BS	0.39 +/- 2.1		0 +/- 2.7		230	
SHETT019	Sheep Creek	F	16						198											
SHETT019	Sheep Creek	UNF/S																		
SLCTT002	Stateland Creek	UNF	68		150		3				160		2	BS	0.28 +/- 2.1		0 +/- 2.8		210	

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TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Total Alkalinity		Total Organic Carbon		Gross Alpha Radiation		Gross Beta Radiation		Total Dissolved Solids	
			(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SLCTT002	Stateland Creek	F	BDL	U (10)					165											
SLUTT005	Slug Creek at USFS boundary	UNF	11		210		5				220		4	BS	1.5 +/- 2.3		2.4 +/- 2.9		250	
SLUTT005	Slug Creek at USFS boundary	F	52						203											
SLUTT005	Slug Creek at USFS boundary	UNF/S																		
SMATT021	Smoky Creek above mining	UNF	BDL	U (10)	210						210		BDL	US (1)	0.61 +/- 2.2		2.5 +/- 3		240	
SMATT021	Smoky Creek above mining	F	46						201											
SMATT021	Smoky Creek above mining	UNF/S																		
SMBTT020	Smoky Creek below mining	UNF	16		200		6				200		6		1.3 +/- 2.5		1.8 +/- 2.8		240	
SMBTT020	Smoky Creek below mining	F	68						199											
SPRTT016	Spring Creek (mouth)	UNF	110		190						190		3	B	1.6 +/- 2.4		0.92 +/- 2.9		210	
SPRTT016	Spring Creek (mouth)	F	BDL	U (10)					188											
SSBTT022	South Fork Sage Creek below mining	UNF	66		210						210		BDL	US (1)	3.7 +/- 3		1.8 +/- 2.8		220	
SSBTT022	South Fork Sage Creek below mining	F	BDL	U (10)					207											
SSBTT022	South Fork Sage Creek below mining	UNF/DUP	66		200						200		BDL	US (1)	5 +/- 3.3		3 +/- 3		220	
SSBTT022	South Fork Sage Creek below mining	F/DUP	BDL	U (10)					210											
TRATT003	Trail Creek near mouth	UNF	BDL	U (10)	160		18				180		5	BS	3.8 +/- 2.9		1.8 +/- 2.8		220	
TRATT003	Trail Creek near mouth	F	66						178											
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	BDL	U (10)	220						220		4	B	9 +/- 4.1		7.6 +/- 3.4		240	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	59						192											

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TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS					FIELD PARAMETERS						
			Total Suspended Solids		Total Phosphorous		pH	DO	Flow	ORP	pH	SC	Temp	Turb
			(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)	(Lab)	(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
ANGTT010	Angus Creek (mouth)	UNF	BDL	U (4)	120		8.1	10.8	2.04	278	8.35	0.338	17.2	10.0
ANGTT010	Angus Creek (mouth)	F												
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	18		74		8.4	11.8	142.06	-0.467	8.25	0.341	11.5	25.3
BFDTT008	Blackfoot River above Dry Valley Creek	F												
BFNTT009	Blackfoot River above Narrows	UNF	6		67		8.6	15.7	73.55	213	8.39	0.339	14.4	23.7
BFNTT009	Blackfoot River above Narrows	F												
BFUTT015	Blackfoot River at upper bridge	UNF	7		44		8.1	11.1	67.62	288	8.00	0.361	9.50	5.00
BFUTT015	Blackfoot River at upper bridge	F												
CALTT004	Caldwell Creek	UNF	300		720		8.5	8.58	0.17	-0.067	8.36	0.425	17.9	ND
CALTT004	Caldwell Creek	F												
CALTT004	Caldwell Creek	UNF/S												
CCATT029	Crow Creek above Deer Creek	UNF	11		53		8.5	13.2	19.23	302	8.52	0.960	13.6	27.7
CCATT029	Crow Creek above Deer Creek	F												
DCMTT028	Deer Creek (mouth)	UNF	4		46		8.3	11.6	7.73	216	8.40	0.396	10.6	41.0
DCMTT028	Deer Creek (mouth)	F												
DIATT018	Diamond Creek at USFS boundary	UNF	BDL	U (4)	32		8	10.7	5.90	247	7.89	0.358	11.3	0.00
DIATT018	Diamond Creek at USFS boundary	F												
DIATT018	Diamond Creek at USFS boundary	UNF/S												
EMCTT017	East Mill Creek above split	UNF	8		74		8.3	11.2	1.18	271	8.08	0.407	10.9	41.0
EMCTT017	East Mill Creek above split	F												
EMCTT017	East Mill Creek above split	UNF/DUP	8		81		8.4	11.2	1.18	271	8.08	0.407	10.9	41.0
EMCTT017	East Mill Creek above split	F/DUP												
EMCTT017	East Mill Creek above split	UNF/S												
GHCTT006	Goodheart Creek	UNF	4		120		8.1	9.11	0.01	236	8.05	0.662	20.3	12.0
GHCTT006	Goodheart Creek	F												
GHCTT006	Goodheart Creek	UNF/S												
GTCTT032	Georgetown Creek	UNF	BDL	U (4)	21		8.2	11.0	1.46	277	8.19	0.386	10.0	10.0
GTCTT032	Georgetown Creek	F												
LBFTT001	Little Blackfoot River	UNF	BDL	U (4)	14		7.9	12.1	9.56	167	7.47	0.876	13.9	4.33
LBFTT001	Little Blackfoot River	F												

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TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS					FIELD PARAMETERS						
			Total Suspended Solids		Total Phosphorous		pH	DO	Flow	ORP	pH	SC	Temp	Turb
			(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)	(Lab)	(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
LBFTT001	Little Blackfoot River	UNF/DUP	BDL	U (4)	16		7.7	12.1	9.56	167	7.47	0.876	13.9	4.33
LBFTT001	Little Blackfoot River	F/DUP												
MACTT011	Middle Angus Creek	UNF	53		140		8.3	9.60	1.49	283	8.40	0.450	13.0	25.0
MACTT011	Middle Angus Creek	F												
MACTT011	Middle Angus Creek	UNF/S												
MCATT030	Montpelier Creek above mining	UNF	4		BDL	U (10)	8.3	10.3	6.31	267	8.39	0.451	15.0	19.0
MCATT030	Montpelier Creek above mining	F												
MCATT030	Montpelier Creek above mining	UNF/S												
MCBTT031	Montpelier Creek below mining	UNF	BDL	U (4)	16		8.4	10.9	6.91	303	8.40	0.585	15.0	19.0
MCBTT031	Montpelier Creek below mining	F												
NNATT013	No Name Creek above mining	UNF	5		160		7.6	10.7	0.30	235	8.04	0.121	10.1	15.0
NNATT013	No Name Creek above mining	F												
NNATT013	No Name Creek above mining	UNF/S												
NNBTT012	No Name Creek below mining	UNF	BDL	U (4)	79		7.8	9.55	2.24	221	7.97	0.369	12.6	ND
NNBTT012	No Name Creek below mining	F												
RASTT014	Rasmussen Creek above Angus Creek	UNF	34		110		8.3	12.5	0.25	263	8.28	0.357	7.20	10.0
RASTT014	Rasmussen Creek above Angus Creek	F												
SCATT024	Sage Creek above mining	UNF	BDL	U (4)	16		8.3	14.5	6.73	276	8.52	0.359	5.80	66.0
SCATT024	Sage Creek above mining	F												
SCATT024	Sage Creek above mining	UNF/S												
SCBTT025	Sage Creek below mining	UNF	7		57		8.3	12.9	5.19	261	8.55	0.361	10.7	41.0
SCBTT025	Sage Creek below mining	F												
SCMTT026	Sage Creek (mouth)	UNF	7		30		8.8	10.1	9.60	235	8.66	0.428	19.6	3.33
SCMTT026	Sage Creek (mouth)	F												
SHETT019	Sheep Creek	UNF	19		92		8.2	11.7	6.11	256	8.33	0.369	9.70	10.0
SHETT019	Sheep Creek	F												
SHETT019	Sheep Creek	UNF/S												
SLCTT002	Stateland Creek	UNF	10		120		8.3	11.4	0.16	218	8.41	0.326	14.3	31.7
SLCTT002	Stateland Creek	F												
SLUTT005	Slug Creek at USFS boundary	UNF	15		130		8.3	10.2	1.28	-0.200	8.16	0.404	13.0	33.3

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TETRA TECH EM INC. 2001 EVENT 1 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS					FIELD PARAMETERS						
			Total Suspended Solids		Total Phosphorous		pH	DO	Flow	ORP	pH	SC	Temp	Turb
			(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)	(Lab)	(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
SLUTT005	Slug Creek at USFS boundary	F												
SLUTT005	Slug Creek at USFS boundary	UNF/S												
SMATT021	Smoky Creek above mining	UNF	BDL	U (4)	14		8.2	15.3	0.12	256	8.11	0.415	6.33	67.7
SMATT021	Smoky Creek above mining	F												
SMATT021	Smoky Creek above mining	UNF/S												
SMBTT020	Smoky Creek below mining	UNF	59		250		8.4	9.77	0.82	270	8.47	0.438	18.9	32.3
SMBTT020	Smoky Creek below mining	F												
SPRTT016	Spring Creek (mouth)	UNF	12		69		8.3	13.0	8.86	236	8.32	0.355	9.20	10.0
SPRTT016	Spring Creek (mouth)	F												
SSBTT022	South Fork Sage Creek below mining	UNF	BDL	U (4)	BDL	U (10)	8.1	11.6	5.35	269	8.09	0.412	12.4	36.0
SSBTT022	South Fork Sage Creek below mining	F												
SSBTT022	South Fork Sage Creek below mining	UNF/DUP	BDL	U (4)	BDL	U (10)	8.1	11.6	5.35	269	8.09	0.412	12.4	36.0
SSBTT022	South Fork Sage Creek below mining	F/DUP												
TRATT003	Trail Creek near mouth	UNF	6		73		8.8	12.6	2.46	-0.133	8.72	0.358	20.0	10.7
TRATT003	Trail Creek near mouth	F												
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	BDL	U (4)	78		7.9	7.73	0.034	273	7.56	0.417	9.53	ND
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F												

Notes:

[1] F = Filtered, UNF = Unfiltered, S = Split Sample, DUP = Field Duplicate

BDL	Below detection limit	mg/L	Milligram per liter	ORP	Oxygen and reduction potential
CFS	Cubic feet per second	mv	Millivolt	SC	Specific conductance
Deg C	Degree Celsius	mS/cm	Millisiemens per centimeter	Temp	Temperature
DO	Dissolved oxygen	ND	No data	Turb	Turbidity
mg $CaCO_3$/L	Miiligram calcium carbonate per liter	NTU	Nephelometric units	ug/L	Microgram per liter

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:

B	Analyte concentration detected at a value between Method Detection Limit (MDL) and Practical Quantification Limit (PQL)
S	TOC analysis was subcontracted to MSA Laboratory
U	Analyte was analyzed for but not detected at the indicated MDL

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
ANGTT010	Angus Creek (mouth)	UNF	48		BDL	U (2.5)	BDL	U (0.5)	11		BDL	U (5)	56		BDL	U (0.13)	5100		BDL	U (0.5)
ANGTT010	Angus Creek (mouth)	F	18		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	130		BDL	U (0.13)			BDL	U (0.5)
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	67		BDL	U (2.5)	BDL	U (0.5)	54		BDL	U (5)	85		BDL	U (0.13)	2500		0.59	
BFDTT008	Blackfoot River above Dry Valley Creek	F	20		BDL	U (2.5)	BDL	U (0.5)	52		BDL	U (5)	240		BDL	U (0.13)			0.82	
BFNTT009	Blackfoot River above Narrows	UNF	72		BDL	U (2.5)	BDL	U (0.5)	56		BDL	U (5)	59		BDL	U (0.13)	1900		BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	F	13		3		BDL	U (0.5)	52		BDL	U (5)	140		BDL	U (0.13)			BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	UNF/DUP	74		BDL	U (2.5)	BDL	U (0.5)	53		BDL	U (5)	87		BDL	U (0.13)	1800		BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	F/DUP	17		BDL	U (2.5)	BDL	U (0.5)	52		BDL	U (5)	220		BDL	U (0.13)			BDL	U (0.5)
BFUTT015	Blackfoot River at upper bridge	UNF	43		BDL	U (2.5)	BDL	U (0.5)	56		BDL	U (5)	42		BDL	U (0.13)	1600		BDL	U (0.5)
BFUTT015	Blackfoot River at upper bridge	F	14		BDL	U (2.5)	BDL	U (0.5)	58		BDL	U (5)	160		BDL	U (0.13)			BDL	U (0.5)
CALTT004	Caldwell Creek	UNF	870		BDL	U (2.5)	BDL	U (0.5)	81		BDL	U (5)	59		BDL	U (0.13)	8500		BDL	U (0.5)
CALTT004	Caldwell Creek	F	20		BDL	U (2.5)	BDL	U (0.5)	82		BDL	U (5)	180		BDL	U (0.13)			BDL	U (0.5)
CCATT029	Crow Creek above Deer Creek	UNF	52		BDL	U (2.5)	1.5		57		BDL	U (5)	72		BDL	U (0.13)	190000		0.56	
CCATT029	Crow Creek above Deer Creek	F	14		BDL	U (2.5)	BDL	U (0.5)	60		BDL	U (5)	180		0.23				BDL	U (0.5)
DCMTT028	Deer Creek (mouth)	UNF	65		BDL	U (2.5)	BDL	U (0.5)	30		BDL	U (5)	64		BDL	U (0.13)	2000		0.71	
DCMTT028	Deer Creek (mouth)	F	32		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	130		BDL	U (0.13)			0.81	
DIATT018	Diamond Creek at USFS boundary	UNF	40		BDL	U (2.5)	BDL	U (0.5)	15		BDL	U (5)	42		BDL	U (0.13)	1400		BDL	U (0.5)
DIATT018	Diamond Creek at USFS boundary	F	23		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	180		0.14				BDL	U (0.5)
EMCTT017	East Mill Creek above split	UNF/4-DAY	120		BDL	U (2.5)	BDL	U (0.5)	15		BDL	U (5)	90		BDL	U (0.13)	2000		BDL	U (0.5)
EMCTT017	East Mill Creek above split	F/4-DAY	26		BDL	U (2.5)	BDL	U (0.5)	22		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
EMCTT017	East Mill Creek above split	UNF/4-DAY	78		BDL	U (2.5)	BDL	U (0.5)	14		BDL	U (5)	38		BDL	U (0.13)	2300		BDL	U (0.5)
EMCTT017	East Mill Creek above split	F/4-DAY	20		BDL	U (2.5)	BDL	U (0.5)	13		BDL	U (5)	42		BDL	U (0.13)			BDL	U (0.5)
EMCTT017	East Mill Creek above split	UNF/4-DAY	90		BDL	U (2.5)	BDL	U (0.5)	20		5		50		BDL	U (0.13)	2300		BDL	U (0.5)
EMCTT017	East Mill Creek above split	F/4-DAY	17		BDL	U (2.5)	BDL	U (0.5)	14		BDL	U (5)	53		0.72				BDL	U (0.5)
GHCTT006	Goodheart Creek	UNF	510		BDL	U (2.5)	BDL	U (0.5)	63		BDL	U (5)	49		BDL	U (0.13)	2100		BDL	U (0.5)
GHCTT006	Goodheart Creek	F	18		BDL	U (2.5)	BDL	U (0.5)	46		BDL	U (5)	67		BDL	U (0.13)			BDL	U (0.5)
GTCTT032	Georgetown Creek	UNF	24		BDL	U (2.5)	1.5		30		BDL	U (5)	77		BDL	U (0.13)	1200		0.54	
GTCTT032	Georgetown Creek	F	23		BDL	U (2.5)	BDL	U (0.5)	34		BDL	U (5)	130		BDL	U (0.13)			BDL	U (0.5)
LBFTT001	Little Blackfoot River	UNF	120		BDL	U (2.5)	BDL	U (0.5)	49		BDL	U (5)	67		BDL	U (0.13)	23000		BDL	U (0.5)
LBFTT001	Little Blackfoot River	F	16		2.7		BDL	U (0.5)	59		BDL	U (5)	250		BDL	U (0.13)			BDL	U (0.5)

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
LBFTT001	Little Blackfoot River	UNF/DUP	110		BDL	U (2.5)	BDL	U (0.5)	45		BDL	U (5)	56		BDL	U (0.13)	23000		BDL	U (0.5)
LBFTT001	Little Blackfoot River	F/DUP	17		BDL	U (2.5)	BDL	U (0.5)	60		BDL	U (5)	240		BDL	U (0.13)			BDL	U (0.5)
MACTT011	Middle Angus Creek	UNF	200		BDL	U (2.5)	BDL	U (0.5)	23		BDL	U (5)	48		BDL	U (0.13)	4700		BDL	U (0.5)
MACTT011	Middle Angus Creek	F	15		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	250		BDL	U (0.13)			BDL	U (0.5)
MACTT011	Middle Angus Creek	UNF/DUP	240		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	100		BDL	U (0.13)	4600		0.51	
MACTT011	Middle Angus Creek	F/DUP	13		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	190		BDL	U (0.13)			BDL	U (0.5)
MCATT030	Montpelier Creek above mining	UNF	270		BDL	U (2.5)	BDL	U (0.5)	51		BDL	U (5)	120		BDL	U (0.13)	2700		BDL	U (0.5)
MCATT030	Montpelier Creek above mining	F	11		BDL	U (2.5)	BDL	U (0.5)	50		BDL	U (5)	160		BDL	U (0.13)			BDL	U (0.5)
MCBTT031	Montpelier Creek below mining	UNF	390		BDL	U (2.5)	BDL	U (0.5)	52		BDL	U (5)	80		BDL	U (0.13)	3100		0.54	
MCBTT031	Montpelier Creek below mining	F	17		BDL	U (2.5)	BDL	U (0.5)	47		BDL	U (5)	110		BDL	U (0.13)			BDL	U (0.5)
NNATT013	No Name Creek above mining	UNF/4-DAY	360		BDL	U (2.5)	BDL	U (0.5)	25		BDL	U (5)	58		BDL	U (0.13)	1400		1.3	
NNATT013	No Name Creek above mining	F/4-DAY	36		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
NNATT013	No Name Creek above mining	UNF/4-DAY	590		BDL	U (2.5)	BDL	U (0.5)	16		BDL	U (5)	58		BDL	U (0.13)	1600		BDL	U (0.5)
NNATT013	No Name Creek above mining	F/4-DAY	57		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	120		0.19				BDL	U (0.5)
NNATT013	No Name Creek above mining	UNF/4-DAY	540		BDL	U (2.5)	BDL	U (0.5)	17		BDL	U (5)	35		0.47		2000		BDL	U (0.5)
NNATT013	No Name Creek above mining	F/4-DAY	66		BDL	U (2.5)	BDL	U (0.5)	26		BDL	U (5)	260		BDL	U (0.13)			BDL	U (0.5)
NNATT013	No Name Creek above mining	UNF/DUP/4-DAY	530		BDL	U (2.5)	BDL	U (0.5)	16		BDL	U (5)	74		BDL	U (0.13)	1900		BDL	U (0.5)
NNATT013	No Name Creek above mining	F/DUP/4-DAY	40		BDL	U (2.5)	BDL	U (0.5)	12		BDL	U (5)	97		BDL	U (0.13)			BDL	U (0.5)
RASTT014	Rasmussen Creek above Angus Creek	UNF	990		BDL	U (2.5)	BDL	U (0.5)	42		BDL	U (5)	49		BDL	U (0.13)	5500		1.7	
RASTT014	Rasmussen Creek above Angus Creek	F	20		BDL	U (2.5)	BDL	U (0.5)	32		BDL	U (5)	180		BDL	U (0.13)			BDL	U (0.5)
SCATT024	Sage Creek above mining	UNF	39		BDL	U (2.5)	BDL	U (0.5)	14		BDL	U (5)	37		BDL	U (0.13)	1100		BDL	U (0.5)
SCATT024	Sage Creek above mining	F	14		BDL	U (2.5)	BDL	U (0.5)	14		BDL	U (5)	49		BDL	U (0.13)			BDL	U (0.5)
SCBTT025	Sage Creek below mining	UNF	94		BDL	U (2.5)	BDL	U (0.5)	16		BDL	U (5)	65		0.25		1100		BDL	U (0.5)
SCBTT025	Sage Creek below mining	F	29		BDL	U (2.5)	BDL	U (0.5)	14		BDL	U (5)	91		BDL	U (0.13)			BDL	U (0.5)
SCMTT026	Sage Creek (mouth)	UNF	57		BDL	U (2.5)	BDL	U (0.5)	35		BDL	U (5)	81		BDL	U (0.13)	6800		0.65	
SCMTT026	Sage Creek (mouth)	F	23		BDL	U (2.5)	BDL	U (0.5)	42		BDL	U (5)	110		BDL	U (0.13)			BDL	U (0.5)
SCPTT027	Sage Creek below Pole Creek	UNF	32		BDL	U (2.5)	BDL	U (0.5)	19		BDL	U (5)	37		BDL	U (0.13)	3200		BDL	U (0.5)
SCPTT027	Sage Creek below Pole Creek	F	23		BDL	U (2.5)	BDL	U (0.5)	18		BDL	U (5)	110		BDL	U (0.13)			BDL	U (0.5)
SHETT019	Sheep Creek	UNF	120		BDL	U (2.5)	BDL	U (0.5)	56		BDL	U (5)	39		BDL	U (0.13)	1900		BDL	U (0.5)
SHETT019	Sheep Creek	F	20		BDL	U (2.5)	BDL	U (0.5)	69		BDL	U (5)	170		BDL	U (0.13)			BDL	U (0.5)

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SLCTT002	Stateland Creek	UNF	220		BDL	U (2.5)	BDL	U (0.5)	20		BDL	U (5)	56		BDL	U (0.13)	5200		BDL	U (0.5)
SLCTT002	Stateland Creek	F	27		BDL	U (2.5)	BDL	U (0.5)	17		BDL	U (5)	88		BDL	U (0.13)			BDL	U (0.5)
SLUTT005	Slug Creek at USFS boundary	UNF	150		BDL	U (2.5)	BDL	U (0.5)	66		BDL	U (5)	76		BDL	U (0.13)	3600		BDL	U (0.5)
SLUTT005	Slug Creek at USFS boundary	F	13		BDL	U (2.5)	BDL	U (0.5)	77		BDL	U (5)	160		0.17				BDL	U (0.5)
SMATT021	Smoky Creek above mining	UNF	62		BDL	U (2.5)	BDL	U (0.5)	11		BDL	U (5)	40		0.49		1200		BDL	U (0.5)
SMATT021	Smoky Creek above mining	F	22		BDL	U (2.5)	BDL	U (0.5)	11		BDL	U (5)	64		BDL	U (0.13)			BDL	U (0.5)
SMBTT020	Smoky Creek below mining	UNF	810		BDL	U (2.5)	BDL	U (0.5)	31		BDL	U (5)	54		BDL	U (0.13)	7000		1.6	
SMBTT020	Smoky Creek below mining	F	18		BDL	U (2.5)	BDL	U (0.5)	26		BDL	U (5)	210		BDL	U (0.13)			BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	28		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	68		BDL	U (0.13)	1800		BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	F/4-DAY	16		BDL	U (2.5)	BDL	U (0.5)	37		BDL	U (5)	160		BDL	U (0.13)			BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	70		BDL	U (2.5)	BDL	U (0.5)	24		5		56		BDL	U (0.13)	6600		BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	F/4-DAY	14		BDL	U (2.5)	BDL	U (0.5)	21		BDL	U (5)	71		BDL	U (0.13)			BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	29		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	64		BDL	U (0.13)	1700		BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	F/4-DAY	27		BDL	U (2.5)	BDL	U (0.5)	25		BDL	U (5)	47		BDL	U (0.13)			BDL	U (0.5)
SSBTT022	South Fork Sage Creek below mining	UNF	54		BDL	U (2.5)	BDL	U (0.5)	31		BDL	U (5)	65		BDL	U (0.13)	4600		BDL	U (0.5)
SSBTT022	South Fork Sage Creek below mining	F	19		BDL	U (2.5)	BDL	U (0.5)	30		BDL	U (5)	58		BDL	U (0.13)			BDL	U (0.5)
TRATT003	Trail Creek near mouth	UNF	76		BDL	U (2.5)	BDL	U (0.5)	36		BDL	U (5)	61		BDL	U (0.13)	5700		BDL	U (0.5)
TRATT003	Trail Creek near mouth	F	11		BDL	U (2.5)	BDL	U (0.5)	49		BDL	U (5)	140		BDL	U (0.13)			BDL	U (0.5)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	110		BDL	U (2.5)	BDL	U (0.5)	51		BDL	U (5)	73		BDL	U (0.13)	2700		BDL	U (0.5)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	32		BDL	U (2.5)	BDL	U (0.5)	52		BDL	U (5)	280		BDL	U (0.13)			BDL	U (0.5)

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
ANGTT010	Angus Creek (mouth)	UNF	BDL	U (0.13)	BDL	U (100)	140		BDL	U (0.25)	12000		35		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
ANGTT010	Angus Creek (mouth)	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	14000		5.9		BDL	U (2.5)	0.58		BDL	U (0.13)
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	0.26		BDL	U (100)	96		0.47		12000		18		BDL	U (2.5)	BDL	U (0.13)	0.26	
BFDTT008	Blackfoot River above Dry Valley Creek	F	BDL	U (0.13)			70		BDL	U (0.25)	12000		16		BDL	U (2.5)	0.77		BDL	U (0.13)
BFNTT009	Blackfoot River above Narrows	UNF	BDL	U (0.13)	BDL	U (100)	110		0.4		11000		13		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
BFNTT009	Blackfoot River above Narrows	F	BDL	U (0.13)			31		BDL	U (0.25)	11000		8.3		BDL	U (2.5)	0.7		BDL	U (0.13)
BFNTT009	Blackfoot River above Narrows	UNF/DUP	0.45		BDL	U (100)	100		12		11000		12		BDL	U (2.5)	BDL	U (0.13)	0.45	
BFNTT009	Blackfoot River above Narrows	F/DUP	BDL	U (0.13)			100		BDL	U (0.25)	12000		8		BDL	U (2.5)	0.5		BDL	U (0.13)
BFUTT015	Blackfoot River at upper bridge	UNF	0.34		BDL	U (100)	81		0.32		11000		13		BDL	U (2.5)	BDL	U (0.13)	0.34	
BFUTT015	Blackfoot River at upper bridge	F	BDL	U (0.13)			39		BDL	U (0.25)	12000		13		BDL	U (2.5)	0.87		BDL	U (0.13)
CALTT004	Caldwell Creek	UNF	BDL	U (0.13)	110		1200		0.6		13000		70		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
CALTT004	Caldwell Creek	F	BDL	U (0.13)			13		BDL	U (0.25)	12000		37		BDL	U (2.5)	0.72		BDL	U (0.13)
CCATT029	Crow Creek above Deer Creek	UNF	BDL	U (0.13)	BDL	U (100)	54		3.5		18000		18		BDL	U (2.5)	0.4		BDL	U (0.13)
CCATT029	Crow Creek above Deer Creek	F	BDL	U (0.13)			50		BDL	U (0.25)	18000		19		BDL	U (2.5)	0.89		BDL	U (0.13)
DCMTT028	Deer Creek (mouth)	UNF	1.3		BDL	U (100)	110		0.26		17000		18		BDL	U (2.5)	0.42		1.3	
DCMTT028	Deer Creek (mouth)	F	BDL	U (0.13)			30		BDL	U (0.25)	18000		15		BDL	U (2.5)	1.6		BDL	U (0.13)
DIATT018	Diamond Creek at USFS boundary	UNF	BDL	U (0.13)	BDL	U (100)	35		BDL	U (0.25)	13000		11		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
DIATT018	Diamond Creek at USFS boundary	F	BDL	U (0.13)			10		BDL	U (0.25)	13000		12		BDL	U (2.5)	0.54		BDL	U (0.13)
EMCTT017	East Mill Creek above split	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	680		BDL	U (0.25)	14000		18		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
EMCTT017	East Mill Creek above split	F/4-DAY	BDL	U (0.13)			16		BDL	U (0.25)	11000		24		BDL	U (2.5)	1.1		BDL	U (0.13)
EMCTT017	East Mill Creek above split	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	88		BDL	U (0.25)	13000		15		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
EMCTT017	East Mill Creek above split	F/4-DAY	BDL	U (0.13)			18		BDL	U (0.25)	13000		3		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
EMCTT017	East Mill Creek above split	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	81		BDL	U (0.25)	14000		15		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
EMCTT017	East Mill Creek above split	F/4-DAY	BDL	U (0.13)			BDL	U (10)	7		14000		2.8		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
GHCTT006	Goodheart Creek	UNF	BDL	U (0.13)	BDL	U (100)	520		BDL	U (0.25)	12000		62		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
GHCTT006	Goodheart Creek	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	9500		36		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
GTCTT032	Georgetown Creek	UNF	BDL	U (0.13)	140		18		BDL	U (0.25)	15000		4		BDL	U (2.5)	0.8		BDL	U (0.13)
GTCTT032	Georgetown Creek	F	BDL	U (0.13)			BDL	U (10)	0.33		15000		6		BDL	U (2.5)	0.67		BDL	U (0.13)
LBFTT001	Little Blackfoot River	UNF	BDL	U (0.13)	610		360		BDL	U (0.25)	33000		4.4		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
LBFTT001	Little Blackfoot River	UNF/DUP	BDL	U (0.13)	610		79		BDL	U (0.25)	34000		4.5		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
LBFTT001	Little Blackfoot River	F/DUP	0.57				BDL	U (10)	BDL	U (0.25)	34000		6.3		2.8		2		0.57	
MACTT011	Middle Angus Creek	UNF	BDL	U (0.13)	BDL	U (100)	260		0.35		14000		71		BDL	U (2.5)	2		BDL	U (0.13)
MACTT011	Middle Angus Creek	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	15000		52		BDL	U (2.5)	0.74		BDL	U (0.13)
MACTT011	Middle Angus Creek	UNF/DUP	BDL	U (0.13)	BDL	U (100)	270		0.28		14000		72		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
MACTT011	Middle Angus Creek	F/DUP	BDL	U (0.13)			12		BDL	U (0.25)	15000		53		BDL	U (2.5)	0.75		BDL	U (0.13)
MCATT030	Montpelier Creek above mining	UNF	BDL	U (0.13)	BDL	U (100)	250		0.35		16000		15		BDL	U (2.5)	1.9		BDL	U (0.13)
MCATT030	Montpelier Creek above mining	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	16000		6.8		BDL	U (2.5)	1.3		BDL	U (0.13)
MCBTT031	Montpelier Creek below mining	UNF	BDL	U (0.13)	BDL	U (100)	440		1.1		18000		21		BDL	U (2.5)	0.38		BDL	U (0.13)
MCBTT031	Montpelier Creek below mining	F	BDL	U (0.13)			18		0.38		17000		7.4		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	480		0.4		6300		120		BDL	U (2.5)	2.4		BDL	U (0.13)
NNATT013	No Name Creek above mining	F/4-DAY	1.8				22		BDL	U (0.25)	6600		130		BDL	U (2.5)	1.1		1.8	
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	530		BDL	U (0.25)	7100		140		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
NNATT013	No Name Creek above mining	F/4-DAY	BDL	U (0.13)			57		0.71		6800		130		BDL	U (2.5)	1.5		BDL	U (0.13)
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	520		3		7500		140		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
NNATT013	No Name Creek above mining	F/4-DAY	BDL	U (0.13)			86		BDL	U (0.25)	6800		130		BDL	U (2.5)	2.8		BDL	U (0.13)
NNATT013	No Name Creek above mining	UNF/DUP/4-DAY	BDL	U (0.13)	BDL	U (100)	470		BDL	U (0.25)	7300		100		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
NNATT013	No Name Creek above mining	F/DUP/4-DAY	BDL	U (0.13)			31		BDL	U (0.25)	6900		94		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
RASTT014	Rasmussen Creek above Angus Creek	UNF	2.3		BDL	U (100)	1000		1.1		9800		59		BDL	U (2.5)	1.5		2.3	
RASTT014	Rasmussen Creek above Angus Creek	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	10000		24		BDL	U (2.5)	0.69		BDL	U (0.13)
SCATT024	Sage Creek above mining	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (10)	BDL	U (0.25)	13000		5.2		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SCATT024	Sage Creek above mining	F	BDL	U (0.13)			39		BDL	U (0.25)	14000		BDL	U (2)	BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SCBTT025	Sage Creek below mining	UNF	BDL	U (0.13)	BDL	U (100)	96		0.89		14000		32		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SCBTT025	Sage Creek below mining	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	14000		25		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SCMTT026	Sage Creek (mouth)	UNF	BDL	U (0.13)	260		56		0.32		18000		9.4		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SCMTT026	Sage Creek (mouth)	F	0.56				50		BDL	U (0.25)	20000		8.6		BDL	U (2.5)	0.64		0.56	
SCPTT027	Sage Creek below Pole Creek	UNF	BDL	U (0.13)	BDL	U (100)	35		BDL	U (0.25)	15000		15		BDL	U (2.5)	3.8		BDL	U (0.13)
SCPTT027	Sage Creek below Pole Creek	F	BDL	U (0.13)			BDL	U (10)	4.3		14000		10		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SHETT019	Sheep Creek	UNF	BDL	U (0.13)	BDL	U (100)	140		BDL	U (0.25)	13000		12		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SHETT019	Sheep Creek	F	BDL	U (0.13)			74		BDL	U (0.25)	13000		15		BDL	U (2.5)	0.6		BDL	U (0.13)

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SLCTT002	Stateland Creek	UNF	BDL	U (0.13)	150		220		BDL	U (0.25)	12000		12		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SLCTT002	Stateland Creek	F	BDL	U (0.13)			16		BDL	U (0.25)	11000		6.6		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SLUTT005	Slug Creek at USFS boundary	UNF	BDL	U (0.13)	230		860		BDL	U (0.25)	14000		32		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SLUTT005	Slug Creek at USFS boundary	F	BDL	U (0.13)			15		BDL	U (0.25)	13000		23		BDL	U (2.5)	0.83		BDL	U (0.13)
SMATT021	Smoky Creek above mining	UNF	BDL	U (0.13)	BDL	U (100)	67		4.2		17000		47		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SMATT021	Smoky Creek above mining	F	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	17000		5.2		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SMBTT020	Smoky Creek below mining	UNF	0.42		100		1100		0.91		16000		140		BDL	U (2.5)	2.3		0.42	
SMBTT020	Smoky Creek below mining	F	BDL	U (0.13)			12		BDL	U (0.25)	16000		50		BDL	U (2.5)	0.67		BDL	U (0.13)
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	16		BDL	U (0.25)	12000		8.8		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SPRTT016	Spring Creek (mouth)	F/4-DAY	31				BDL	U (10)	BDL	U (0.25)	11000		11		BDL	U (2.5)	0.51		31	
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	22		BDL	U (0.25)	11000		10		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SPRTT016	Spring Creek (mouth)	F/4-DAY	BDL	U (0.13)			BDL	U (10)	BDL	U (0.25)	11000		8.1		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (0.13)	BDL	U (100)	30		BDL	U (0.25)	12000		13		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SPRTT016	Spring Creek (mouth)	F/4-DAY	0.81				10		4.8		12000		12		BDL	U (2.5)	BDL	U (0.13)	0.81	
SSBTT022	South Fork Sage Creek below mining	UNF	BDL	U (0.13)	270		30		BDL	U (0.25)	20000		8.4		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
SSBTT022	South Fork Sage Creek below mining	F	1.5				BDL	U (10)	BDL	U (0.25)	21000		2.5		BDL	U (2.5)	BDL	U (0.13)	1.5	
TRATT003	Trail Creek near mouth	UNF	BDL	U (0.13)	BDL	U (100)	120		BDL	U (0.25)	12000		18		BDL	U (2.5)	BDL	U (0.13)	BDL	U (0.13)
TRATT003	Trail Creek near mouth	F	BDL	U (0.13)			18		BDL	U (0.25)	11000		16		BDL	U (2.5)	0.67		BDL	U (0.13)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	1.1		110		170		1		13000		24		BDL	U (2.5)	2.5		1.1	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	BDL	U (0.13)			12		BDL	U (0.25)	13000		22		BDL	U (2.5)	0.77		BDL	U (0.13)

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Nitrate		Potassium		Selenium		Silver		Sodium		Sulfate		Thallium		Uranium		Vanadium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
ANGTT010	Angus Creek (mouth)	UNF	BDL	U (100)	1300		BDL	U (1)	BDL	U (0.25)	6200		19000		BDL	U (2.5)	0.5		BDL	U (0.25)
ANGTT010	Angus Creek (mouth)	F			500		BDL	U (1)	16		4400				BDL	U (2.5)	0.4		0.27	
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	BDL	U (100)	550		1.6		BDL	U (0.25)	4000		10000		BDL	U (2.5)	0.73		0.97	
BFDTT008	Blackfoot River above Dry Valley Creek	F			540		2.3		BDL	U (0.25)	4100				BDL	U (2.5)	0.46		0.8	
BFNTT009	Blackfoot River above Narrows	UNF	130		BDL	U (500)	1.3		BDL	U (0.25)	4000		9300		BDL	U (2.5)	0.64		0.72	
BFNTT009	Blackfoot River above Narrows	F			BDL	U (500)	1.6		BDL	U (0.25)	4600				BDL	U (2.5)	0.47		BDL	U (0.25)
BFNTT009	Blackfoot River above Narrows	UNF/DUP	BDL	U (100)	BDL	U (500)	1.6		BDL	U (0.25)	3700		9300		BDL	U (2.5)	0.63		0.64	
BFNTT009	Blackfoot River above Narrows	F/DUP			510		1.8		BDL	U (0.25)	4100				BDL	U (2.5)	0.41		0.56	
BFUTT015	Blackfoot River at upper bridge	UNF	BDL	U (100)	BDL	U (500)	1.7		BDL	U (0.25)	4200		9400		BDL	U (2.5)	0.66		0.75	
BFUTT015	Blackfoot River at upper bridge	F			610		2.2		BDL	U (0.25)	4900				BDL	U (2.5)	0.42		0.71	
CALTT004	Caldwell Creek	UNF	BDL	U (100)	1300		BDL	U (1)	BDL	U (0.25)	7500		22000		BDL	U (2.5)	0.7		BDL	U (0.25)
CALTT004	Caldwell Creek	F			1100		BDL	U (1)	BDL	U (0.25)	7400				BDL	U (2.5)	0.7		0.67	
CCATT029	Crow Creek above Deer Creek	UNF	320		1200		BDL	U (1)	3.5		110000		28000		BDL	U (2.5)	1.9		1	
CCATT029	Crow Creek above Deer Creek	F			1100		1.2		BDL	U (0.25)	110000				BDL	U (2.5)	1.3		1.1	
DCMTT028	Deer Creek (mouth)	UNF	BDL	U (100)	590		BDL	U (1)	BDL	U (0.25)	3200		7100		BDL	U (2.5)	1.6		1.9	
DCMTT028	Deer Creek (mouth)	F			620		1.6		BDL	U (0.25)	3300				BDL	U (2.5)	1		1.1	
DIATT018	Diamond Creek at USFS boundary	UNF	130		590		BDL	U (1)	BDL	U (0.25)	4400		9900		BDL	U (2.5)	0.6		BDL	U (0.25)
DIATT018	Diamond Creek at USFS boundary	F			510		BDL	U (1)	BDL	U (0.25)	4100				BDL	U (2.5)	0.56		BDL	U (0.25)
EMCTT017	East Mill Creek above split	UNF/4-DAY	330		590		91		BDL	U (0.25)	4400		23000		BDL	U (2.5)	0.43		BDL	U (0.25)
EMCTT017	East Mill Creek above split	F/4-DAY			1300		88		BDL	U (0.25)	5300				BDL	U (2.5)	0.48		0.66	
EMCTT017	East Mill Creek above split	UNF/4-DAY	380		BDL	U (500)	14		0.35		5000		17000		BDL	U (2.5)	0.39		BDL	U (0.25)
EMCTT017	East Mill Creek above split	F/4-DAY			BDL	U (500)	88		BDL	U (0.25)	4900				BDL	U (2.5)	0.39		BDL	U (0.25)
EMCTT017	East Mill Creek above split	UNF/4-DAY	250		510		22		0.84		4700		17000		BDL	U (2.5)	0.4		BDL	U (0.25)
EMCTT017	East Mill Creek above split	F/4-DAY			BDL	U (500)	95		BDL	U (0.25)	4800				BDL	U (2.5)	0.39		BDL	U (0.25)
GHCTT006	Goodheart Creek	UNF	320		1200		BDL	U (1)	BDL	U (0.25)	6300		9200		BDL	U (2.5)	0.68		1.5	
GHCTT006	Goodheart Creek	F			950		BDL	U (1)	BDL	U (0.25)	6300				BDL	U (2.5)	0.5		0.41	
GTCTT032	Georgetown Creek	UNF	180		540		1.5		BDL	U (0.25)	2200		29000		BDL	U (2.5)	1.7		1.3	
GTCTT032	Georgetown Creek	F			640		2.2		BDL	U (0.25)	BDL	U (2000)			BDL	U (2.5)	1		0.83	
LBFTT001	Little Blackfoot River	UNF	260		2200		BDL	U (1)	BDL	U (0.25)	20000		58000		BDL	U (2.5)	1.8		BDL	U (0.25)
LBFTT001	Little Blackfoot River	F			2300		1.4		BDL	U (0.25)	23000				BDL	U (2.5)	2.7		1.1	

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Nitrate		Potassium		Selenium		Silver		Sodium		Sulfate		Thallium		Uranium		Vanadium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
LBFTT001	Little Blackfoot River	UNF/DUP	BDL	U (100)	2300		BDL	U (1)	BDL	U (0.25)	20000		59000		BDL	U (2.5)	1.8		BDL	U (0.25)
LBFTT001	Little Blackfoot River	F/DUP			2400		1		BDL	U (0.25)	18000				BDL	U (2.5)	1.8		0.91	
MACTT011	Middle Angus Creek	UNF	540		510		BDL	U (1)	BDL	U (0.25)	5200		57000		BDL	U (2.5)	0.93		1.1	
MACTT011	Middle Angus Creek	F			620		BDL	U (1)	BDL	U (0.25)	5900				BDL	U (2.5)	0.57		0.38	
MACTT011	Middle Angus Creek	UNF/DUP	1300		550		BDL	U (1)	BDL	U (0.25)	5100		55000		BDL	U (2.5)	0.94		0.73	
MACTT011	Middle Angus Creek	F/DUP			580		BDL	U (1)	BDL	U (0.25)	5600				BDL	U (2.5)	0.58		BDL	U (0.25)
MCATT030	Montpelier Creek above mining	UNF	230		950		BDL	U (1)	BDL	U (0.25)	6400		52000		BDL	U (2.5)	0.67		1	
MCATT030	Montpelier Creek above mining	F			1000		BDL	U (1)	BDL	U (0.25)	6800				BDL	U (2.5)	0.4		0.56	
MCBTT031	Montpelier Creek below mining	UNF	BDL	U (100)	1100		BDL	U (1)	BDL	U (0.25)	6800		67000		BDL	U (2.5)	0.78		1.7	
MCBTT031	Montpelier Creek below mining	F			1000		BDL	U (1)	4.6		7000				BDL	U (2.5)	0.75		0.75	
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (100)	650		BDL	U (1)	BDL	U (0.25)	3700		4100		BDL	U (2.5)	0.57		0.87	
NNATT013	No Name Creek above mining	F/4-DAY			570		BDL	U (1)	BDL	U (0.25)	3500				BDL	U (2.5)	0.36		0.48	
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (100)	700		BDL	U (1)	BDL	U (0.25)	4000		4300		BDL	U (2.5)	0.46		BDL	U (0.25)
NNATT013	No Name Creek above mining	F/4-DAY			650		BDL	U (1)	BDL	U (0.25)	4600				BDL	U (2.5)	0.41		0.57	
NNATT013	No Name Creek above mining	UNF/4-DAY	110		760		BDL	U (1)	BDL	U (0.25)	4600		4400		BDL	U (2.5)	0.45		BDL	U (0.25)
NNATT013	No Name Creek above mining	F/4-DAY			660		BDL	U (1)	BDL	U (0.25)	4200				BDL	U (2.5)	0.42		0.94	
NNATT013	No Name Creek above mining	UNF/DUP/4-DAY	BDL	U (100)	640		BDL	U (1)	BDL	U (0.25)	4300		4500		BDL	U (2.5)	0.49		0.36	
NNATT013	No Name Creek above mining	F/DUP/4-DAY			BDL	U (500)	BDL	U (1)	BDL	U (0.25)	4500				BDL	U (2.5)	0.47		BDL	U (0.25)
RASTT014	Rasmussen Creek above Angus Creek	UNF	BDL	U (100)	940		BDL	U (1)	BDL	U (0.25)	5400		11000		BDL	U (2.5)	0.85		2.9	
RASTT014	Rasmussen Creek above Angus Creek	F			800		1.6		BDL	U (0.25)	5600				BDL	U (2.5)	0.48		1.1	
SCATT024	Sage Creek above mining	UNF	BDL	U (100)	580		BDL	U (1)	BDL	U (0.25)	2800		14000		BDL	U (2.5)	0.43		BDL	U (0.25)
SCATT024	Sage Creek above mining	F			540		BDL	U (1)	BDL	U (0.25)	3400				BDL	U (2.5)	0.44		BDL	U (0.25)
SCBTT025	Sage Creek below mining	UNF	BDL	U (100)	560		BDL	U (1)	BDL	U (0.25)	3600		17000		BDL	U (2.5)	0.51		BDL	U (0.25)
SCBTT025	Sage Creek below mining	F			520		BDL	U (1)	BDL	U (0.25)	3800				BDL	U (2.5)	0.46		BDL	U (0.25)
SCMTT026	Sage Creek (mouth)	UNF	BDL	U (100)	700		2.3		BDL	U (0.25)	6600		28000		BDL	U (2.5)	2.2		0.97	
SCMTT026	Sage Creek (mouth)	F			730		3.6		BDL	U (0.25)	7500				BDL	U (2.5)	1.6		1.3	
SCPTT027	Sage Creek below Pole Creek	UNF	300		1100		BDL	U (1)	BDL	U (0.25)	6300		32000		BDL	U (2.5)	0.47		BDL	U (0.25)
SCPTT027	Sage Creek below Pole Creek	F			1100		BDL	U (1)	BDL	U (0.25)	6200				BDL	U (2.5)	0.47		BDL	U (0.25)
SHETT019	Sheep Creek	UNF	BDL	U (100)	580		BDL	U (1)	0.34		4600		10000		BDL	U (2.5)	0.47		BDL	U (0.25)
SHETT019	Sheep Creek	F			500		BDL	U (1)	BDL	U (0.25)	4500				BDL	U (2.5)	0.46		0.37	

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Nitrate		Potassium		Selenium		Silver		Sodium		Sulfate		Thallium		Uranium		Vanadium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SLCTT002	Stateland Creek	UNF	640		710		1.3		BDL	U (0.25)	7700		11000		BDL	U (2.5)	0.83		1.1	
SLCTT002	Stateland Creek	F			760		1.2		3.2		7400				BDL	U (2.5)	0.78		0.65	
SLUTT005	Slug Creek at USFS boundary	UNF	100		2500		BDL	U (1)	BDL	U (0.25)	5500		3300		BDL	U (2.5)	1.1		BDL	U (0.25)
SLUTT005	Slug Creek at USFS boundary	F			2600		BDL	U (1)	BDL	U (0.25)	5300				BDL	U (2.5)	1.1		1.8	
SMATT021	Smoky Creek above mining	UNF	150		690		BDL	U (1)	BDL	U (0.25)	5100		15000		BDL	U (2.5)	0.3		BDL	U (0.25)
SMATT021	Smoky Creek above mining	F			700		BDL	U (1)	BDL	U (0.25)	5300				BDL	U (2.5)	0.32		BDL	U (0.25)
SMBTT020	Smoky Creek below mining	UNF	BDL	U (100)	940		BDL	U (1)	0.33		6300		15000		BDL	U (2.5)	0.92		2.1	
SMBTT020	Smoky Creek below mining	F			810		BDL	U (1)	BDL	U (0.25)	6000				BDL	U (2.5)	0.51		0.67	
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (100)	BDL	U (500)	5.7		BDL	U (0.25)	4200		8900		BDL	U (2.5)	0.41		BDL	U (0.25)
SPRTT016	Spring Creek (mouth)	F/4-DAY			BDL	U (500)	6.1		BDL	U (0.25)	4100				BDL	U (2.5)	0.4		BDL	U (0.25)
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	110		510		5.3		BDL	U (0.25)	3700		16000		BDL	U (2.5)	0.42		BDL	U (0.25)
SPRTT016	Spring Creek (mouth)	F/4-DAY			BDL	U (500)	5.5		BDL	U (0.25)	4000				BDL	U (2.5)	0.37		BDL	U (0.25)
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (100)	BDL	U (500)	4.4		BDL	U (0.25)	3900		8600		BDL	U (2.5)	0.44		BDL	U (0.25)
SPRTT016	Spring Creek (mouth)	F/4-DAY			520		4.6		BDL	U (0.25)	4400				BDL	U (2.5)	0.41		BDL	U (0.25)
SSBTT022	South Fork Sage Creek below mining	UNF	140		730		1.2		BDL	U (0.25)	5400		13000		BDL	U (2.5)	1.9		BDL	U (0.25)
SSBTT022	South Fork Sage Creek below mining	F			750		1.6		BDL	U (0.25)	5200				BDL	U (2.5)	1.8		BDL	U (0.25)
TRATT003	Trail Creek near mouth	UNF	BDL	U (100)	690		BDL	U (1)	BDL	U (0.25)	5800		9600		BDL	U (2.5)	0.45		BDL	U (0.25)
TRATT003	Trail Creek near mouth	F			680		BDL	U (1)	BDL	U (0.25)	5500				BDL	U (2.5)	0.41		0.87	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	190		650		1.3		BDL	U (0.25)	3600		12000		BDL	U (2.5)	1		1.1	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F			670		2		2.6		4000				BDL	U (2.5)	0.59		0.47	

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Total Alkalinity		Total Organic Carbon		Total Dissolved Solids		Total Suspended Solids		Total Phosphorous	
			(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)
ANGTT010	Angus Creek (mouth)	UNF	BDL	U (10)	180						180		5	B	230		BDL	U (4)	130	
ANGTT010	Angus Creek (mouth)	F	12						195											
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	11		180		18				190		3	B	150		BDL	U (4)	30	
BFDTT008	Blackfoot River above Dry Valley Creek	F	14						172											
BFNTT009	Blackfoot River above Narrows	UNF	13		160		18				180		4	B	150		BDL	U (4)	33	
BFNTT009	Blackfoot River above Narrows	F	12						165											
BFNTT009	Blackfoot River above Narrows	UNF/DUP	BDL	U (10)	170		9				180		3	B	120		BDL	U (4)	32	
BFNTT009	Blackfoot River above Narrows	F/DUP	12						172											
BFUTT015	Blackfoot River at upper bridge	UNF	BDL	U (10)	170		18				190		20	B	150		BDL	U (4)	27	
BFUTT015	Blackfoot River at upper bridge	F	13						177											
CALTT004	Caldwell Creek	UNF	14		180		15				200		5	B	270		48		140	
CALTT004	Caldwell Creek	F	12						202											
CCATT029	Crow Creek above Deer Creek	UNF	11		200		18				220		3	B	570		BDL	U (4)	35	
CCATT029	Crow Creek above Deer Creek	F	14						244											
DCMTT028	Deer Creek (mouth)	UNF	10		210		13				220		4	B	240		BDL	U (4)	35	
DCMTT028	Deer Creek (mouth)	F	13						209											
DIATT018	Diamond Creek at USFS boundary	UNF	BDL	U (10)	200						200		1	B	220		BDL	U (4)	38	
DIATT018	Diamond Creek at USFS boundary	F	12						193											
EMCTT017	East Mill Creek above split	UNF/4-DAY	BDL	U (10)	190						190		2	B	240		6		68	
EMCTT017	East Mill Creek above split	F/4-DAY	14						175											
EMCTT017	East Mill Creek above split	UNF/4-DAY	BDL	U (10)	190						190				200		BDL	U (4)	55	
EMCTT017	East Mill Creek above split	F/4-DAY	BDL	U (10)					173											
EMCTT017	East Mill Creek above split	UNF/4-DAY	BDL	U (10)	190						190				230		BDL	U (4)	45	
EMCTT017	East Mill Creek above split	F/4-DAY	BDL	U (10)					190											
GHCTT006	Goodheart Creek	UNF	BDL	U (10)	190						190		4	B	250		27		120	
GHCTT006	Goodheart Creek	F	BDL	U (10)					184											
GTCTT032	Georgetown Creek	UNF	11		170		18				190		3	B	190		BDL	U (4)	28	
GTCTT032	Georgetown Creek	F	14						194											
LBFTT001	Little Blackfoot River	UNF	BDL	U (10)	410						410		2	B	520		5		32	
LBFTT001	Little Blackfoot River	F	21						440											

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TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Total Alkalinity		Total Organic Carbon		Total Dissolved Solids		Total Suspended Solids		Total Phosphorous	
			(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)
LBFTT001	Little Blackfoot River	UNF/DUP	11		410						410		BDL	U (1)	530		7		23	
LBFTT001	Little Blackfoot River	F/DUP	22						440											
MACTT011	Middle Angus Creek	UNF	12		170		9				180		3	B	210		7		59	
MACTT011	Middle Angus Creek	F	17						212											
MACTT011	Middle Angus Creek	UNF/DUP	14		170		9				180		5	B	220		6		59	
MACTT011	Middle Angus Creek	F/DUP	14						214											
MCATT030	Montpelier Creek above mining	UNF	BDL	U (10)	170		18				190		3	B	270		18		30	
MCATT030	Montpelier Creek above mining	F	12						211											
MCBTT031	Montpelier Creek below mining	UNF	11		180		13				200		5	B	300		20		72	
MCBTT031	Montpelier Creek below mining	F	14						235											
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (10)	140		4				150		4	B	130		9		97	
NNATT013	No Name Creek above mining	F/4-DAY	12						127											
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (10)	150						150				170		7		100	
NNATT013	No Name Creek above mining	F/4-DAY	12						130											
NNATT013	No Name Creek above mining	UNF/4-DAY	BDL	U (10)	140						140				180		8		110	
NNATT013	No Name Creek above mining	F/4-DAY	13						130											
NNATT013	No Name Creek above mining	UNF/DUP/4-DAY	BDL	U (10)	140						140				150		10		110	
NNATT013	No Name Creek above mining	F/DUP/4-DAY	BDL	U (10)					151											
RASTT014	Rasmussen Creek above Angus Creek	UNF	19		150		18				160		3	B	180		34		110	
RASTT014	Rasmussen Creek above Angus Creek	F	13						154											
SCATT024	Sage Creek above mining	UNF	BDL	U (10)	170		9				180		3	B	210		BDL	U (4)	18	
SCATT024	Sage Creek above mining	F	BDL	U (10)					158											
SCBTT025	Sage Creek below mining	UNF	BDL	U (10)	180						180		3	B	210		BDL	U (4)	70	
SCBTT025	Sage Creek below mining	F	BDL	U (10)					185											
SCMTT026	Sage Creek (mouth)	UNF	BDL	U (10)	190		18				210		2	B	260		BDL	U (4)	18	
SCMTT026	Sage Creek (mouth)	F	12						207											
SCPTT027	Sage Creek below Pole Creek	UNF	BDL	U (10)	170		9				180		3	B	240		BDL	U (4)	36	
SCPTT027	Sage Creek below Pole Creek	F	BDL	U (10)					180											
SHETT019	Sheep Creek	UNF	BDL	U (10)	190						190		2	B	220		4		48	
SHETT019	Sheep Creek	F	12						188											

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TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Total Alkalinity		Total Organic Carbon		Total Dissolved Solids		Total Suspended Solids		Total Phosphorous	
			(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)
SLCTT002	Stateland Creek	UNF	BDL	U (10)	170						170		3	B	210		6		120	
SLCTT002	Stateland Creek	F	BDL	U (10)					190											
SLUTT005	Slug Creek at USFS boundary	UNF	BDL	U (10)	220						220		4	B	260		6		100	
SLUTT005	Slug Creek at USFS boundary	F	12						201											
SMATT021	Smoky Creek above mining	UNF	BDL	U (10)	210						210		4	B	240		13		66	
SMATT021	Smoky Creek above mining	F	BDL	U (10)					205											
SMBTT020	Smoky Creek below mining	UNF	15		200		18				220		4	B	260		38		170	
SMBTT020	Smoky Creek below mining	F	13						208											
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (10)	170		6				170		2	B	210		BDL	U (4)	34	
SPRTT016	Spring Creek (mouth)	F/4-DAY	12						175											
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (10)	180		9				190				210		BDL	U (4)	50	
SPRTT016	Spring Creek (mouth)	F/4-DAY	BDL	U (10)					175											
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	BDL	U (10)	190						190				200		BDL	U (4)	23	
SPRTT016	Spring Creek (mouth)	F/4-DAY	BDL	U (10)					187											
SSBTT022	South Fork Sage Creek below mining	UNF	BDL	U (10)	200						200		3	B	240		BDL	U (4)	59	
SSBTT022	South Fork Sage Creek below mining	F	BDL	U (10)					206											
TRATT003	Trail Creek near mouth	UNF	BDL	U (10)	140		27				170		4	B	180		BDL	U (4)	38	
TRATT003	Trail Creek near mouth	F	14						160											
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	BDL	U (10)	170		9				180		7		170		BDL	U (4)	37	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	14						171											

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TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	FIELD PARAMETERS						
			DO	Flow	ORP	pH	SC	Temp	Turb
			(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
ANGTT010	Angus Creek (mouth)	UNF	9.42	1.67	110	8.40	0.365	12.5	0.00
ANGTT010	Angus Creek (mouth)	F							
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	10.9	53.79	113	8.49	0.345	8.04	0.00
BFDTT008	Blackfoot River above Dry Valley Creek	F							
BFNTT009	Blackfoot River above Narrows	UNF	13.2	48.60	122	8.76	0.326	7.74	0.00
BFNTT009	Blackfoot River above Narrows	F							
BFNTT009	Blackfoot River above Narrows	UNF/DUP	13.2	48.60	122	8.76	0.326	7.74	0.00
BFNTT009	Blackfoot River above Narrows	F/DUP							
BFUTT015	Blackfoot River at upper bridge	UNF	11.5	41.46	147	8.67	0.339	8.25	0.00
BFUTT015	Blackfoot River at upper bridge	F							
CALTT004	Caldwell Creek	UNF	8.38	0.02	69	8.51	0.407	14.9	28.2
CALTT004	Caldwell Creek	F							
CCATT029	Crow Creek above Deer Creek	UNF	14.0	11.71	201	7.67	nd	5.67	3.13
CCATT029	Crow Creek above Deer Creek	F							
DCMTT028	Deer Creek (mouth)	UNF	12.9	1.77	190	7.84	0.367	5.48	1.67
DCMTT028	Deer Creek (mouth)	F							
DIATT018	Diamond Creek at USFS boundary	UNF	nd	5.47	188	7.95	0.377	9.84	-4.93
DIATT018	Diamond Creek at USFS boundary	F							
EMCTT017	East Mill Creek above split	UNF/4-DAY	nd	1.06	56	8.39	0.372	9.73	0.00
EMCTT017	East Mill Creek above split	F/4-DAY							
EMCTT017	East Mill Creek above split	UNF/4-DAY	nd	1.06	56	8.39	0.372	9.73	0.00
EMCTT017	East Mill Creek above split	F/4-DAY							
EMCTT017	East Mill Creek above split	UNF/4-DAY	nd	1.06	56	8.39	0.372	9.73	0.00
EMCTT017	East Mill Creek above split	F/4-DAY							
GHCTT006	Goodheart Creek	UNF	8.42	0.03	72	8.44	0.391	19.3	11.4
GHCTT006	Goodheart Creek	F							
GTCTT032	Georgetown Creek	UNF	nd	0.10	209	8.34	0.377	8.34	0.00
GTCTT032	Georgetown Creek	F							
LBFTT001	Little Blackfoot River	UNF	8.55	6.79	109	7.19	0.862	14.4	1.30
LBFTT001	Little Blackfoot River	F							

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	FIELD PARAMETERS						
			DO	Flow	ORP	pH	SC	Temp	Turb
			(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
LBFTT001	Little Blackfoot River	UNF/DUP	110	8.55	6.79	109	7.19	0.862	14.4
LBFTT001	Little Blackfoot River	F/DUP	17						
MACTT011	Middle Angus Creek	UNF	200	nd	0.75	177	8.59	0.390	6.53
MACTT011	Middle Angus Creek	F	15						
MACTT011	Middle Angus Creek	UNF/DUP	240	nd	0.75	177	8.59	0.390	6.53
MACTT011	Middle Angus Creek	F/DUP	13						
MCATT030	Montpelier Creek above mining	UNF	270	10.6	41.91	173	7.99	0.407	13.5
MCATT030	Montpelier Creek above mining	F	11						
MCBTT031	Montpelier Creek below mining	UNF	390	9.48	35.49	149	8.03	0.439	12.9
MCBTT031	Montpelier Creek below mining	F	17						
NNATT013	No Name Creek above mining	UNF/4-DAY	360	nd	0.04	112	7.88	0.265	9.11
NNATT013	No Name Creek above mining	F/4-DAY	36						
NNATT013	No Name Creek above mining	UNF/4-DAY	590	nd	0.04	112	7.88	0.265	9.11
NNATT013	No Name Creek above mining	F/4-DAY	57						
NNATT013	No Name Creek above mining	UNF/4-DAY	540	nd	0.04	112	7.88	0.265	9.11
NNATT013	No Name Creek above mining	F/4-DAY	66						
NNATT013	No Name Creek above mining	UNF/DUP/4-DAY	530	nd	0.04	112	7.88	0.265	9.11
NNATT013	No Name Creek above mining	F/DUP/4-DAY	40						
RASTT014	Rasmussen Creek above Angus Creek	UNF	990	nd	0.25	144	8.96	0.306	7.54
RASTT014	Rasmussen Creek above Angus Creek	F	20						
SCATT024	Sage Creek above mining	UNF	39	12.7	4.54	173	7.76	0.302	7.64
SCATT024	Sage Creek above mining	F	14						
SCBTT025	Sage Creek below mining	UNF	94	11.9	2.66	184	8.14	0.343	9.71
SCBTT025	Sage Creek below mining	F	29						
SCMTT026	Sage Creek (mouth)	UNF	57	11.4	8.86	48	8.10	0.394	9.00
SCMTT026	Sage Creek (mouth)	F	23						
SCPTT027	Sage Creek below Pole Creek	UNF	32	13.0	0.47	157	8.54	0.378	22.0
SCPTT027	Sage Creek below Pole Creek	F	23						
SHETT019	Sheep Creek	UNF	120	nd	4.68	44	8.35	0.364	10.5
SHETT019	Sheep Creek	F	20						

TABLE H-8

TETRA TECH EM INC. 2001 EVENT 2 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	FIELD PARAMETERS						
			DO	Flow	ORP	pH	SC	Temp	Turb
			(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
SLCTT002	Stateland Creek	UNF	9.26	0.04	49	8.34	0.325	12.4	3.93
SLCTT002	Stateland Creek	F							
SLUTT005	Slug Creek at USFS boundary	UNF	8.68	1.05	62	8.30	0.401	12.2	3.43
SLUTT005	Slug Creek at USFS boundary	F							
SMATT021	Smoky Creek above mining	UNF	11.9	0.10	170	7.83	0.393	5.93	4.90
SMATT021	Smoky Creek above mining	F							
SMBTT020	Smoky Creek below mining	UNF	11.8	0.61	186	7.83	0.389	9.59	35.5
SMBTT020	Smoky Creek below mining	F							
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	nd	8.73	-45	8.42	0.348	11.5	0.00
SPRTT016	Spring Creek (mouth)	F/4-DAY							
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	nd	8.73	-45	8.42	0.348	11.5	0.00
SPRTT016	Spring Creek (mouth)	F/4-DAY							
SPRTT016	Spring Creek (mouth)	UNF/4-DAY	nd	8.73	-45	8.42	0.348	11.5	0.00
SPRTT016	Spring Creek (mouth)	F/4-DAY							
SSBTT022	South Fork Sage Creek below mining	UNF	10.3	6.30	194	7.69	0.395	11.8	8.23
SSBTT022	South Fork Sage Creek below mining	F							
TRATT003	Trail Creek near mouth	UNF	11.9	1.53	108	8.89	0.317	15.8	0.00
TRATT003	Trail Creek near mouth	F							
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	11.3	0.35	113	8.35	0.337	6.63	0.13
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F							

Notes:

[1] F = Filtered, UNF = Unfiltered, DUP = Field Duplicate, 4-DAY = 4-Day Averaging Sample

BDL	Below detection limit	mg $CaCO_3$/L	Miiligram calcium carbonate per liter	ND	No data	Temp	Temperature
CFS	Cubic feet per second	mg/L	Milligram per liter	NTU	Nephelometric units	Turb	Turbidity
Deg C	Degree Celsius	mv	Millivolt	ORP	Oxygen and reduction potential	ug/L	Microgram per liter
DO	Dissolved oxygen	mS/cm	Millisiemens per centimeter	SC	Specific conductance		

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
U Analyte was analyzed for but not detected at the indicated MDL

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	26		BDL	U (2.5)	BDL	U (0.5)	43		BDL	U (5)	42		BDL	U (0.13)	2000		BDL	U (0.5)
BFDTT008	Blackfoot River above Dry Valley Creek	F	25		BDL	U (2.5)	BDL	U (0.5)	BDL	U (10)	BDL	U (5)	51		BDL	U (0.13)			BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	UNF	25		BDL	U (2.5)	BDL	U (0.5)	49		BDL	U (5)	88		BDL	U (0.13)	1900		BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	F	21		BDL	U (2.5)	BDL	U (0.5)	55		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	UNF/DUP	23		BDL	U (2.5)	BDL	U (0.5)	49		BDL	U (5)	60		BDL	U (0.13)	1900		BDL	U (0.5)
BFNTT009	Blackfoot River above Narrows	F/DUP	12		BDL	U (2.5)	BDL	U (0.5)	53		BDL	U (5)	73		BDL	U (0.13)			BDL	U (0.5)
BFUTT015	Blackfoot River at upper bridge	UNF	40		BDL	U (2.5)	BDL	U (0.5)	52		BDL	U (5)	73		BDL	U (0.13)	1900		BDL	U (0.5)
BFUTT015	Blackfoot River at upper bridge	F	23		BDL	U (2.5)	BDL	U (0.5)	53		BDL	U (5)	94		BDL	U (0.13)			BDL	U (0.5)
CALTT004	Caldwell Creek	UNF	380		BDL	U (2.5)	BDL	U (0.5)	100		BDL	U (5)	60		BDL	U (0.13)	9900		BDL	U (0.5)
CALTT004	Caldwell Creek	F	28		BDL	U (2.5)	BDL	U (0.5)	93		BDL	U (5)	87		BDL	U (0.13)			BDL	U (0.5)
CALTT004	Caldwell Creek	UNF/DUP	630		BDL	U (2.5)	BDL	U (0.5)	180		BDL	U (5)	80		0.71		9900		BDL	U (0.5)
CALTT004	Caldwell Creek	F/DUP	33		BDL	U (2.5)	BDL	U (0.5)	96		BDL	U (5)	210		BDL	U (0.13)			BDL	U (0.5)
CCATT029	Crow Creek above Deer Creek	UNF	24		BDL	U (2.5)	BDL	U (0.5)	44		BDL	U (5)	65		BDL	U (0.13)	79000		BDL	U (0.5)
CCATT029	Crow Creek above Deer Creek	F	13		BDL	U (2.5)	BDL	U (0.5)	52		BDL	U (5)	64		BDL	U (0.13)			BDL	U (0.5)
DCMTT028	Deer Creek (mouth)	UNF	17		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	62		BDL	U (0.13)	1800		BDL	U (0.5)
DCMTT028	Deer Creek (mouth)	F	15		BDL	U (2.5)	BDL	U (0.5)	31		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
DIATT018	Diamond Creek at USFS boundary	UNF	20		BDL	U (2.5)	BDL	U (0.5)	22		BDL	U (5)	65		BDL	U (0.13)	1200		BDL	U (0.5)
DIATT018	Diamond Creek at USFS boundary	F	20		BDL	U (2.5)	BDL	U (0.5)	25		BDL	U (5)	58		BDL	U (0.13)			BDL	U (0.5)
EMCTT017	East Mill Creek above split	UNF	13		BDL	U (2.5)	BDL	U (0.5)	23		BDL	U (5)	74		BDL	U (0.13)	1800		BDL	U (0.5)
EMCTT017	East Mill Creek above split	F	14		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	60		BDL	U (0.13)			BDL	U (0.5)
EMCTT017	East Mill Creek above split	UNF/S	4		BDL	U (0.2)	BDL	U (0.5)	26		BDL	U (2)	20	B	BDL	U (0.1)			0.4	BI
EMCTT017	East Mill Creek above split	F/S	39		BDL	U (0.2)	BDL	U (0.5)	26		BDL	U (2)	20	B	BDL	U (0.1)			0.5	BI
GTCTT032	Georgetown Creek	UNF	32		BDL	U (2.5)	BDL	U (0.5)	31		BDL	U (5)	82		BDL	U (0.13)	1200		BDL	U (0.5)
GTCTT032	Georgetown Creek	F	21		BDL	U (2.5)	BDL	U (0.5)	35		BDL	U (5)	87		BDL	U (0.13)			0.95	
LBFTT001	Little Blackfoot River	UNF	38		BDL	U (2.5)	BDL	U (0.5)	59		BDL	U (5)	85		BDL	U (0.13)	19000		BDL	U (0.5)
LBFTT001	Little Blackfoot River	F	26		BDL	U (2.5)	BDL	U (0.5)	62		BDL	U (5)	130		BDL	U (0.13)			1.4	
MACTT011	Middle Angus Creek	UNF	67		BDL	U (2.5)	BDL	U (0.5)	23		BDL	U (5)	69		BDL	U (0.13)	5100		BDL	U (0.5)
MACTT011	Middle Angus Creek	F	17		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	58		BDL	U (0.13)			BDL	U (0.5)
MCATT030	Montpelier Creek above mining	UNF	9.3		BDL	U (2.5)	BDL	U (0.5)	51		BDL	U (5)	75		BDL	U (0.13)	5200		BDL	U (0.5)
MCATT030	Montpelier Creek above mining	F	12		BDL	U (2.5)	BDL	U (0.5)	57		BDL	U (5)	86		BDL	U (0.13)			BDL	U (0.5)

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
MCBTT031	Montpelier Creek below mining	UNF			BDL	U (2.5)	BDL	U (0.5)	48		BDL	U (5)	97		BDL	U (0.13)	6100		BDL	U (0.5)
MCBTT031	Montpelier Creek below mining	F	11		2.6		BDL	U (0.5)	49		BDL	U (5)	87		BDL	U (0.13)			BDL	U (0.5)
RASTT014	Rasmussen Creek above Angus Creek	UNF	400		BDL	U (2.5)	0.98		38		BDL	U (5)	68		0.14		4900		BDL	U (0.5)
RASTT014	Rasmussen Creek above Angus Creek	F	36		BDL	U (2.5)	BDL	U (0.5)	34		BDL	U (5)	120		BDL	U (0.13)			BDL	U (0.5)
SCATT024	Sage Creek above mining	UNF	11		BDL	U (2.5)	BDL	U (0.5)	24		BDL	U (5)	60		BDL	U (0.13)	1000		BDL	U (0.5)
SCATT024	Sage Creek above mining	F	31		BDL	U (2.5)	BDL	U (0.5)	28		BDL	U (5)	80		BDL	U (0.13)			BDL	U (0.5)
SCBTT025	Sage Creek below mining	UNF	37		BDL	U (2.5)	BDL	U (0.5)	32		BDL	U (5)	110		BDL	U (0.13)	1200		BDL	U (0.5)
SCBTT025	Sage Creek below mining	F	19		BDL	U (2.5)	BDL	U (0.5)	36		BDL	U (5)	96		BDL	U (0.13)			BDL	U (0.5)
SCMTT026	Sage Creek (mouth)	UNF	26		BDL	U (2.5)	BDL	U (0.5)	40		BDL	U (5)	54		BDL	U (0.13)	6400		BDL	U (0.5)
SCMTT026	Sage Creek (mouth)	F	27		BDL	U (2.5)	BDL	U (0.5)	42		BDL	U (5)	64		BDL	U (0.13)			BDL	U (0.5)
SCMTT026	Sage Creek (mouth)	UNF/DUP	32		BDL	U (2.5)	BDL	U (0.5)	40		BDL	U (5)	76		BDL	U (0.13)	6500		BDL	U (0.5)
SCMTT026	Sage Creek (mouth)	F/DUP	13		BDL	U (2.5)	BDL	U (0.5)	40		BDL	U (5)	62		BDL	U (0.13)			BDL	U (0.5)
SCPTT027	Sage Creek below Pole Creek	UNF	10		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	70		BDL	U (0.13)	4000		BDL	U (0.5)
SCPTT027	Sage Creek below Pole Creek	F	17		BDL	U (2.5)	BDL	U (0.5)	32		BDL	U (5)	110		0.19				BDL	U (0.5)
SHETT019	Sheep Creek	UNF	30		BDL	U (2.5)	BDL	U (0.5)	65		BDL	U (5)	73		BDL	U (0.13)	1800		BDL	U (0.5)
SHETT019	Sheep Creek	F	15		BDL	U (2.5)	BDL	U (0.5)	70		BDL	U (5)	63		BDL	U (0.13)			BDL	U (0.5)
SLCTT002	Stateland Creek	UNF	400		BDL	U (2.5)	BDL	U (0.5)	47		BDL	U (5)	60		0.35		4800		BDL	U (0.5)
SLCTT002	Stateland Creek	F	29		BDL	U (2.5)	BDL	U (0.5)	41		BDL	U (5)	50		BDL	U (0.13)			BDL	U (0.5)
SLUTT005	Slug Creek at USFS boundary	UNF	45		BDL	U (2.5)	BDL	U (0.5)	81		BDL	U (5)	63		BDL	U (0.13)	3700		BDL	U (0.5)
SLUTT005	Slug Creek at USFS boundary	F	34		BDL	U (2.5)	BDL	U (0.5)	87		BDL	U (5)	180		BDL	U (0.13)			BDL	U (0.5)
SMATT021	Smoky Creek above mining	UNF	110		BDL	U (2.5)	BDL	U (0.5)	25		BDL	U (5)	64		BDL	U (0.13)	1100		BDL	U (0.5)
SMATT021	Smoky Creek above mining	F	92		BDL	U (2.5)	BDL	U (0.5)	26		BDL	U (5)	340		BDL	U (0.13)			BDL	U (0.5)
SMBTT020	Smoky Creek below mining	UNF	98		BDL	U (2.5)	BDL	U (0.5)	27		BDL	U (5)	88		BDL	U (0.13)	5100		BDL	U (0.5)
SMBTT020	Smoky Creek below mining	F	22		BDL	U (2.5)	BDL	U (0.5)	26		BDL	U (5)	100		BDL	U (0.13)			BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	UNF	17		BDL	U (2.5)	BDL	U (0.5)	36		BDL	U (5)	87		BDL	U (0.13)	1500		BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	F	26		BDL	U (2.5)	BDL	U (0.5)	42		BDL	U (5)	110		BDL	U (0.13)			BDL	U (0.5)
SPRTT016	Spring Creek (mouth)	UNF/S	3	B	BDL	U (0.2)	BDL	U (0.5)	41		BDL	U (2)	10	B	BDL	U (0.1)			0.4	BI
SPRTT016	Spring Creek (mouth)	F/S	15		BDL	U (0.2)	BDL	U (0.5)	41		BDL	U (2)	10	B	BDL	U (0.1)			0.4	BI
SSBTT022	South Fork Sage Creek below mining	UNF	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	41		BDL	U (5)	48		0.36		4200		BDL	U (0.5)
SSBTT022	South Fork Sage Creek below mining	F	13		BDL	U (2.5)	BDL	U (0.5)	43		BDL	U (5)	41		BDL	U (0.13)			0.86	

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chloride		Chromium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SSBTT022	South Fork Sage Creek below mining	UNF/S	3	B	BDL	U (0.2)	BDL	U (0.5)	44		BDL	U (2)	10	B	BDL	U (0.1)			0.8	I
SSBTT022	South Fork Sage Creek below mining	F/S	7		BDL	U (0.2)	BDL	U (0.5)	44		BDL	U (2)	10	B	BDL	U (0.1)			0.8	I
TRATT003	Trail Creek near mouth	UNF	31		BDL	U (2.5)	BDL	U (0.5)	58		BDL	U (5)	58		BDL	U (0.13)	6700		BDL	U (0.5)
TRATT003	Trail Creek near mouth	F	570		BDL	U (2.5)	BDL	U (0.5)	65		BDL	U (5)	65		BDL	U (0.13)			1	
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	50		BDL	U (2.5)	BDL	U (0.5)	46		BDL	U (5)	71		BDL	U (0.13)	2000		BDL	U (0.5)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	22		BDL	U (2.5)	BDL	U (0.5)	50		BDL	U (5)	180		BDL	U (0.13)			BDL	U (0.5)

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	5.8		BDL	U (100)	BDL	U (0.25)	12000		8.4		0.0012		BDL	U (2.5)	43		BDL	U (100)
BFDTT008	Blackfoot River above Dry Valley Creek	F	BDL	U (0.13)			BDL	U (0.25)	14000		5.7				BDL	U (2.5)	BDL	U (0.13)		
BFNTT009	Blackfoot River above Narrows	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	12000		4.9		0.0019		BDL	U (2.5)	1.1		BDL	U (100)
BFNTT009	Blackfoot River above Narrows	F	BDL	U (0.13)			BDL	U (0.25)	13000		2.5				BDL	U (2.5)	0.78			
BFNTT009	Blackfoot River above Narrows	UNF/DUP	BDL	U (0.13)	BDL	U (100)	0.54		12000		5.7		0.0028		BDL	U (2.5)	1.3		6300	
BFNTT009	Blackfoot River above Narrows	F/DUP	BDL	U (0.13)			BDL	U (0.25)	13000		2				BDL	U (2.5)	BDL	U (0.13)		
BFUTT015	Blackfoot River at upper bridge	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	12000		9.7		0.0026		BDL	U (2.5)	1.1		250	
BFUTT015	Blackfoot River at upper bridge	F	BDL	U (0.13)			BDL	U (0.25)	13000		6.1				BDL	U (2.5)	0.14			
CALTT004	Caldwell Creek	UNF	0.74		150		0.75		14000		120		0.0024		BDL	U (2.5)	2		BDL	U (100)
CALTT004	Caldwell Creek	F	BDL	U (0.13)			BDL	U (0.25)	14000		36				BDL	U (2.5)	0.69			
CALTT004	Caldwell Creek	UNF/DUP	0.67		140		2.3		16000		810		0.0081		BDL	U (2.5)	2.2		BDL	U (100)
CALTT004	Caldwell Creek	F/DUP	BDL	U (0.13)			BDL	U (0.25)	15000		76				BDL	U (2.5)	0.96			
CCATT029	Crow Creek above Deer Creek	UNF	3.3		170		BDL	U (0.25)	16000		19		0.0008		BDL	U (2.5)	1		BDL	U (100)
CCATT029	Crow Creek above Deer Creek	F	3.1				BDL	U (0.25)	17000		12				BDL	U (2.5)	8.6			
DCMTT028	Deer Creek (mouth)	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	18000		14		0.0006		BDL	U (2.5)	0.91		BDL	U (100)
DCMTT028	Deer Creek (mouth)	F	BDL	U (0.13)			BDL	U (0.25)	19000		10				BDL	U (2.5)	0.2			

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
DIATT018	Diamond Creek at USFS boundary	UNF	BDL	U (0.13)	BDL	U (100)	0.29		12000		19		0.0015		BDL	U (2.5)	1.2		BDL	U (100)
DIATT018	Diamond Creek at USFS boundary	F	BDL	U (0.13)			BDL	U (0.25)	14000		14				BDL	U (2.5)	1.2			
EMCTT017	East Mill Creek above split	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	12000		8.5		0.0006		BDL	U (2.5)	1.3		260	
EMCTT017	East Mill Creek above split	F	BDL	U (0.13)			BDL	U (0.25)	13000		BDL	U (2)			BDL	U (2.5)	BDL	U (0.13)		
EMCTT017	East Mill Creek above split	UNF/S	BDL	U (10)			BDL	U (0.1)			BDL	U (5)			0.1	B	1.7			
EMCTT017	East Mill Creek above split	F/S	BDL	U (10)			0.1	B			9	B			0.1	B	2			
GTCTT032	Georgetown Creek	UNF	BDL	U (0.13)	180		BDL	U (0.25)	16000		2.4		0.0003	B	BDL	U (2.5)	1.5		140	
GTCTT032	Georgetown Creek	F	BDL	U (0.13)			BDL	U (0.25)	17000		BDL	U (2)			BDL	U (2.5)	0.5			
LBFTT001	Little Blackfoot River	UNF	0.6		610		BDL	U (0.25)	36000		3		0.0029		BDL	U (2.5)	4.4		140	
LBFTT001	Little Blackfoot River	F	0.33				BDL	U (0.25)	25000		BDL	U (2)			BDL	U (2.5)	3.4			
MACTT011	Middle Angus Creek	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	14000		59		0.0008		BDL	U (2.5)	1.5		110	
MACTT011	Middle Angus Creek	F	0.39				BDL	U (0.25)	14000		39				BDL	U (2.5)	0.86			
MCATT030	Montpelier Creek above mining	UNF	BDL	U (0.13)	120		BDL	U (0.25)	20000		9.7		0.0004	B	BDL	U (2.5)	0.9		BDL	U (100)
MCATT030	Montpelier Creek above mining	F	BDL	U (0.13)			BDL	U (0.25)	20000		6.9				BDL	U (2.5)	BDL	U (0.13)		
MCBTT031	Montpelier Creek below mining	UNF	BDL	U (0.13)	170		BDL	U (0.25)	27000		17		0.0005	B	BDL	U (2.5)	1.2		BDL	U (100)
MCBTT031	Montpelier Creek below mining	F	BDL	U (0.13)			BDL	U (0.25)	28000		13				BDL	U (2.5)	0.69			
RASTT014	Rasmussen Creek above Angus Creek	UNF	0.23		BDL	U (100)	0.39		10000		68		0.0023		BDL	U (2.5)	1.9		2200	
RASTT014	Rasmussen Creek above Angus Creek	F	BDL	U (0.13)			BDL	U (0.25)	11000		39				BDL	U (2.5)	0.19			
SCATT024	Sage Creek above mining	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	14000		2.7		BDL	U (0.0002)	BDL	U (2.5)	0.91		BDL	U (100)
SCATT024	Sage Creek above mining	F	BDL	U (0.13)			BDL	U (0.25)	15000		BDL	U (2)			BDL	U (2.5)	BDL	U (0.13)		
SCBTT025	Sage Creek below mining	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	16000		31		0.001		BDL	U (2.5)	1.4		BDL	U (100)
SCBTT025	Sage Creek below mining	F	BDL	U (0.13)			BDL	U (0.25)	16000		18				BDL	U (2.5)	0.45			
SCMTT026	Sage Creek (mouth)	UNF	BDL	U (0.13)	310		BDL	U (0.25)	20000		25		0.0007		BDL	U (2.5)	0.77		BDL	U (100)
SCMTT026	Sage Creek (mouth)	F	1.6				BDL	U (0.25)	20000		7.3				BDL	U (2.5)	40			
SCMTT026	Sage Creek (mouth)	UNF/DUP	BDL	U (0.13)	300		BDL	U (0.25)	21000		26		0.0006		BDL	U (2.5)	0.97		BDL	U (100)
SCMTT026	Sage Creek (mouth)	F/DUP	BDL	U (0.13)	BDL	U (100)	0.29		12000		19		0.0015		BDL	U (2.5)	1.2			
SCPTT027	Sage Creek below Pole Creek	UNF	BDL	U (0.13)			BDL	U (0.25)	14000		14				BDL	U (2.5)	1.2		BDL	U (100)
SCPTT027	Sage Creek below Pole Creek	F	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	12000		8.5		0.0006		BDL	U (2.5)	1.3			
SHETT019	Sheep Creek	UNF	BDL	U (0.13)			BDL	U (0.25)	13000		BDL	U (2)			BDL	U (2.5)	BDL	U (0.13)	BDL	U (100)
SHETT019	Sheep Creek	F	BDL	U (10)			BDL	U (0.1)			BDL	U (5)			0.1	B	1.7			

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Fluoride		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
SLCTT002	Stateland Creek	UNF	0.66		160		0.58		11000		57		0.006		BDL	U (2.5)	2.5		BDL	U (100)
SLCTT002	Stateland Creek	F	BDL	U (0.13)			BDL	U (0.25)	11000		22				BDL	U (2.5)	1.1			
SLUTT005	Slug Creek at USFS boundary	UNF	BDL	U (0.13)	260		BDL	U (0.25)	14000		17		0.0018		BDL	U (2.5)	1.4		BDL	U (100)
SLUTT005	Slug Creek at USFS boundary	F	BDL	U (0.13)			BDL	U (0.25)	15000		14				BDL	U (2.5)	0.23			
SMATT021	Smoky Creek above mining	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	16000		56		0.0009		BDL	U (2.5)	1.4		BDL	U (100)
SMATT021	Smoky Creek above mining	F	1.6				BDL	U (0.25)	18000		7.6				BDL	U (2.5)	BDL	U (0.13)		
SMBTT020	Smoky Creek below mining	UNF	BDL	U (0.13)	120		BDL	U (0.25)	16000		82		0.0011		BDL	U (2.5)	1.2		BDL	U (100)
SMBTT020	Smoky Creek below mining	F	0.68				BDL	U (0.25)	17000		39				BDL	U (2.5)	12			
SPRTT016	Spring Creek (mouth)	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	11000		15		0.0004	B	BDL	U (2.5)	1.1		BDL	U (100)
SPRTT016	Spring Creek (mouth)	F	BDL	U (0.13)			BDL	U (0.25)	12000		13				BDL	U (2.5)	0.99			
SPRTT016	Spring Creek (mouth)	UNF/S	BDL	U (10)			0.1	B			15	B			0.2	B	2.1			
SPRTT016	Spring Creek (mouth)	F/S	BDL	U (10)			0.1	B			16	B			0.2	B	2			
SSBTT022	South Fork Sage Creek below mining	UNF	BDL	U (0.13)	300		BDL	U (0.25)	20000		3				BDL	U (2.5)	0.78		130	
SSBTT022	South Fork Sage Creek below mining	F	BDL	U (0.13)			BDL	U (0.25)	21000		BDL	U (2)			BDL	U (2.5)	1.8			
SSBTT022	South Fork Sage Creek below mining	UNF/S	BDL	U (10)			BDL	U (0.1)			BDL	U (5)			1.3		1.7			
SSBTT022	South Fork Sage Creek below mining	F/S	BDL	U (10)			BDL	U (0.1)			BDL	U (5)			1.3		1.7			
TRATT003	Trail Creek near mouth	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	13000		19		0.0006		BDL	U (2.5)	1.4		BDL	U (100)
TRATT003	Trail Creek near mouth	F	3.5				BDL	U (0.25)	14000		15				BDL	U (2.5)	2			
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	BDL	U (0.13)	BDL	U (100)	BDL	U (0.25)	13000		17		0.0008		BDL	U (2.5)	1.9		BDL	U (100)
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	BDL	U (0.13)			BDL	U (0.25)	14000		13				BDL	U (2.5)	BDL	U (0.13)		

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Selenium		Silver		Sulfate		Thallium		Uranium		Vanadium		Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)
BFDTT008	Blackfoot River above Dry Valley Creek	UNF	1.7		0.25		9600		BDL	U (2.5)	0.43		BDL	U (0.25)	15		160		4	
BFDTT008	Blackfoot River above Dry Valley Creek	F	1.6		BDL	U (0.25)			BDL	U (2.5)	0.5		6.6		56					
BFNTT009	Blackfoot River above Narrows	UNF	1		BDL	U (0.25)	9300		BDL	U (2.5)	0.4		0.3		BDL	U (10)	150		9	
BFNTT009	Blackfoot River above Narrows	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.45		BDL	U (0.25)	12					
BFNTT009	Blackfoot River above Narrows	UNF/DUP	2		0.37		9400		BDL	U (2.5)	0.39		BDL	U (0.25)	BDL	U (10)	150		9	
BFNTT009	Blackfoot River above Narrows	F/DUP	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.44		BDL	U (0.25)	BDL	U (10)				
BFUTT015	Blackfoot River at upper bridge	UNF	1.1		BDL	U (0.25)	9900		BDL	U (2.5)	0.4		BDL	U (0.25)	12		170		7	
BFUTT015	Blackfoot River at upper bridge	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.46		BDL	U (0.25)	BDL	U (10)				
CALTT004	Caldwell Creek	UNF	1.4		BDL	U (0.25)	17000		BDL	U (2.5)	0.77		2.2		32		220			
CALTT004	Caldwell Creek	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.93		0.56		12					
CALTT004	Caldwell Creek	UNF/DUP	1.5		BDL	U (0.25)	17000		BDL	U (2.5)	0.68		3.8		110		240			
CALTT004	Caldwell Creek	F/DUP	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.92		0.9		12					
CCATT029	Crow Creek above Deer Creek	UNF	1.1		BDL	U (0.25)	15000		BDL	U (2.5)	0.87		BDL	U (0.25)	14		210		4	
CCATT029	Crow Creek above Deer Creek	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.94		BDL	U (0.25)	13					
DCMTT028	Deer Creek (mouth)	UNF	1.6		BDL	U (0.25)	5900		BDL	U (2.5)	1		1.2		12		170		45	
DCMTT028	Deer Creek (mouth)	F	1.1		BDL	U (0.25)			BDL	U (2.5)	1.1		BDL	U (0.25)	13					
DIATT018	Diamond Creek at USFS boundary	UNF	1.6		BDL	U (0.25)	9500		BDL	U (2.5)	0.51		BDL	U (0.25)	BDL	U (10)	200			
DIATT018	Diamond Creek at USFS boundary	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.62		BDL	U (0.25)	10					
EMCTT017	East Mill Creek above split	UNF	22		BDL	U (0.25)	9000		BDL	U (2.5)	0.31		BDL	U (0.25)	BDL	U (10)	180			
EMCTT017	East Mill Creek above split	F	21		BDL	U (0.25)			BDL	U (2.5)	0.34		BDL	U (0.25)	14					
EMCTT017	East Mill Creek above split	UNF/S	19	I	BDL	U (0.05)			BDL	U (0.05)	0.31		0.66	I	BDL	U (10)				
EMCTT017	East Mill Creek above split	F/S	18	I	BDL	U (0.05)			BDL	U (0.05)	0.32		0.34	I	BDL	U (10)				
GTCTT032	Georgetown Creek	UNF	2		BDL	U (0.25)	29000		BDL	U (2.5)	0.97		0.37		13		180			
GTCTT032	Georgetown Creek	F	1.7		BDL	U (0.25)			BDL	U (2.5)	1.1		BDL	U (0.25)	10					
LBFTT001	Little Blackfoot River	UNF	2.1		BDL	U (0.25)	47000		BDL	U (2.5)	1.6		BDL	U (0.25)	20		430			
LBFTT001	Little Blackfoot River	F	1.6		BDL	U (0.25)			BDL	U (2.5)	1.8		BDL	U (0.25)	18					
MACTT011	Middle Angus Creek	UNF	BDL	U (1)	BDL	U (0.25)	37000		BDL	U (2.5)	0.43		BDL	U (0.25)	10		190			
MACTT011	Middle Angus Creek	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.48		BDL	U (0.25)	12					
MCATT030	Montpelier Creek above mining	UNF	BDL	U (1)	BDL	U (0.25)	62000		BDL	U (2.5)	0.6		BDL	U (0.25)	11		190			
MCATT030	Montpelier Creek above mining	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.67		BDL	U (0.25)	12					

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Selenium		Silver		Sulfate		Thallium		Uranium		Vanadium		Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)
MCBTT031	Montpelier Creek below mining	UNF	3.3		BDL	U (0.25)	150000		BDL	U (2.5)	0.73		0.44		18		190			
MCBTT031	Montpelier Creek below mining	F	3.5		BDL	U (0.25)			4.7		1.8		BDL	U (0.25)	15					
RASTT014	Rasmussen Creek above Angus Creek	UNF	BDL	U (1)	BDL	U (0.25)	9200		BDL	U (2.5)	0.51		1.2		15		160		8	
RASTT014	Rasmussen Creek above Angus Creek	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.53		BDL	U (0.25)	13					
SCATT024	Sage Creek above mining	UNF	BDL	U (1)	BDL	U (0.25)	19000		BDL	U (2.5)	0.42		BDL	U (0.25)	10		180			
SCATT024	Sage Creek above mining	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.53		BDL	U (0.25)	12					
SCBTT025	Sage Creek below mining	UNF	BDL	U (1)	BDL	U (0.25)	26000		BDL	U (2.5)	0.54		BDL	U (0.25)	12		200			
SCBTT025	Sage Creek below mining	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.56		BDL	U (0.25)	14					
SCMTT026	Sage Creek (mouth)	UNF	5.1		BDL	U (0.25)	28000		BDL	U (2.5)	1.3		BDL	U (0.25)	13		170		13	
SCMTT026	Sage Creek (mouth)	F	4.4		BDL	U (0.25)			BDL	U (2.5)	1.5		BDL	U (0.25)	25					
SCMTT026	Sage Creek (mouth)	UNF/DUP	5.4		BDL	U (0.25)	26000		BDL	U (2.5)	1.3		BDL	U (0.25)	13		180		9	
SCMTT026	Sage Creek (mouth)	F/DUP	4.7		BDL	U (0.25)			BDL	U (2.5)	1.6		0.8		BDL	U (10)				
SCPTT027	Sage Creek below Pole Creek	UNF	1.2		BDL	U (0.25)	34000		BDL	U (2.5)	0.35		BDL	U (0.25)	BDL	U (10)	140		6	
SCPTT027	Sage Creek below Pole Creek	F	1.1		BDL	U (0.25)			4.2		1.5		BDL	U (0.25)	BDL	U (10)				
SHETT019	Sheep Creek	UNF	BDL	U (1)	BDL	U (0.25)	6500		BDL	U (2.5)	0.45		1.9		BDL	U (10)	190		13	
SHETT019	Sheep Creek	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.5		BDL	U (0.25)	BDL	U (10)				
SLCTT002	Stateland Creek	UNF	2.2		BDL	U (0.25)	6100		BDL	U (2.5)	1.1		3.2		21		180			
SLCTT002	Stateland Creek	F	1.4		BDL	U (0.25)			BDL	U (2.5)	1.2		1.3		14					
SLUTT005	Slug Creek at USFS boundary	UNF	BDL	U (1)	BDL	U (0.25)	3300		BDL	U (2.5)	1.3		BDL	U (0.25)	BDL	U (10)	220			
SLUTT005	Slug Creek at USFS boundary	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	1.5		0.55		11					
SMATT021	Smoky Creek above mining	UNF	BDL	U (1)	BDL	U (0.25)	16000		BDL	U (2.5)	0.27		BDL	U (0.25)	10		210			
SMATT021	Smoky Creek above mining	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.31		BDL	U (0.25)	12					
SMBTT020	Smoky Creek below mining	UNF	BDL	U (1)	BDL	U (0.25)	15000		BDL	U (2.5)	0.46		0.85		10		200		13	
SMBTT020	Smoky Creek below mining	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.55		BDL	U (0.25)	16					
SPRTT016	Spring Creek (mouth)	UNF	1		BDL	U (0.25)	7400		BDL	U (2.5)	0.34		BDL	U (0.25)	BDL	U (10)	200			
SPRTT016	Spring Creek (mouth)	F	2.3		BDL	U (0.25)			BDL	U (2.5)	0.39		BDL	U (0.25)	11					
SPRTT016	Spring Creek (mouth)	UNF/S	2	BI	BDL	U (0.05)			BDL	U (0.05)	0.34		0.83	I	BDL	U (10)				
SPRTT016	Spring Creek (mouth)	F/S	BDL	UI (1)	BDL	U (0.05)			BDL	U (0.05)	0.34		0.69	I	BDL	U (10)				
SSBTT022	South Fork Sage Creek below mining	UNF	2.2		BDL	U (0.25)	13000		BDL	U (2.5)	1.7		0.94		BDL	U (10)	200			
SSBTT022	South Fork Sage Creek below mining	F	1.8		BDL	U (0.25)			BDL	U (2.5)	1.9		BDL	U (0.25)	11					

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Selenium		Silver		Sulfate		Thallium		Uranium		Vanadium		Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)
SSBTT022	South Fork Sage Creek below mining	UNF/S	BDL	U (1)	BDL	U (0.05)			BDL	U (0.05)	1.65		1.16		BDL	U (10)				
SSBTT022	South Fork Sage Creek below mining	F/S	BDL	U (1)	BDL	U (0.05)			BDL	U (0.05)	1.64		1.21		BDL	U (10)				
TRATT003	Trail Creek near mouth	UNF	BDL	U (1)	BDL	U (0.25)	7000		BDL	U (2.5)	0.32		BDL	U (0.25)	10		190			
TRATT003	Trail Creek near mouth	F	BDL	U (1)	BDL	U (0.25)			BDL	U (2.5)	0.35		BDL	U (0.25)	13					
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF	1.4		BDL	U (0.25)	9700		BDL	U (2.5)	0.46		BDL	U (0.25)	BDL	U (10)	160			
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	1.4		BDL	U (0.25)			BDL	U (2.5)	0.54		BDL	U (0.25)	BDL	U (10)				

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS												FIELD PARAMETERS						
			Hardness		Total Alkalinity		Total Organic Carbon		Total Dissolved Solids		Total Suspended Solids		Total Phosphorous		DO	Flow	ORP	pH	SC	Temp	Turb
			(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)	(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
BFDTT008	Blackfoot River above Dry Valley Creek	UNF			170		2	B	160		BDL	U (4)	10		11.2	31.18	174	8.53	0.314	15.4	0.78
BFDTT008	Blackfoot River above Dry Valley Creek	F	170												11.2	31.18	174	8.53	0.314	15.4	0.78
BFNTT009	Blackfoot River above Narrows	UNF			160		3	B	190		BDL	U (4)	11		15.3	23.45	136	8.47	0.311	14.9	1.23
BFNTT009	Blackfoot River above Narrows	F	168												15.3	23.45	136	8.47	0.311	14.9	1.23
BFNTT009	Blackfoot River above Narrows	UNF/DUP			160		4	B	230		BDL	U (4)	11		15.3	23.45	136	8.47	0.311	14.9	1.23
BFNTT009	Blackfoot River above Narrows	F/DUP	168												15.3	23.45	136	8.47	0.311	14.9	1.23
BFUTT015	Blackfoot River at upper bridge	UNF			180		30	B	190		BDL	U (4)	20		13.8	19.84	142	8.40	0.335	15.0	1.92
BFUTT015	Blackfoot River at upper bridge	F	183												13.8	19.84	142	8.40	0.335	15.0	1.92
CALTT004	Caldwell Creek	UNF			220		9		250		54		220		7.21	0.01	183	8.27	0.451	18.8	61.9
CALTT004	Caldwell Creek	F	227												7.21	0.01	183	8.27	0.451	18.8	61.9
CALTT004	Caldwell Creek	UNF/DUP			240		6		250		490		720		7.21	0.01	183	8.27	0.451	18.8	61.9
CALTT004	Caldwell Creek	F/DUP	232												7.21	0.01	183	8.27	0.451	18.8	61.9
CCATT029	Crow Creek above Deer Creek	UNF			210		5	B	370		BDL	U (4)	27		9.43	14.43	100	8.67	0.641	12.0	ND
CCATT029	Crow Creek above Deer Creek	F	225												9.43	14.43	100	8.67	0.641	12.0	ND
DCMTT028	Deer Creek (mouth)	UNF			210		1	B	220		BDL	U (4)	32		8.90	1.48	-6	8.64	0.375	11.3	ND
DCMTT028	Deer Creek (mouth)	F	216												8.90	1.48	-6	8.64	0.375	11.3	ND
DIATT018	Diamond Creek at USFS boundary	UNF			200		2	B	220		BDL	U (4)	32		8.53	2.87	113	7.92	0.376	10.5	0.71

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

			ANALYTICAL RESULTS												FIELD PARAMETERS						
			Hardness		Total Alkalinity		Total Organic Carbon		Total Dissolved Solids		Total Suspended Solids		Total Phosphorous		DO	Flow	ORP	pH	SC	Temp	Turb
STATION ID	STATION NAME	SAMPLE TYPE[1]	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)	(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
DIATT018	Diamond Creek at USFS boundary	F	205												8.53	2.87	113	7.92	0.376	10.5	0.71
EMCTT017	East Mill Creek above split	UNF			180		4	B	240		BDL	U (4)	38		9.97	0.70	135	7.78	0.342	6.19	1.03
EMCTT017	East Mill Creek above split	F	188												9.97	0.70	135	7.78	0.342	6.19	1.03
EMCTT017	East Mill Creek above split	UNF/S													9.97	0.70	135	7.78	0.342	6.19	1.03
EMCTT017	East Mill Creek above split	F/S													9.97	0.70	135	7.78	0.342	6.19	1.03
GTCTT032	Georgetown Creek	UNF			180		BDL	U (1)	230		BDL	U (4)	19		8.41	2.73	44.9	8.47	0.379	9.75	nd
GTCTT032	Georgetown Creek	F	217												8.41	2.73	44.9	8.47	0.379	9.75	nd
LBFTT001	Little Blackfoot River	UNF			430		2	B	520		8		22		8.03	ND	62.1	7.19	0.932	16.4	0.88
LBFTT001	Little Blackfoot River	F	469												8.03	ND	62.1	7.19	0.932	16.4	0.88
MACTT011	Middle Angus Creek	UNF			190		2	B	310		BDL	U (4)	36		9.88	0.06	37.4	8.17	0.431	4.60	2.95
MACTT011	Middle Angus Creek	F	227												9.88	0.06	37.4	8.17	0.431	4.60	2.95
MCATT030	Montpelier Creek above mining	UNF			190		2	B	280		BDL	U (4)	10		8.69	3.16	101	8.44	0.463	9.65	nd
MCATT030	Montpelier Creek above mining	F	237												8.69	3.16	101	8.44	0.463	9.65	nd
MCBTT031	Montpelier Creek below mining	UNF			190		2	B	390		BDL	U (4)	15		8.54	3.81	130	8.27	0.639	8.96	nd
MCBTT031	Montpelier Creek below mining	F	345												8.54	3.81	130	8.27	0.639	8.96	nd
RASTT014	Rasmussen Creek above Angus Creek	UNF			170		2	B	250		36		120		8.87	0.13	73.2	8.55	0.332	11.9	12.4
RASTT014	Rasmussen Creek above Angus Creek	F	173												8.87	0.13	73.2	8.55	0.332	11.9	12.4
SCATT024	Sage Creek above mining	UNF			180		BDL	U (1)	180		BDL	U (4)	10		9.83	1.58	45.8	8.45	0.357	8.45	0.33
SCATT024	Sage Creek above mining	F	194												9.83	1.58	45.8	8.45	0.357	8.45	0.33
SCBTT025	Sage Creek below mining	UNF			200		BDL	U (1)	190		BDL	U (4)	45		9.21	0.60	103	8.43	0.394	14.2	2.50
SCBTT025	Sage Creek below mining	F	217												9.21	0.60	103	8.43	0.394	14.2	2.50
SCMTT026	Sage Creek (mouth)	UNF			190		3	B	240		6		22		8.00	12.57	44.8	8.90	0.334	17.0	nd
SCMTT026	Sage Creek (mouth)	F	210												8.00	12.57	44.8	8.90	0.334	17.0	nd
SCMTT026	Sage Creek (mouth)	UNF/DUP			190		2	B	250		5		21		8.00	12.57	44.8	8.90	0.334	17.0	nd
SCMTT026	Sage Creek (mouth)	F/DUP	210												8.00	12.57	44.8	8.90	0.334	17.0	nd
SCPTT027	Sage Creek below Pole Creek	UNF			150		2	B	170		BDL	U (4)	BDL	U (10)	9.85	0.12	110	8.57	0.348	15.7	0.06
SCPTT027	Sage Creek below Pole Creek	F	182												9.85	0.12	110	8.57	0.348	15.7	0.06
SHETT019	Sheep Creek	UNF			200		5		240		BDL	U (4)	32		10.8	2.41	67.9	8.59	0.372	14.6	1.02
SHETT019	Sheep Creek	F	200												10.8	2.41	67.9	8.59	0.372	14.6	1.02
SLCTT002	Stateland Creek	UNF			180		4	B	260		71		250		9.41	0.03	139	8.11	0.282	16.0	31.1

TABLE H-9

TETRA TECH EM INC. 2001 EVENT 3 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS												FIELD PARAMETERS						
			Hardness		Total Alkalinity		Total Organic Carbon		Total Dissolved Solids		Total Suspended Solids		Total Phosphorous		DO	Flow	ORP	pH	SC	Temp	Turb
			(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(ug/L)	Flag (ug/L)	(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
SLCTT002	Stateland Creek	F	170												9.41	0.03	139	8.11	0.282	16.0	31.1
SLUTT005	Slug Creek at USFS boundary	UNF			220		3	B	210		BDL	U (4)	82		11.0	0.29	159	8.12	0.393	6.58	1.65
SLUTT005	Slug Creek at USFS boundary	F	217												11.0	0.29	159	8.12	0.393	6.58	1.65
SMATT021	Smoky Creek above mining	UNF			210		BDL	U (1)	210		21		52		9.16	0.11	148	8.17	0.356	7.30	1.80
SMATT021	Smoky Creek above mining	F	221												9.16	0.11	148	8.17	0.356	7.30	1.80
SMBTT020	Smoky Creek below mining	UNF			210		2	B	210		23		110		7.91	0.38	47.9	8.56	0.408	15.2	6.50
SMBTT020	Smoky Creek below mining	F	220												7.91	0.38	47.9	8.56	0.408	15.2	6.50
SPRTT016	Spring Creek (mouth)	UNF			200				240		BDL	U (4)	28		10.4	4.68	111	7.89	0.344	10.0	0.88
SPRTT016	Spring Creek (mouth)	F	164												10.4	4.68	111	7.89	0.344	10.0	0.88
SPRTT016	Spring Creek (mouth)	UNF/S													10.4	4.68	111	7.89	0.344	10.0	0.88
SPRTT016	Spring Creek (mouth)	F/S													10.4	4.68	111	7.89	0.344	10.0	0.88
SSBTT022	South Fork Sage Creek below mining	UNF			200				200		BDL	U (4)	11		8.36	5.25	76.9	7.95	0.396	11.9	0.24
SSBTT022	South Fork Sage Creek below mining	F	216												8.36	5.25	76.9	7.95	0.396	11.9	0.24
SSBTT022	South Fork Sage Creek below mining	UNF/S													8.36	5.25	76.9	7.95	0.396	11.9	0.24
SSBTT022	South Fork Sage Creek below mining	F/S													8.36	5.25	76.9	7.95	0.396	11.9	0.24
TRATT003	Trail Creek near mouth	UNF			190		7		180		BDL	U (4)	19		12.1	0.44	219	8.24	0.365	13.3	0.97
TRATT003	Trail Creek near mouth	F	192												12.1	0.44	219	8.24	0.365	13.3	0.97
WVCTT007	Wooley Valley Creek at Blackfoot River Road	UNF			160		4	B	160		BDL	U (4)	36		11.6	0.16	176	8.40	0.308	14.8	2.86
WVCTT007	Wooley Valley Creek at Blackfoot River Road	F	165												11.6	0.16	176	8.40	0.308	14.8	2.86

Notes:

[1] F = Filtered, UNF = Unfiltered, DUP = Field Duplicate, S = Split Sample

BDL	Below detection limit	mg $CaCO_3$/L	Miiligram calcium carbonate per liter	ND	No data	Temp	Temperature
CFS	Cubic feet per second	mg/L	Milligram per liter	NTU	Nephelometric units	Turb	Turbidity
Deg C	Degree Celsius	mv	Millivolt	ORP	Oxygen and reduction potential	ug/L	Microgram per liter
DO	Dissolved oxygen	mS/cm	Millisiemens per centimeter	SC	Specific conductance		

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:

B	Analyte concentration detected at a value between Method Detection Limit (MDL) and Practical Quantitation Limit (PQL)
I	Value estimated due to matrix interferences
U	Analyte was analyzed for but not detected at the indicated MDL

TABLE H-10

TETRA TECH EM INC. 2001 EVENT 4 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
EMCNTT045	East Mill Creek North (wetland area)	UNF	760		BDL	U (0.2)	BDL	U (0.5)	34		BDL	U (0.1)	10	B	0.7		4.6		2.3	B
EMCTT043	East Mill Creek	UNF	64.6		BDL	U (0.2)	BDL	U (0.5)	24		BDL	U (0.1)	10	B	BDL	U (0.1)	0.3	B	BDL	U (0.5)
KCTT042	Kendall Creek	UNF	34.1		BDL	U (0.2)	BDL	U (0.5)	29		BDL	U (0.1)	20	B	BDL	U (0.1)	BDL	U (0.1)	BDL	U (0.5)
LSCTT040	Lower Sage Creek	UNF	10		BDL	U (0.2)	BDL	U (0.5)	41		BDL	U (0.1)	20	B	BDL	U (0.1)	0.2	B	BDL	U (0.5)
MCTT044	Maybe Creek	UNF	218		BDL	U (0.4)	5	B	33		5		30	B	1.8		0.9	B	1	B
SCAETT047	Spring Creek above East Mill Creek	UNF	10.7		BDL	U (0.2)	0.6	B	40		BDL	U (0.1)	10	B	BDL	U (0.1)	0.4	B	BDL	U (0.5)
SCAETT047	Spring Creek above East Mill Creek	UNF/DUP	16.6		BDL	U (0.2)	BDL	U (0.5)	41		BDL	U (0.1)	10	B	BDL	U (0.1)	BDL	U (0.1)	1	B
SCBETT046	Spring Creek below East Mill Creek	UNF	45.1		BDL	U (0.2)	BDL	U (0.5)	38		BDL	U (0.1)	10	B	BDL	U (0.1)	BDL	U (0.1)	BDL	U (0.5)
USCTT041	Upper Sage Creek	UNF	99		BDL	U (0.4)	BDL	U (1)	29		BDL	U (0.2)	20	B	BDL	U (0.2)	BDL	U (0.2)	BDL	U (1)

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)
EMCNTT045	East Mill Creek North (wetland area)	UNF	0.7		11800		119		0.0094		0.3	B	5.4		38		0.07	BO	BDL	U (0.05)
EMCTT043	East Mill Creek	UNF	BDL	U (0.1)	12100		12	B	0.0014		BDL	U (0.1)	1.2		36		BDL	UO (0.05)	BDL	U (0.05)
KCTT042	Kendall Creek	UNF	BDL	U (0.1)	7800		BDL	U (5)	0.0008		0.1	B	0.9	B	BDL	U (1)	BDL	UO (0.05)	BDL	U (0.05)
LSCTT040	Lower Sage Creek	UNF	BDL	U (0.1)	19400		BDL	U (5)	0.0007		1.5		1.2		4	B	BDL	UO (0.05)	BDL	U (0.05)
MCTT044	Maybe Creek	UNF	BDL	U (0.2)	38500		31		0.0009		10.1		28.5		1140		BDL	UO (0.1)	0.2	B
SCAETT047	Spring Creek above East Mill Creek	UNF	BDL	U (0.1)	10900		BDL	U (5)	0.0006		0.2	B	0.8	B	BDL	U (1)	BDL	U (0.05)	BDL	U (0.05)
SCAETT047	Spring Creek above East Mill Creek	UNF/DUP	BDL	U (0.1)	10900		6	B	0.0009		0.1	B	1.5		1	B	BDL	UO (0.05)	BDL	U (0.05)
SCBETT046	Spring Creek below East Mill Creek	UNF	BDL	U (0.1)	11000		20	B	0.0028		0.2	B	1.1		3	B	BDL	UO (0.05)	BDL	U (0.05)
USCTT041	Upper Sage Creek	UNF	BDL	U (0.2)	14000		18	B	0.0005		BDL	U (0.2)	1	B	BDL	U (1)	BDL	UO (0.1)	BDL	U (0.1)

TABLE H-10

TETRA TECH EM INC. 2001 EVENT 4 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Uranium		Vanadium		Zinc		Bicarbonate Alkalinity		Carbonate Alkalinity		Hardness		Hydroxide Alkalinity		Total Alkalinity		Total Organic Carbon	
			(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(ug/L)	Flag (ug/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg $CaCO_3$/L)	Flag (mg $CaCO_3$/L)	(mg/L)	Flag (mg/L)
EMCNTT045	East Mill Creek North (wetland area)	UNF	0.55		4.76		50	B	184		BDL	U (2)	179		BDL	U (2)	184		2	B
EMCTT043	East Mill Creek	UNF	0.35		0.72		20	B	182		BDL	U (2)	175		BDL	U (2)	182		BDL	U (1)
KCTT042	Kendall Creek	UNF	0.32		BDL	U (0.05)	20	B	167		BDL	U (2)	161		BDL	U (2)	167		BDL	U (1)
LSCTT040	Lower Sage Creek	UNF	1.41		1.23		10	B	185		7	B	213		BDL	U (2)	192		2	B
MCTT044	Maybe Creek	UNF	5.4		6.2		90		171		BDL	U (2)	548		BDL	U (2)	171		4	B
SCAETT047	Spring Creek above East Mill Creek	UNF	0.35		0.47		20	B	168		10		173		BDL	U (2)	178		2	B
SCAETT047	Spring Creek above East Mill Creek	UNF/DUP	0.4		0.52		20	B	168		10	B	173		BDL	U (2)	178		2	B
SCBETT046	Spring Creek below East Mill Creek	UNF	0.39		0.62		20	B	189		BDL	U (2)	177		BDL	U (2)	189		2	B
USCTT041	Upper Sage Creek	UNF	0.4	B	BDL	U (0.1)	20	B	176		BDL	U (2)	188		BDL	U (2)	176		BDL	U (1)

STATION ID	STATION NAME	SAMPLE TYPE[1]	FIELD PARAMETERS						
			DO	Flow	ORP	pH	SC	Temp	Turb
			(mg/L)	(CFS)	(mV)	(Field)	(mS/cm)	(Deg C)	(NTU)
EMCNTT045	East Mill Creek North (wetland area)	UNF	9.38	100	7.68	0.233	11.5	ND	9.38
EMCTT043	East Mill Creek	UNF	10.0	223	7.83	0.206	10.8	ND	10.0
KCTT042	Kendall Creek	UNF	10.6	79.4	7.92	0.194	10.1	ND	10.6
LSCTT040	Lower Sage Creek	UNF	10.2	222	8.16	0.338	17.1	ND	10.2
MCTT044	Maybe Creek	UNF	9.27	170	8.04	0.768	12.2	ND	9.27
SCAETT047	Spring Creek above East Mill Creek	UNF	14.6	120	8.15	0.279	16.8	ND	14.6
SCAETT047	Spring Creek above East Mill Creek	UNF/DUP						ND	
SCBETT046	Spring Creek below East Mill Creek	UNF	12.3	198	7.66	0.297	15.0	ND	12.3
USCTT041	Upper Sage Creek	UNF	7.98	149	8.35	0.289	15.0	ND	7.98

Notes:

[1] UNF = Unfiltered, DUP = Field Duplicate

BDL	Below detection limit	mg $CaCO_3$/L	Miiligram calcium carbonate per liter	ND	No data	Temp	Temperature
CFS	Cubic feet per second	mg/L	Milligram per liter	NTU	Nephelometric units	Turb	Turbidity
Deg C	Degree Celsius	mv	Millivolt	ORP	Oxygen and reduction potential	ug/L	Microgram per liter
DO	Dissolved oxygen	mS/cm	Millisiemens per centimeter	SC	Specific conductance		

TABLE H-10

TETRA TECH EM INC. 2001 EVENT 4 SURFACE WATER ANALYTICAL RESULTS AND FIELD DATA

Notes (continued):

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:

B	Analyte concentration detected at a value between Method Detection Limit (MDL) and Practical Quantitation Limit (PQL)
O	Value estimated due to QC outside acceptable limits
U	Analyte was analyzed for but not detected at the indicated MDL

TABLE H-11

TETRA TECH EM INC. 2001 SEDIMENT ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
BFDTT008	Blackfoot River above Dry Valley Creek				BDL	U (1.6)	5.2		87		0.51		BDL	U (2)	1		16		6.4	
BFNTT009	Blackfoot River above Narrows				BDL	U (1.6)	6.1		110		0.63		BDL	U (2)	0.65		42		4.2	
BFUTT015	Blackfoot River at upper bridge				BDL	U (1.6)	2.8		80		0.64		BDL	U (2)	0.69		25		7	
CALTT004	Caldwell Creek				BDL	U (1.6)	2		94		0.62		BDL	U (2)	1.1		21		8.5	
CCATT029	Crow Creek above Deer Creek				BDL	U (1.6)	5.7		93		0.52		BDL	U (2)	0.7		44		3.2	
DCMTT028	Deer Creek (mouth)		24000		BDL	U (0.38)	7.4		170		0.78		BDL	U (2)	4.3		74		16	
DIATT018	Diamond Creek at USFS boundary				BDL	U (1.6)	1.4		140		1.1		25		0.42		50		15	
EMCNTT045	East Mill Creek North (wetland area)		24900	I	BDL	U (0.2)	7.7		174		1		29		11.9		191		44	
EMCTT017	East Mill Creek above split				BDL	U (1.6)	BDL	U (0.5)	130		1.3		12		5.4		83		24	
EMCTT043	East Mill Creek		23600	I	BDL	U (0.1)	5.1		137		1.2		26		6.54		65		21	
GHCTT006	Goodheart Creek				BDL	U (1.6)	16		260		0.9		18		5.8		130		14	
GTCTT032	Georgetown Creek				BDL	U (1.6)	10		75		0.78		BDL	U (2)	8.3		77		14	
KCTT042	Kendall Creek		16200	I	BDL	U (0.04)	3.7		137		0.8		12		0.58		22		13	
LSCTT040	Lower Sage Creek		11400	I	BDL	U (0.04)	1.6		95.6		0.5		15		1.77		27		7	
MCATT030	Montpelier Creek above mining				BDL	U (1.6)	1.8		80		0.6		21		BDL	U (0.2)	11		4.8	
MCBTT031	Montpelier Creek below mining				BDL	U (1.6)	2.4		71		0.66		3		4.5		25		7	
MCBTT031	Montpelier Creek below mining	DUP			BDL	U (1.6)	11		87		0.74		BDL	U (2)	3.4		36		7.7	
MCTT044	Maybe Creek		25500	I	BDL	U (0.4)	3	B	108		1		26		14		47		19	
NNATT013	No Name Creek above mining				2.3		6.6		230		1.6		13		5.1		100		25	
NNBTT012	No Name Creek below mining		41000		BDL	U (0.38)	9.9		250		1.4		BDL	U (2)	8.4		110		28	
SCAETT047	Spring Creek above East Mill Creek		9500	I	BDL	U (0.04)	1.1		82.3		0.39		13		0.72		27		6	
SCAETT047	Spring Creek above East Mill Creek	DUP	9660	I	BDL	U (0.04)	1.3		87.1		0.46		12		0.85		32		7	
SCATT024	Sage Creek above mining				BDL	U (1.6)	12		160		1.2		14		BDL	U (0.2)	43		13	
SCBETT046	Spring Creek below East Mill Creek		20500	I	BDL	U (0.04)	2.5		163		0.74		21		1.23		37		11	
SCMTT026	Sage Creek (mouth)				BDL	U (1.6)	5.3		110		0.7		7.7		0.99		39		5.3	
SCPTT027	Sage Creek below Pole Creek				2		2.8		160		1.1		3.6		1.8		49		15	
SHETT019	Sheep Creek				BDL	U (1.6)	11		140		1		13		BDL	U (0.2)	31		9.2	
SLCTT002	Stateland Creek				3.5		5.9		170		1.4		5.7		2.8		99		20	
SLUTT005	Slug Creek at USFS boundary				BDL	U (1.6)	5.3		140		0.89		6.5		2.5		51		9.4	
SLUTT005	Slug Creek at USFS boundary	DUP			2.5		7.8		110		0.78		12		2.7		33		8.6	

TABLE H-11

TETRA TECH EM INC. 2001 SEDIMENT ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
SMATT021	Smoky Creek above mining				BDL	U (1.6)	12		180		1.3		8.9		BDL	U (0.2)	43		17	
SPRTT016	Spring Creek (mouth)				BDL	U (1.6)	1.8		94		0.9		BDL	U (2)	1.5		43		10	
SSBTT022	South Fork Sage Creek below mining				BDL	U (1.6)	11		130		0.86		BDL	U (2)	2.4		68		9.2	
USCTT041	Upper Sage Creek		19000	I	BDL	U (0.04)	3.7		162		0.73		23		1.1		31		12	

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Lead		Manganese		Mercury		Mercury		Molybdenum		Nickel		Selenium		Silver		Sodium	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(µg/kg)	Flag (µg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
BFDTT008	Blackfoot River above Dry Valley Creek		BDL	U (1.5)	360				27		BDL	U (3.8)	24	2		BDL	U (0.2)	130		2
BFNTT009	Blackfoot River above Narrows		1.6		350				13		BDL	U (3.8)	15	1.6		BDL	U (0.2)	150		1.6
BFUTT015	Blackfoot River at upper bridge		BDL	U (1.5)	220				12		BDL	U (3.8)	18	1.1		BDL	U (0.2)	BDL	U (100)	1.1
CALTT004	Caldwell Creek		BDL	U (1.5)	290				8.8		BDL	U (3.8)	17	0.52		BDL	U (0.2)	BDL	U (100)	0.52
CCATT029	Crow Creek above Deer Creek		BDL	U (1.5)	320				11		BDL	U (3.8)	17	1.2		BDL	U (0.2)	590		1.2
DCMTT028	Deer Creek (mouth)		12		1200		0.089						35	4.2		0.23		190		4.2
DIATT018	Diamond Creek at USFS boundary		14		540				25		BDL	U (3.8)	19	1.3		BDL	U (0.2)	170		1.3
EMCNTT045	East Mill Creek North (wetland area)		20		874		0.227	I			5		81	188		2.04	I			188
EMCTT017	East Mill Creek above split		4.7		1300				11		BDL	U (3.8)	54	21		BDL	U (0.2)	BDL	U (100)	21
EMCTT043	East Mill Creek		13.4		1580		0.052	I			2	B	46	15		0.47	I			15
GHCTT006	Goodheart Creek		8.5		3200				10		BDL	U (3.8)	99	58		BDL	U (0.2)	220		58
GTCTT032	Georgetown Creek		BDL	U (1.5)	170				54		BDL	U (3.8)	26	4.6		BDL	U (0.2)	280		4.6
KCTT042	Kendall Creek		13.1		954		0.032	I			BDL	U (1)	19.2	1.1		0.04	BI			1.1
LSCTT040	Lower Sage Creek		6.24		564		0.027	BI			BDL	U (1)	13.5	3.4		0.11	I			3.4
MCATT030	Montpelier Creek above mining		BDL	U (1.5)	270				8.4		BDL	U (3.8)	6.4	0.57		BDL	U (0.2)	140		0.57
MCBTT031	Montpelier Creek below mining		BDL	U (1.5)	230				19		BDL	U (3.8)	11	1.6		BDL	U (0.2)	230		1.6
MCBTT031	Montpelier Creek below mining	DUP	BDL	U (1.5)	270				16		BDL	U (3.8)	13	1.7		BDL	U (0.2)	170		1.7
MCTT044	Maybe Creek		12.4		1640		0.03	I			2	B	164	29		0.2	BI			29
NNATT013	No Name Creek above mining		13		630				12		4		44	2.6		BDL	U (0.2)	BDL	U (100)	2.6

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TETRA TECH EM INC. 2001 SEDIMENT ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Lead		Manganese		Mercury		Mercury		Molybdenum		Nickel		Selenium		Silver		Sodium	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(µg/kg)	Flag (µg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
NNBTT012	No Name Creek below mining		20		2600		0.12						58		2.6		0.27		130	
SCAETT047	Spring Creek above East Mill Creek		5.62		67		0.032	I			BDL	U (1)	8.16		2		0.05	BI		
SCAETT047	Spring Creek above East Mill Creek	DUP	6.47		64.9		0.047	I			1	B	8.67		1.9		0.08	I		
SCATT024	Sage Creek above mining		6.7		1500				13		BDL	U (3.8)	22		1		BDL	U (0.2)	160	
SCBETT046	Spring Creek below East Mill Creek		8.66		701		0.052	I			1	B	15.4		1.9		0.1	I		
SCMTT026	Sage Creek (mouth)		BDL	U (1.5)	630				14		BDL	U (3.8)	16		2.8		BDL	U (0.2)	690	
SCPTT027	Sage Creek below Pole Creek		4.4		2100				14		BDL	U (3.8)	37		2.8		BDL	U (0.2)	160	
SHETT019	Sheep Creek		6.1		530				26		BDL	U (3.8)	16		0.92		BDL	U (0.2)	BDL	U (100)
SLCTT002	Stateland Creek		7.4		380				12		BDL	U (3.8)	39		3.8		BDL	U (0.2)	230	
SLUTT005	Slug Creek at USFS boundary		7.2		430				17		BDL	U (3.8)	17		1		BDL	U (0.2)	260	
SLUTT005	Slug Creek at USFS boundary	DUP	3.8		310				11		BDL	U (3.8)	16		0.86		BDL	U (0.2)	130	
SMATT021	Smoky Creek above mining		12		2600				34		BDL	U (3.8)	23		1.4		BDL	U (0.2)	160	
SPRTT016	Spring Creek (mouth)		1.7		390				12		BDL	U (3.8)	23		4.4		BDL	U (0.2)	BDL	U (100)
SSBTT022	South Fork Sage Creek below mining		5.7		1600				14		BDL	U (3.8)	27		1.4		BDL	U (0.2)	240	
USCTT041	Upper Sage Creek		10.1		1790		0.019	BI			1	B	19.8		1		0.06	I		

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Thallium		Uranium		Vanadium		Zinc		% > 2 mm		% Clay		Conductivity		Organic Carbon		% Solids	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)	(%)	Flag (%)	(dS/m)	Flag (dS/m)	(%)	Flag (%)	(%)	Flag (%)
BFDTT008	Blackfoot River above Dry Valley Creek		BDL	U (2)	9.6		14		38		15		1.6		1.7		0.94			
BFNTT009	Blackfoot River above Narrows		7.6		4.8		26		44		24		3.2		1.2		1.1			
BFUTT015	Blackfoot River at upper bridge		BDL	U (2)	7.9		18		35		26		1.6		1.6		1.1			
CALTT004	Caldwell Creek		BDL	U (2)	3.8		20		58		17		2.6		1		1.8			
CCATT029	Crow Creek above Deer Creek		4.3		3.3		23		57		26		1.2		2.2		1.3			
DCMTT028	Deer Creek (mouth)		BDL	U (0.38)			57		230		9		20.9		0.81		4.3			
DIATT018	Diamond Creek at USFS boundary		BDL	U (2)	4.8		48		96		13		0.8		1.4		2.9			
EMCNTT045	East Mill Creek North (wetland area)		0.48		4.04		133		517								7.36		19.1	

TABLE H-11

TETRA TECH EM INC. 2001 SEDIMENT ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Thallium		Uranium		Vanadium		Zinc		% > 2 mm		% Clay		Conductivity		Organic Carbon		% Solids	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)	(%)	Flag (%)	(dS/m)	Flag (dS/m)	(%)	Flag (%)	(%)	Flag (%)
EMCTT017	East Mill Creek above split		BDL	U (2)	16		94		210		16		0.6		1		2.9			
EMCTT043	East Mill Creek		0.34		4.77		73.6		218								0.94		64.8	
GHCTT006	Goodheart Creek		BDL	U (2)	9.5		76		400		24		20.1		1.8		7.4			
GTCTT032	Georgetown Creek		24		20		72		150		26		1.2		1.2		2			
KCTT042	Kendall Creek		0.17		0.59		22.3		84								4.12		33.5	
LSCTT040	Lower Sage Creek		0.22		3.66		26.8		76								1.55		57.7	
MCATT030	Montpelier Creek above mining		4.5		2.8		14		38		12		1.2		1.1		1.2			
MCBTT031	Montpelier Creek below mining		6.7		14		33		92		19		3.2		1.3		1			
MCBTT031	Montpelier Creek below mining	DUP	18		9.3		49		95		16		3.2		1.3		1.3			
MCTT044	Maybe Creek		0.2	B	3.6		55.7		866								1.99		57.7	
NNATT013	No Name Creek above mining		BDL	U (2)	12		72		210		24		37.9		1.6		4.6			
NNBTT012	No Name Creek below mining		0.58				92		330		2		30.9		0.51		3.2			
SCAETT047	Spring Creek above East Mill Creek		0.07		0.98		17.2		40								5.26		20.3	
SCAETT047	Spring Creek above East Mill Creek	DUP	0.09		1.73		19.1		42								7.24		27.9	
SCATT024	Sage Creek above mining		3.7		9		47		77		35		1.2		1.4		2.1			
SCBETT046	Spring Creek below East Mill Creek		0.12		1.64		37.3		70								1.41		55	
SCMTT026	Sage Creek (mouth)		6.9		8.7		31		77		19		2.2		2.7		1.6			
SCPTT027	Sage Creek below Pole Creek		BDL	U (2)	12		49		110		15		5.6		1.2		2.8			
SHETT019	Sheep Creek		2.8		4.4		34		66		15		1.8		0.93		2.4			
SLCTT002	Stateland Creek		BDL	U (2)	14		61		170		18		33.3		1.3		4			
SLUTT005	Slug Creek at USFS boundary		BDL	U (2)	3.6		39		100		23		17.2		0.76		3.3			
SLUTT005	Slug Creek at USFS boundary	DUP	BDL	U (2)	2.7		27		77		15		2.6		1		2.9			
SMATT021	Smoky Creek above mining		BDL	U (2)	6.2		55		96		16		22.2		0.63		4.5			
SPRTT016	Spring Creek (mouth)		BDL	U (2)	5.3		34		72		26		2.6		1.6		2.1			
SSBTT022	South Fork Sage Creek below mining		4		7.9		48		110		29		1.2		0.66		1.2			
USCTT041	Upper Sage Creek		0.14		1.09		32		88								1.99		60.7	

TABLE H-11

TETRA TECH EM INC. 2001 SEDIMENT ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS				FIELD PARAMETERS	
			% Sand		% Silt		ORP	pH
			(%)	Flag (%)	(%)	Flag (%)	(Mv)	
BFDTT008	Blackfoot River above Dry Valley Creek		80.2		18.2		113	7.7
BFNTT009	Blackfoot River above Narrows		77.2		19.6		122	7.6
BFUTT015	Blackfoot River at upper bridge		70.2		28.2		147	7.6
CALTT004	Caldwell Creek		58.2		39.2		69	7.6
CCATT029	Crow Creek above Deer Creek		74.2		24.6		201	7.7
DCMTT028	Deer Creek (mouth)		39		40.1		-6	7.9
DIATT018	Diamond Creek at USFS boundary		47.2		52		188	7.1
EMCNTT045	East Mill Creek North (wetland area)						100	7.1
EMCTT017	East Mill Creek above split		58.2		41.2		56	7.3
EMCTT043	East Mill Creek						223	7.7
GHCTT006	Goodheart Creek		35		44.9		72	7.4
GTCTT032	Georgetown Creek		80.2		18.6		209	7.6
KCTT042	Kendall Creek						79.4	7.5
LSCTT040	Lower Sage Creek						222	7.6
MCATT030	Montpelier Creek above mining		71.2		27.6		173	7.6
MCBTT031	Montpelier Creek below mining		69.2		27.6		149	7.7
MCBTT031	Montpelier Creek below mining	DUP	65.2		31.6		149	7.7
MCTT044	Maybe Creek						170	7.8
NNATT013	No Name Creek above mining		8		54.1		112	7
NNBTT012	No Name Creek below mining		29.6		39.5			7.3
SCAETT047	Spring Creek above East Mill Creek						120	7
SCAETT047	Spring Creek above East Mill Creek	DUP					120	6.9
SCATT024	Sage Creek above mining		73.2		25.6		173	7.7
SCBETT046	Spring Creek below East Mill Creek						198	7.5
SCMTT026	Sage Creek (mouth)		61.2		36.6		48	7.8
SCPTT027	Sage Creek below Pole Creek		46.2		48.2		157	7.6
SHETT019	Sheep Creek		42.2		56		44	7.5
SLCTT002	Stateland Creek		12.4		54.3		49	6.5
SLUTT005	Slug Creek at USFS boundary		15.6		67.2		62	7.2
SLUTT005	Slug Creek at USFS boundary	DUP	53.2		44.2		62	7.4

TABLE H-11

TETRA TECH EM INC. 2001 SEDIMENT ANALYTICAL RESULTS AND FIELD DATA

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS				FIELD PARAMETERS	
			% Sand		% Silt		ORP	pH
			(%)	Flag (%)	(%)	Flag (%)	(Mv)	
SMATT021	Smoky Creek above mining		32.3		45.5		170	7.4
SPRTT016	Spring Creek (mouth)		57.2		40.2		-45	7.4
SSBTT022	South Fork Sage Creek below mining		79.2		19.6		194	7.6
USCTT041	Upper Sage Creek						149	7.7

Notes:

[1] DUP = Field Duplicate

BDL Below detection limit
mg/kg Milligram per kilogram
Mv Millivolt
ORP Oxygen and reduction potential
µg/kg Microgram per kilogram

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
B Analyte concentration detected at a value between Method Detection Limit (MDL) and Practical Quantification Limit (PQL)
I Value estimated due to matrix interferences
U Analyte was analyzed for but not detected at the indicated MDL

TABLE H-12

TETRA TECH EM INC. 2001 RIPARIAN SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper		Lead	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
001	Rasmussen Mine Unit 4 Site (001)	BDL	U (1.6)	8.9		190		1.5		22		4.4		75		16		12	
002	Rasmussen Mine Unit 4 Site (002)	17		29		98		1.7		43		63		970		120		BDL	U (1.5)
003	Blackfoot River Wildlife Management Area (003)	BDL	U (1.6)	4.7		250		1.6		13		1.2		63		21		11	
004	Blackfoot River Wildlife Management Area (004)	3.4		7.7		250		1.6		21		0.23		59		17		7.9	
005	Lower Mill Creek Canyon	2.6		8.3		200		1.4		12		4.3		96		24		16	
006	Mill Creek (East)	2.5		7.7		200		1.4		22		0.79		51		17		4.8	
007	Diamond Creek	BDL	U (1.6)	6.7		150		1.2		12		BDL	U (0.2)	35		11		12	
008	Blackfoot River Wildlife Management Area	BDL	U (1.6)	10		150		1.1		10		BDL	U (0.2)	36		9.6		4.5	
009	No Name Creek above mining	BDL	U (1.6)	5.2		250		1.8		BDL	U (2)	2.7		110		25		10	
010	No Name Creek above mining	5.6		5.5		290		1.7		24		1.1		71		26		16	
011	No Name Creek above mining	BDL	U (1.6)	7.7		160		1.1		BDL	U (2)	1.2		56		12		13	

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Sodium		Thallium		Uranium	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
001	Rasmussen Mine Unit 4 Site (001)	1400		31		BDL	U (3.8)	34		2.4		BDL	U (0.2)	BDL	U (100)	BDL	U (2)	8.4	
002	Rasmussen Mine Unit 4 Site (002)	270		620		31		280		150		5.2		890		BDL	U (2)	BDL	U (2)
003	Blackfoot River Wildlife Management Area (003)	1300		19		BDL	U (3.8)	27		0.88		BDL	U (0.2)	200		BDL	U (2)	10	
004	Blackfoot River Wildlife Management Area (004)	820		20		BDL	U (3.8)	24		1		BDL	U (0.2)	170		BDL	U (2)	11	
005	Lower Mill Creek Canyon	690		71		BDL	U (3.8)	46		6.6		BDL	U (0.2)	120		BDL	U (2)	5.2	
006	Mill Creek (East)	1500		30		BDL	U (3.8)	25		0.99		BDL	U (0.2)	180		BDL	U (2)	3	
007	Diamond Creek	790		14		BDL	U (3.8)	19		0.43		BDL	U (0.2)	BDL	U (100)	BDL	U (2)	4.1	
008	Blackfoot River Wildlife Management Area	400		57		BDL	U (3.8)	15		0.92		BDL	U (0.2)	160		BDL	U (2)	6	
009	No Name Creek above mining	2100		70		BDL	U (3.8)	37		1		BDL	U (0.2)	200		BDL	U (2)	9.3	
010	No Name Creek above mining	3500		28		BDL	U (3.8)	33		0.75		BDL	U (0.2)	120		BDL	U (2)	6.7	
011	No Name Creek above mining	910		16		BDL	U (3.8)	23		0.58		BDL	U (0.2)	140		BDL	U (2)	6.3	

TABLE H-12

TETRA TECH EM INC. 2001 RIPARIAN SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS								
		Vanadium		Zinc		Electrical Conductivity		Organic Carbon		pH
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(dS/m)	Flag (dS/m)	(%)	Flag (%)	
001	Rasmussen Mine Unit 4 Site (001)	72		140		1.3		2.6		6.9
002	Rasmussen Mine Unit 4 Site (002)	500		1400		1.2		5.7		7.1
003	Blackfoot River Wildlife Management Area (003)	74		150		0.19		2.5		5.6
004	Blackfoot River Wildlife Management Area (004)	68		130		0.3		2.2		6.8
005	Lower Mill Creek Canyon	98		190		0.53		5.7		7
006	Mill Creek (East)	59		110		0.33		3.7		6.1
007	Diamond Creek	44		73		0.27		1.6		6.7
008	Blackfoot River Wildlife Management Area	40		66		0.61		2.5		7.5
009	No Name Creek above mining	83		190		0.29		2.4		6.4
010	No Name Creek above mining	70		140		0.3		2.2		6.2
011	No Name Creek above mining	50		91		0.29		2.2		5.9

Notes:

BDL Below detection limit
mg/kg Milligram per kilogram

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
U Analyte was analyzed for but not detected at the indicated MDL

TABLE H-13

TETRA TECH EM INC. 2001 RIPARIAN PLANT TISSUE ANALYTICAL RESULTS

(Page 1 OF 2)

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Beryllium		Boron		Cadmium		Chromium		Cobalt		Copper	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
001	Rasmussen Mine Unit 4 Site (001)	990		BDL	U (0.84)	BDL	U (0.2)	0.039		19		3.5		5.4		0.36		14	
002	Rasmussen Mine Unit 4 Site (002)	51		BDL	U (0.84)	BDL	U (0.2)	BDL	U (0.02)	40		46		0.56		BDL	U (0.12)	9.3	
003	Blackfoot River Wildlife Management Area (003)	37		BDL	U (0.84)	BDL	U (0.2)	0.021		8.6		0.48		1.2		BDL	U (0.12)	6.1	
004	Blackfoot River Wildlife Management Area (004)	2700		BDL	U (0.84)	BDL	U (0.2)	0.1		14		0.55		4.7		0.75		8.4	
005	Lower Mill Creek Canyon	50		BDL	U (0.84)	BDL	U (0.2)	BDL	U (0.02)	16		3.7		0.48		0.95		7.4	
006	Mill Creek (East)	110		BDL	U (0.84)	0.47		BDL	U (0.02)	23		0.34		0.58		BDL	U (0.12)	12	
007	Diamond Creek	69		BDL	U (0.84)	BDL	U (0.2)	BDL	U (0.02)	25		0.19		0.75		BDL	U (0.12)	10	
008	Blackfoot River Wildlife Management Area	83		BDL	U (0.84)	BDL	U (0.2)	BDL	U (0.02)	21		2.4		0.72		0.33		9.3	
009	No Name Creek above mining	63		BDL	U (0.84)	BDL	U (0.2)	BDL	U (0.02)	24		2.2		0.9		0.14		7.3	
010	No Name Creek above mining	36		BDL	U (0.84)	BDL	U (0.2)	BDL	U (0.02)	21		0.65		0.55		BDL	U (0.12)	15	
011	No Name Creek above mining	730		BDL	U (0.84)	0.42		0.027		12		0.6		2.8		0.35		4.7	

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Iron		Lead		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
001	Rasmussen Mine Unit 4 Site (001)	430		1.1		93		10		BDL	U (0.4)	3.5		1.2		BDL	U (0.2)	BDL	U (1)
002	Rasmussen Mine Unit 4 Site (002)	18		BDL	U (0.85)	240		BDL	U (8)	BDL	U (0.4)	8.6		18		BDL	U (0.2)	BDL	U (1)
003	Blackfoot River Wildlife Management Area (003)	79		BDL	U (0.85)	30		BDL	U (8)	BDL	U (0.4)	1.4		0.09		BDL	U (0.2)	BDL	U (1)
004	Blackfoot River Wildlife Management Area (004)	1600		2.6		72		20		0.49		2.8		0.22		BDL	U (0.2)	BDL	U (1)
005	Lower Mill Creek Canyon	24		BDL	U (0.85)	200		BDL	U (8)	BDL	U (0.4)	2.1		9.4		BDL	U (0.2)	BDL	U (1)
006	Mill Creek (East)	31		BDL	U (0.85)	42		BDL	U (8)	BDL	U (0.4)	1.4		3.9		BDL	U (0.2)	BDL	U (1)
007	Diamond Creek	19		BDL	U (0.85)	30		BDL	U (8)	1.4		4.3		0.16		BDL	U (0.2)	BDL	U (1)
008	Blackfoot River Wildlife Management Area	57		BDL	U (0.85)	100		BDL	U (8)	BDL	U (0.4)	3.5		0.38		BDL	U (0.2)	BDL	U (1)
009	No Name Creek above mining	33		BDL	U (0.85)	48		BDL	U (8)	BDL	U (0.4)	2.3		0.46		BDL	U (0.2)	BDL	U (1)
010	No Name Creek above mining	13		BDL	U (0.85)	60		BDL	U (8)	BDL	U (0.4)	1.8		0.24		BDL	U (0.2)	BDL	U (1)
011	No Name Creek above mining	270		0.92		61		14		BDL	U (0.4)	2.1		0.21		BDL	U (0.2)	BDL	U (1)

TABLE H-13

TETRA TECH EM INC. 2001 RIPARIAN PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS					
		Uranium		Vanadium		Zinc	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
001	Rasmussen Mine Unit 4 Site (001)	3.2		3		40	
002	Rasmussen Mine Unit 4 Site (002)	3.2		1		790	
003	Blackfoot River Wildlife Management Area (003)	BDL	U (0.8)	1		36	
004	Blackfoot River Wildlife Management Area (004)	6.8		5.3		44	
005	Lower Mill Creek Canyon	BDL	U (0.8)	0.52		160	
006	Mill Creek (East)	BDL	U (0.8)	0.67		28	
007	Diamond Creek	BDL	U (0.8)	0.73		25	
008	Blackfoot River Wildlife Management Area	1.2		0.72		160	
009	No Name Creek above mining	BDL	U (0.8)	0.92		140	
010	No Name Creek above mining	BDL	U (0.8)	0.68		39	
011	No Name Creek above mining	0.92		1.9		23	

Notes:

BDL Below detection limit
mg/kg Milligram per kilogram

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
U Analyte was analyzed for but not detected at the indicated MDL

TABLE H-14

TETRA TECH EM INC. 2001 AQUATIC PLANT TISSUE ANALYTICAL RESULTS

(Page 1 OF 2)

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Cobalt	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCNTT045	East Mill Creek North (wetland area)		175		BDL	U (0.58)	BDL	U (0.45)	18	B	BDL	U (0.02)	32.1		0.07	B	5.4		BDL	U (0.18)
EMCTT043	East Mill Creek		4500		1	B	2.2		62.9		0.27	B	18.9		11.5		45.2		2.4	B
KCTT042	Kendall Creek		494		0.54	B	BDL	U (0.34)	28.4		BDL	U (0.01)	11.2	B	0.15	B	10.1		0.32	B
LSCTT040	Lower Sage Creek		92.5		BDL	U (0.29)	BDL	U (0.23)	44.7		BDL	U (0.01)	28.3		0.04	B	5.2		0.16	B
LSCTT040	Lower Sage Creek		1510		BDL	U (1.1)	BDL	U (0.82)	106		0.05	B	45.3		0.85	B	15.5		0.75	B
LSCTT040	Lower Sage Creek	DUP	857		0.85	B	BDL	U (0.47)	57.3		0.03	B	32.1		0.53	B	42.2		0.74	B
SCAETT047	Spring Creek above East Mill Creek		67.7		0.2	B	BDL	U (0.11)	30.3		BDL	U (0.004)	34.5		0.06	B	1.3		BDL	U (0.04)
SCAETT047	Spring Creek above East Mill Creek		1040		BDL	U (1.4)	BDL	U (1.1)	73.1	B	BDL	U (0.04)	24	B	0.36	B	23		1.2	B
SCBETT046	Spring Creek below East Mill Creek		4020		1.1	B	5.7		123		0.23	B	374		0.78	B	33.8		3.1	B
SCBETT046	Spring Creek below East Mill Creek		6360		0.69	B	2.4		113		0.33	B	17.8		1.3		52.6		3.7	B
USCTT041	Upper Sage Creek		189		BDL	U (0.21)	0.18	B	18.5		BDL	U (0.01)	25.6		0.09	B	6.7		0.2	B

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Potassium	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCNTT045	East Mill Creek North (wetland area)		3.3	B	379		0.76		2290		263		BDL	U (0.01)	3.1		2.8	B	12100	
EMCTT043	East Mill Creek		11.4		5680		5.3		3110		852		BDL	U (0.01)	1.8		23.9		14900	
KCTT042	Kendall Creek		6		631		0.96		2620		345		BDL	U (0.01)	0.51	B	4.8	B	20300	
LSCTT040	Lower Sage Creek		1.7	B	154		0.71		3170		538		BDL	U (0.01)	0.48	B	2.5	B	15700	
LSCTT040	Lower Sage Creek		5.7	B	1930		3.8		5800		1360		BDL	U (0.01)	1.9	B	8.8	B	28500	
LSCTT040	Lower Sage Creek	DUP	5.6		1210		2.6		4190		475		BDL	U (0.08)	2.7		19		28800	
SCAETT047	Spring Creek above East Mill Creek		1.8		130		0.38		2160		253		BDL	U (0.02)	1.1		0.49	B	13100	
SCAETT047	Spring Creek above East Mill Creek		6.5	B	1990		2.3		3530		1010		BDL	U (0.19)	0.62	B	9.4	B	21400	
SCBETT046	Spring Creek below East Mill Creek		5.2		7130		5.1		3200		2080		BDL	U (0.01)	0.67	B	16		10500	
SCBETT046	Spring Creek below East Mill Creek		6		9440		7.2		3430		1800		BDL	U (0.01)	0.55	B	24.2		8200	
USCTT041	Upper Sage Creek		2.5		322		0.55		1830		508		BDL	U (0.01)	0.83		3.2		18900	

TABLE H-14

TETRA TECH EM INC. 2001 AQUATIC PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS											
			Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCNTT045	East Mill Creek North (wetland area)		14.6		0.36	B	120	B	BDL	UN (0.47)	0.94	B	68.7	
EMCTT043	East Mill Creek		39.4		0.98	B	1640		BDL	UN (0.52)	24.4		162	
KCTT042	Kendall Creek		0.77		0.37	B	480	B	BDL	UN (0.36)	1.1	B	36.9	
LSCTT040	Lower Sage Creek		2.8		0.32	B	732		BDL	UN (0.23)	0.35	B	43.1	
LSCTT040	Lower Sage Creek		6.6		0.99	B	2250		BDL	UN (0.85)	4.7	B	62.5	
LSCTT040	Lower Sage Creek	DUP	6.3		0.38	B	1010		BDL	UN (0.49)	2.7	B	45.4	
SCAETT047	Spring Creek above East Mill Creek		0.49		0.18	B	132	B	BDL	UN (0.11)	0.18	B	58.1	
SCAETT047	Spring Creek above East Mill Creek		2	B	1.2	B	1160	B	BDL	UN (1.1)	2.5	B	41.2	
SCBETT046	Spring Creek below East Mill Creek		5.5		1.1	B	5460		BDL	UN (0.53)	9.8		35.3	
SCBETT046	Spring Creek below East Mill Creek		9		0.99	B	340	B	BDL	UN (0.33)	13.3		58.1	
USCTT041	Upper Sage Creek		0.53		0.29	B	75	B	BDL	UN (0.17)	0.61	B	26.6	

Notes:

[1] S = Split Sample, DUP = Field Duplicate

BDL Below detection limit
mg/kg Milligram per kilogram

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
B Analyte concentration detected at a value between Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL)
N Matrix spiked sample recovery not within control limits
U Analyte was analyzed for but not detected, less than the IDL

TABLE H-15

TETRA TECH EM INC. 2001 BENTHIC INVERTEBRATE ANALYTICAL RESULTS

(Page 1 OF 2)

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Cobalt	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCTT043	East Mill Creek		283		BDL	U (0.14)	BDL	U (0.19)	2.9	B	BDL	U (0.02)	0.59	B	1.1		1.8		BDL	U (0.12)
KCTT042	Kendall Creek		203		BDL	U (0.17)	BDL	U (0.24)	3.4	B	BDL	U (0.03)	0.76	B	0.27	B	0.09	B	BDL	U (0.15)
LSCTT040	Lower Sage Creek		150		0.06	B	BDL	U (0.07)	3.3	B	BDL	U (0.01)	0.33	B	0.07	B	0.42		0.06	B
MCTT044	Maybe Creek		795		BDL	U (3.6)	BDL	U (5)	7.6	B	BDL	U (0.6)	BDL	U (6.2)	6	B	BDL	U (1.2)	BDL	U (3)
SCAETT047	Spring Creek above East Mill Creek		21.5	B	0.72	B	BDL	U (0.4)	1.7	B	BDL	U (0.12)	2.2	B	BDL	U (0.12)	BDL	U (0.23)	BDL	U (0.58)
SCAETT047	Spring Creek above East Mill Creek	DUP	8.4	B	0.31	B	BDL	U (0.4)	3.9	B	BDL	U (0.05)	0.57	B	0.05	B	BDL	U (0.1)	BDL	U (0.24)
SCBETT046	Spring Creek below East Mill Creek		497		BDL	U (0.04)	0.14	B	6.6		0.02	B	1.6	B	0.1	B	0.98		0.21	B
USCTT041	Upper Sage Creek		261		0.12	B	BDL	U (0.14)	3	B	BDL	U (0.02)	0.43	B	0.18	B	0.51	B	0.14	B

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS																	
			Copper		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Potassium	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCTT043	East Mill Creek		4.1		370		0.32		142	B	13.9				0.14	B	0.94	B	94.8	B
KCTT042	Kendall Creek		2.7		265		0.4		145	B	15.4				BDL	U (0.13)	BDL	U (0.14)	108	B
LSCTT040	Lower Sage Creek		2		158		0.21		153		22.9		BDL	U (0.02)	0.07	B	0.28	B	163	
MCTT044	Maybe Creek		7.1	B	798		4.6	B	408	B	33.5				BDL	U (2.6)	4.2	B	469	B
SCAETT047	Spring Creek above East Mill Creek		1	B	84.2		0.74	B	BDL	U (49.7)	3.6	B			0.81	B	BDL	U (0.54)	BDL	U (66.4)
SCAETT047	Spring Creek above East Mill Creek	DUP	0.43	B	234		0.84		71	B	8.9				BDL	U (0.21)	BDL	U (0.23)	500	B
SCBETT046	Spring Creek below East Mill Creek		1.8		475		0.66		179		36		BDL	U (0.01)	0.05	B	0.6	B	137	
USCTT041	Upper Sage Creek		2.5		256		0.26		121	B	27.1				0.08	B	0.27	B	128	B

TABLE H-15

TETRA TECH EM INC. 2001 BENTHIC INVERTEBRATE ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS											
			Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
			(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCTT043	East Mill Creek		2.4		BDL	U (0.12)	27.6	B	BDL	U (0.18)	1.6	B	51.5	
KCTT042	Kendall Creek		0.32	B	BDL	U (0.16)	76	B	BDL	U (0.22)	0.45	B	45.3	
LSCTT040	Lower Sage Creek		1.2		BDL	U (0.04)	137	B	BDL	U (0.06)	0.54	B	39.1	
MCTT044	Maybe Creek		29.5		BDL	U (3.2)	BDL	U (711)	BDL	U (4.6)	BDL	U (3.6)	122	
SCAETT047	Spring Creek above East Mill Creek		0.99	B	BDL	U (0.62)	BDL	U (137)	BDL	U (0.88)	BDL	U (0.69)	18.5	
SCAETT047	Spring Creek above East Mill Creek	DUP	2.6		BDL	U (0.26)	846		BDL	U (0.37)	BDL	U (0.29)	6.4	
SCBETT046	Spring Creek below East Mill Creek		1.2		BDL	U (0.03)	99.1	B	BDL	U (0.05)	0.99	B	13.6	
USCTT041	Upper Sage Creek		0.29		BDL	U (0.09)	31.9	B	BDL	U (0.13)	0.59	B	30.3	

Notes:

[1] DUP = Field Duplicate

BDL Below detection limit
mg/kg Milligram per kilogram

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
B Analyte concentration detected at a value between Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL)
U Analyte was analyzed for but not detected, less than the IDL

TABLE H-16

TETRA TECH EM INC. 2001 FISH TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Cobalt	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCTT043	East Mill Creek	68		BDL	U (0.15)	BDL	U (0.21)	1.5	B	BDL	U (0.03)	0.42	B	1.5		2.2		0.25	B
KCTT042	Kendall Creek	139		BDL	U (0.14)	BDL	U (0.19)	1.7	B	BDL	U (0.02)	0.38	B	0.16	B	1.8		0.24	B
LSCTT040	Lower Sage Creek	19.7		BDL	U (0.14)	BDL	U (0.2)	1.4	B	BDL	U (0.02)	BDL	U (0.25)	0.07	B	2.2		0.16	B
SCAETT047	Spring Creek above East Mill Creek	72.9		BDL	U (0.16)	BDL	U (0.23)	9.4	B	BDL	U (0.03)	BDL	U (0.28)	0.06	B	1.2		BDL	U (0.14)
SCAETT047	Spring Creek above East Mill Creek	53.2		BDL	U (0.14)	BDL	U (0.19)	5.6	B	BDL	U (0.02)	0.25	B	0.06	B	2.2		0.15	B
SCBETT046	Spring Creek below East Mill Creek	150		BDL	U (0.19)	BDL	U (0.27)	9.1	B	BDL	U (0.03)	0.81	B	0.23	B	3.1		0.19	B
SCBETT046	Spring Creek below East Mill Creek	53.8		BDL	U (0.16)	BDL	U (0.22)	2.4	B	BDL	U (0.03)	BDL	U (0.27)	0.19	B	3.6		BDL	U (0.13)
USCTT041	Upper Sage Creek	67.5		BDL	U (0.14)	BDL	U (0.2)	0.92	B	BDL	U (0.02)	BDL	U (0.24)	0.23	B	1.2		0.18	B

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Molybdenum		Nickel		Potassium	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
EMCTT043	East Mill Creek	7.7		151		0.58		1390		9.5		BDL	UN (0.4)	0.24	B	0.73	B	15700	
KCTT042	Kendall Creek	2.2		245		0.43		1280		13.6		BDL	UN (0.28)	0.2	B	0.57	B	15700	
LSCTT040	Lower Sage Creek	4		84.2		0.58		1500		7.7		BDL	UN (0.35)	0.19	B	0.59	B	16000	
SCAETT047	Spring Creek above East Mill Creek	4.6		142		1.4		1570		15.9		BDL	UN (0.31)	0.24	B	BDL	U (0.13)	14800	
SCAETT047	Spring Creek above East Mill Creek	2.7		132		0.52		1370		15.4		BDL	UN (0.35)	0.23	B	0.43	B	16200	
SCBETT046	Spring Creek below East Mill Creek	6		245		1.3		1730		30.3		BDL	UN (0.44)	0.43	B	0.92	B	13700	
SCBETT046	Spring Creek below East Mill Creek	5.4		131		0.61		1450		11.9		BDL	UN (0.44)	0.23	B	1.2	B	18000	
USCTT041	Upper Sage Creek	5.3		130		0.41		1090		14.4		BDL	UN (0.29)	0.19	B	0.37	B	14400	

TABLE H-16

TETRA TECH EM INC. 2001 FISH TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS											
		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
			Flag		Flag		Flag		Flag		Flag		Flag
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
EMCTT043	East Mill Creek	33		BDL	U (0.14)	4640		BDL	U (0.2)	BDL	U (0.48)	87.9	E
KCTT042	Kendall Creek	4.5		BDL	U (0.12)	3330		BDL	U (0.18)	BDL	U (0.43)	71.2	E
LSCTT040	Lower Sage Creek	11.8		BDL	U (0.13)	3800		BDL	U (0.18)	BDL	U (0.44)	89.5	E
SCAETT047	Spring Creek above East Mill Creek	17.8		BDL	U (0.64)	5740		BDL	U (0.21)	BDL	U (0.51)	72.9	E
SCAETT047	Spring Creek above East Mill Creek	6.3		BDL	U (0.12)	3170		BDL	U (0.17)	BDL	U (0.42)	81.4	E
SCBETT046	Spring Creek below East Mill Creek	27		BDL	U (0.17)	4540		BDL	U (0.25)	BDL	U (0.6)	124	E
SCBETT046	Spring Creek below East Mill Creek	19.3		BDL	U (0.14)	4590		BDL	U (0.2)	BDL	U (0.49)	124	E
USCTT041	Upper Sage Creek	4.6		BDL	U (0.13)	3810		BDL	U (0.18)	BDL	U (0.44)	75.2	E

Notes:

[1] DUP = Field Duplicate

BDL Below detection limit
mg/kg Milligram per kilogram

Flag columns present data qualifiers reported by analytical laboratories. More than one flag may be reported.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
B Analyte concentration detected at a value between Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL)
E The reported value is estimated because of the presence of interference
N Matrix spiked sample recovery was not within control limits
U Analyte was analyzed for but not detected, less than the IDL

TABLE H-17

SUMMARY OF SUMMER 2001 MONTGOMERY WATSON SAMPLING LOCATIONS

MW Station Identification	MW Station Name	Sample Location Type	Status	Summer 2001 Media Sampled by MW				
				Soil	Plant Tissue	Small Mammal Tissue	Insect Tissue	Worm Tissue
WD062	Conda Mine Middle Limb North Waste Dump	WRP	IMP	X	X	X	X	
WD086	Henry Mine Center Pit #1 Overburden Dump	WRP	IMP	X	X	X	X	
WD081	Ballard Mine Pit #1 Overburden Dump #2	WRP	IMP	X	X	X	X	
WD053	Champ Mine Extension Dump	WRP	IMP	X	X	X	X	
BB004	Phosphoria Outcrop near Wood Canyon Road	UP	BG	X	X	X	X	
BB005	Phosphoria Outcrop west of Slug Valley	UP	BG	X	X	X		
BB006	Phosphoria Outcrop near Stewart Creek	UP	BG	X	X	X	X	
BB007	Phosphoria Outcrop near Timber Creek	UP	BG	X	X	X		
ST026	Blackfoot River above Wooley Range Ridge Creek	RIP	IMP	X	X	X	X	X
ST076	Trail Creek above Blackfoot River	RIP	IMP	X	X	X	X	
ST130	Angus Creek below Upper Angus Creek Reservoir	RIP	IMP	X	X	X	X	X
ST227	East Mill Creek below North Maybe Mine	RIP	IMP	X	X	X	X	X
ST049	Little Blackfoot River above Reese Creek	RIP	BG	X	X	X	X	X
ST153	Diamond Creek above Kendall Creek	RIP	BG	X	X	X	X	X
ST235	Meadow Creek	RIP	BG	X	X	X	X	X
ST237	Timber Creek	RIP	BG	X	X	X	X	X

Notes:

BG Background
IMP Mining-impacted
MW Montgomery Watson
RIP Riparian zone
UP Upland
WRP Waste rock pile

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Bicarbonate Alkalinity		Boron		Cadmium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS005	North Maybe Mine East Mill Dump Seep	F	BDL	U (1)	BDL	U (2.5)	0.55		0.028		BDL	U (0.005)			BDL	U (0.025)	0.94	
DS005	North Maybe Mine East Mill Dump Seep	UNF											200					
DS006	Champ Mine Goodheart Creek Seep	F	9		BDL	U (2.5)	0.96		0.028		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
DS006	Champ Mine Goodheart Creek Seep	UNF											290					
DS007	Mountain Fuel Mine Seep #1	F	BDL	U (1)	BDL	U (2.5)	0.79		0.032		BDL	U (0.005)			BDL	U (0.025)	0.21	
DS007	Mountain Fuel Mine Seep #1	UNF											220					
DS008	Mountain Fuel Mine Seep #2	F	BDL	U (1)	BDL	U (2.5)	1.4		0.02		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
DS008	Mountain Fuel Mine Seep #2	UNF											210					
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	F	2.8		BDL	U (2.5)	BDL	U (0.5)	BDL	U (0.01)	BDL	U (0.005)			0.036		8.9	
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	UNF											170					
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	F	4.8		BDL	U (2.5)	0.78		0.032		BDL	U (0.005)			BDL	U (0.025)	0.17	
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	UNF											250					
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.05		BDL	U (0.005)			BDL	U (0.025)	1.2	
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	UNF											300					
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.05		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	UNF											340					
DS015	Conda Mine Waste Dump South Woodall Seep	F	BDL	U (1)	BDL	U (2.5)	1.1		0.013		BDL	U (0.005)			0.035		6.8	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF											210					
DS015	Conda Mine Waste Dump South Woodall Seep	F	BDL	U (1)	BDL	U (2.5)	1.1		0.013		BDL	U (0.005)			0.037		7.3	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF											200					
DS015	Conda Mine Waste Dump South Woodall Seep	F	BDL	U (1)	BDL	U (2.5)	0.96		0.014		BDL	U (0.005)			0.038		6.8	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF											210					
DS017	Conda Mine Meadow Dump Seep	F	4.8		BDL	U (2.5)	BDL	U (0.5)	0.075		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
DS017	Conda Mine Meadow Dump Seep	UNF											210					
DS018	Conda Mine Dump Seep #4	F	BDL	U (1)	BDL	U (2.5)	0.97		0.02		BDL	U (0.005)			BDL	U (0.025)	6.1	
DS018	Conda Mine Dump Seep #4	UNF											390					
DS019	Conda Mine Dump Seep #7	F	4.8		BDL	U (2.5)	1.2		0.02		BDL	U (0.005)			BDL	U (0.025)	4.6	
DS019	Conda Mine Dump Seep #7	UNF											290					
DS020	Mountain Fuel New Spring #1	F	BDL	U (1)	BDL	U (2.5)	4.5		0.064		BDL	U (0.005)			BDL	U (0.025)	12	
DS020	Mountain Fuel New Spring #1	UNF											350					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Bicarbonate Alkalinity		Boron		Cadmium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS021	Conda Mine French Drain	F	7		BDL	U (2.5)	1.6		0.099		BDL	U (0.005)			BDL	U (0.025)	0.19	
DS021	Conda Mine French Drain	UNF											340					
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.015		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	UNF											410					
DS023	Conda Mine Dump Seep #2	F	BDL	U (1)	BDL	U (2.5)	1.1		0.046		BDL	U (0.005)			BDL	U (0.025)	0.19	
DS023	Conda Mine Dump Seep #2	UNF											34					
DS024	Conda Mine Dump Seep #3	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.037		BDL	U (0.005)			BDL	U (0.025)	3.3	
DS024	Conda Mine Dump Seep #3	UNF											320					
DS025	Enoch Valley West Dump Seep	F	BDL	U (1)	BDL	U (2.5)	8.1		0.031		BDL	U (0.005)			0.026		0.8	
DS025	Enoch Valley West Dump Seep	UNF											200					
DS026	Enoch Valley South Dump Seep	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.023		BDL	U (0.005)			BDL	U (0.025)	4.9	
DS026	Enoch Valley South Dump Seep	UNF											320					
DS027	Ballard Mine Garden Hose Dump Seep	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.039		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
DS027	Ballard Mine Garden Hose Dump Seep	UNF											270					
DS028	Smoky Canyon Dump Seep D-P10	F	3.9		BDL	U (2.5)	0.74		0.054		BDL	U (0.005)			0.15		0.94	
DS028	Smoky Canyon Dump Seep D-P10	UNF											72					
DS029	Smoky Canyon Dump Seep D-P7	F	4.4		BDL	U (2.5)	BDL	U (0.5)	0.066		BDL	U (0.005)			0.037		8.8	
DS029	Smoky Canyon Dump Seep D-P7	UNF											350					
SP003	Mountain Fuel Mine Stock Pond	F	15		BDL	U (2.5)	4.7		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP003	Mountain Fuel Mine Stock Pond	UNF											47					
SP003	Mountain Fuel Mine Stock Pond	F	12		BDL	U (2.5)	4.6		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP003	Mountain Fuel Mine Stock Pond	UNF											52					
SP003	Mountain Fuel Mine Stock Pond	F	8.6		BDL	U (2.5)	4.6		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP003	Mountain Fuel Mine Stock Pond	UNF											53					
SP004	Mountain Fuel Mine Spring #2	F	9.5		3.1		4		0.056		BDL	U (0.005)			BDL	U (0.025)	1.7	
SP004	Mountain Fuel Mine Spring #2	UNF											93					
SP005	Mountain Fuel Mine Spring #3	F	15		BDL	U (2.5)	3		0.058		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP005	Mountain Fuel Mine Spring #3	UNF											91					
SP007	Wooley Valley Mine Unit III Shop Pond	F	19		BDL	U (2.5)	3		0.022		BDL	U (0.005)			0.032		BDL	U (0.13)
SP007	Wooley Valley Mine Unit III Shop Pond	UNF											110					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Bicarbonate Alkalinity		Boron		Cadmium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP008	Wooley Valley Mine Unit III Overburden Pond	F	2.9		BDL	U (2.5)	BDL	U (0.5)	BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	0.14	
SP008	Wooley Valley Mine Unit III Overburden Pond	UNF											52					
SP009	Lanes Creek Mine Pond	F	14		BDL	U (2.5)	4.4		0.016		BDL	U (0.005)			BDL	U (0.025)	0.31	
SP009	Lanes Creek Mine Pond	UNF											85					
SP010	Ballard Mine Dredge Pond	F	1.3		BDL	U (2.5)	3.3		0.034		BDL	U (0.005)			0.036		0.37	
SP010	Ballard Mine Dredge Pond	UNF											230					
SP011	Ballard Mine Upper Elk Pond	F	11		BDL	U (2.5)	6.1		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	1.3	
SP011	Ballard Mine Upper Elk Pond	UNF											78					
SP012	Ballard Mine Lower Elk Pond	F	5.4		BDL	U (2.5)	3.9		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	0.97	
SP012	Ballard Mine Lower Elk Pond	UNF											80					
SP014	Henry Mine Henry Pond	F	1.7		BDL	U (2.5)	1.6		0.03		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP014	Henry Mine Henry Pond	UNF											110					
SP015	Henry Mine Smith Pond	F	1		BDL	U (2.5)	2.1		0.03		BDL	U (0.005)			BDL	U (0.025)	0.21	
SP015	Henry Mine Smith Pond	UNF											250					
SP016	Henry Mine Center Henry Pond	F	7.3		BDL	U (2.5)	1.3		0.036		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP016	Henry Mine Center Henry Pond	UNF											150					
SP017	Enoch Valley Mine South Pond	F	3.5		BDL	U (2.5)	1		0.02		BDL	U (0.005)			BDL	U (0.025)	0.39	
SP017	Enoch Valley Mine South Pond	UNF											110					
SP018	Enoch Valley Mine Keyhole Pond	F	74		BDL	U (2.5)	0.82		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	50	
SP018	Enoch Valley Mine Keyhole Pond	UNF											130					
SP019	Enoch Valley Mine Bat Cave Pond	F	6.2		BDL	U (2.5)	3.3		0.011		BDL	U (0.005)			BDL	U (0.025)	0.14	
SP019	Enoch Valley Mine Bat Cave Pond	UNF											30					
SP020	Enoch Valley Mine West Pond	F	7		BDL	U (2.5)	1.5		0.015		BDL	U (0.005)			BDL	U (0.025)	0.13	
SP020	Enoch Valley Mine West Pond	UNF											9					
SP021	Enoch Valley Mine Stock Pond	F	2.4		BDL	U (2.5)	1.6		0.011		BDL	U (0.005)			BDL	U (0.025)	4.6	
SP021	Enoch Valley Mine Stock Pond	UNF											120					
SP022	Enoch Valley Mine Tipple Pond	F	4.1		BDL	U (2.5)	1.8		0.068		BDL	U (0.005)			0.082		0.17	
SP022	Enoch Valley Mine Tipple Pond	UNF											56					
SP023	Enoch Valley Mine Haul Road Pond	F	5.7		BDL	U (2.5)	3.6		0.032		BDL	U (0.005)			0.32		0.33	
SP023	Enoch Valley Mine Haul Road Pond	UNF											52					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Bicarbonate Alkalinity		Boron		Cadmium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP025	W Pit Pond	F	25		BDL	U (2.5)	30		0.055		BDL	U (0.005)			0.073		BDL	U (0.13)
SP025	W Pit Pond	UNF											180					
SP026	Z Pit Pond	F	6.5		BDL	U (2.5)	1.1		0.032		BDL	U (0.005)			0.033		BDL	U (0.13)
SP026	Z Pit Pond	UNF											65					
SP027	South 40 Pit Pond	F	2.2		BDL	U (2.5)	2.9		0.074		BDL	U (0.005)			0.035		0.64	
SP027	South 40 Pit Pond	UNF											100					
SP027	South 40 Pit Pond	F	200		BDL	U (2.5)	2.8		0.074		BDL	U (0.005)			0.032		0.71	
SP027	South 40 Pit Pond	UNF											100					
SP027	South 40 Pit Pond	F	3		BDL	U (2.5)	2.8		0.074		BDL	U (0.005)			0.036		0.66	
SP027	South 40 Pit Pond	UNF											100					
SP030	Dredge Pond	F	9.2		BDL	U (2.5)	5.2		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP030	Dredge Pond	UNF											85					
SP030	Dredge Pond	F	3.2		BDL	U (2.5)	5.4		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP030	Dredge Pond	UNF											76					
SP030	Dredge Pond	F	10		BDL	U (2.5)	5.2		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP030	Dredge Pond	UNF											83					
SP031	Enoch Valley Mine Shop Pond	F	16		BDL	U (2.5)	2.7		0.028		BDL	U (0.005)			0.086		1.6	
SP031	Enoch Valley Mine Shop Pond	UNF											73					
SP032	Wooley Valley Mine Large Haul Road Pond	F	4		BDL	U (2.5)	BDL	U (0.5)	0.02		BDL	U (0.005)			0.04		0.27	
SP032	Wooley Valley Mine Large Haul Road Pond	UNF											100					
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.023		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF											160					
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	1.5		BDL	U (2.5)	BDL	U (0.5)	0.025		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF											170					
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	1.7		BDL	U (2.5)	BDL	U (0.5)	0.023		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF											180					
SP034	Conda Mine Hoorah Hollow Pond	F	BDL	U (1)	BDL	U (2.5)	BDL	U (0.5)	0.028		BDL	U (0.005)			BDL	U (0.025)	0.27	
SP034	Conda Mine Hoorah Hollow Pond	UNF											180					
SP035	Conda Mine NL4 Pond	F	9.9		BDL	U (2.5)	2.2		0.032		BDL	U (0.005)			BDL	U (0.025)	2.6	
SP035	Conda Mine NL4 Pond	UNF											65					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Bicarbonate Alkalinity		Boron		Cadmium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP036	Gay Mine Pond #1 above A-12 Pit	F	1.8		BDL	U (2.5)	3.3		0.11		BDL	U (0.005)			0.094		BDL	U (0.13)
SP036	Gay Mine Pond #1 above A-12 Pit	UNF											160					
SP037	Gay Mine Pond #2 above A-12 Pit	F	2.4		BDL	U (2.5)	2.6		0.12		BDL	U (0.005)			0.071		BDL	U (0.13)
SP037	Gay Mine Pond #2 above A-12 Pit	UNF											140					
SP038	Gay Mine A-12 Lake in A-12 Pit	F	2		BDL	U (2.5)	2.3		0.073		BDL	U (0.005)			0.063		0.21	
SP038	Gay Mine A-12 Lake in A-12 Pit	UNF											71					
SP041	Gay Mine East Limb North Pond	F	6.4		BDL	U (2.5)	1.9		0.08		BDL	U (0.005)			0.045		BDL	U (0.13)
SP041	Gay Mine East Limb North Pond	UNF											150					
SP044	North Maybe Mine Pit Pond	F	9.9		BDL	U (2.5)	3.5		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	1	
SP044	North Maybe Mine Pit Pond	UNF											58					
SP045	Champ Mine Pit Pond	F	11		BDL	U (2.5)	1.3		0.025		BDL	U (0.005)			BDL	U (0.025)	2.7	
SP045	Champ Mine Pit Pond	UNF											110					
SP045	Champ Mine Pit Pond	F	6.3		BDL	U (2.5)	1.3		0.024		BDL	U (0.005)			BDL	U (0.025)	2.6	
SP045	Champ Mine Pit Pond	UNF																
SP045	Champ Mine Pit Pond	F	10		BDL	U (2.5)	1.3		0.025		BDL	U (0.005)			BDL	U (0.025)	2.6	
SP045	Champ Mine Pit Pond	UNF											110					
SP046	Champ Mine Extension Pit Pond	F	6.7		BDL	U (2.5)	1.7		0.022		BDL	U (0.005)			BDL	U (0.025)	0.83	
SP046	Champ Mine Extension Pit Pond	UNF											63					
SP047	Mountain Fuel Mine North Pit Pond	F	9.2		BDL	U (2.5)	1.3		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	3.6	
SP047	Mountain Fuel Mine North Pit Pond	UNF											81					
SP048	Mountain Fuel Mine East Limb Pit Pond	F	9.3		BDL	U (2.5)	1.2		0.073		BDL	U (0.005)			BDL	U (0.025)	5.8	
SP048	Mountain Fuel Mine East Limb Pit Pond	UNF											91					
SP050	Wooley Valley Mine Unit III Pit Pond (South)	F	30		BDL	U (2.5)	BDL	U (0.5)	0.019		BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF											46					
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF																
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	18		BDL	U (2.5)	0.87		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF											48					
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	17		BDL	U (2.5)	0.85		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF											51					
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	18		BDL	U (2.5)	0.89		BDL	U (0.01)	BDL	U (0.005)			BDL	U (0.025)	BDL	U (0.13)

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Aluminum		Antimony		Arsenic		Barium		Beryllium		Bicarbonate Alkalinity		Boron		Cadmium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF											56					
SP054	Smoky Canyon Mine A Pit Pond	F	8.3		BDL	U (2.5)	0.78		BDL	U (0.01)	BDL	U (0.005)			0.036		0.32	
SP054	Smoky Canyon Mine A Pit Pond	UNF											54					
SP055	Henry Mine South Pit Pond	F	2.3		BDL	U (2.5)	0.8		0.018		BDL	U (0.005)			BDL	U (0.025)	39	
SP055	Henry Mine South Pit Pond	UNF											140					
SP059	Ballard Mine Pit #4 Stock Pond	F	38		BDL	U (2.5)	3		0.016		BDL	U (0.005)			BDL	U (0.025)	0.57	
SP059	Ballard Mine Pit #4 Stock Pond	UNF											60					
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	F	7.5		BDL	U (2.5)	BDL	U (0.5)	0.017		BDL	U (0.005)			BDL	U (0.025)	1.3	
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	UNF											120					
SP061	Dry Valley Mine Pit B Pond	F	1.1		2.9		BDL	U (0.5)	0.049		BDL	U (0.005)			BDL	U (0.025)	9.4	
SP061	Dry Valley Mine Pit B Pond	UNF											110					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Calcium		Carbonate Alkalinity		Chloride		Chromium		Copper		Fluoride		Iron		Lead	
			(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS005	North Maybe Mine East Mill Dump Seep	F	140						9.5		0.86				BDL	U (0.01)	BDL	U (0.25)
DS005	North Maybe Mine East Mill Dump Seep	UNF					3.4						0.3					
DS006	Champ Mine Goodheart Creek Seep	F	350						6.7		1.7				BDL	U (0.01)	BDL	U (0.25)
DS006	Champ Mine Goodheart Creek Seep	UNF					6.2						0.7					
DS007	Mountain Fuel Mine Seep #1	F	110						3.7		1.1				BDL	U (0.01)	0.3	
DS007	Mountain Fuel Mine Seep #1	UNF					5.1						0.14					
DS008	Mountain Fuel Mine Seep #2	F	38						0.75		0.76				BDL	U (0.01)	BDL	U (0.25)
DS008	Mountain Fuel Mine Seep #2	UNF			9		4						0.14					
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	F	490						0.7		3.9				0.019		BDL	U (0.25)
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	UNF					24						1.7					
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	F	130						5.3		1.5				BDL	U (0.01)	0.34	
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	UNF					5.1						BDL	U (0.1)				
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	F	120						28		1.6				BDL	U (0.01)	BDL	U (0.25)
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	UNF					5.2						0.47					
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	F	390						22		1.4				BDL	U (0.01)	BDL	U (0.25)
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	UNF					3						0.65					
DS015	Conda Mine Waste Dump South Woodall Seep	F	590						12		4				BDL	U (0.01)	BDL	U (0.25)
DS015	Conda Mine Waste Dump South Woodall Seep	UNF					6.9						3.1					
DS015	Conda Mine Waste Dump South Woodall Seep	F	610						12		4				BDL	U (0.01)	BDL	U (0.25)
DS015	Conda Mine Waste Dump South Woodall Seep	UNF					6.9						3.1					
DS015	Conda Mine Waste Dump South Woodall Seep	F	590						15		3.8				BDL	U (0.01)	BDL	U (0.25)
DS015	Conda Mine Waste Dump South Woodall Seep	UNF					7						3.1					
DS017	Conda Mine Meadow Dump Seep	F	120						4.8		0.4				BDL	U (0.01)	BDL	U (0.25)
DS017	Conda Mine Meadow Dump Seep	UNF					9						0.12					
DS018	Conda Mine Dump Seep #4	F	460						17		2.1				BDL	U (0.01)	0.3	
DS018	Conda Mine Dump Seep #4	UNF					5						1					
DS019	Conda Mine Dump Seep #7	F	560						6.8		3.3				0.022		BDL	U (0.25)
DS019	Conda Mine Dump Seep #7	UNF					4.3						1.4					
DS020	Mountain Fuel New Spring #1	F	290						0.53		1.5				0.058		BDL	U (0.25)
DS020	Mountain Fuel New Spring #1	UNF					9.9						0.59					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Calcium		Carbonate Alkalinity		Chloride		Chromium		Copper		Fluoride		Iron		Lead	
			(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS021	Conda Mine French Drain	F	190						7.9		0.84				0.022		BDL	U (0.25)
DS021	Conda Mine French Drain	UNF					6.7						0.39					
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	F	100						18		0.96				BDL	U (0.01)	BDL	U (0.25)
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	UNF					3.3						0.17					
DS023	Conda Mine Dump Seep #2	F	200						1.7		1.5				BDL	U (0.01)	BDL	U (0.25)
DS023	Conda Mine Dump Seep #2	UNF					2.7						0.43					
DS024	Conda Mine Dump Seep #3	F	550						12		3.3				BDL	U (0.01)	BDL	U (0.25)
DS024	Conda Mine Dump Seep #3	UNF					3.1											
DS025	Enoch Valley West Dump Seep	F	250						19		1.5				6.5		BDL	U (0.25)
DS025	Enoch Valley West Dump Seep	UNF					5						0.51					
DS026	Enoch Valley South Dump Seep	F	280						10		1.7				BDL	U (0.01)	BDL	U (0.25)
DS026	Enoch Valley South Dump Seep	UNF					7.5						0.38					
DS027	Ballard Mine Garden Hose Dump Seep	F	130						23		0.58				BDL	U (0.01)	BDL	U (0.25)
DS027	Ballard Mine Garden Hose Dump Seep	UNF					5.7						BDL	U (0.1)				
DS028	Smoky Canyon Dump Seep D-P10	F	210						5.5		1.7				BDL	U (0.01)	BDL	U (0.25)
DS028	Smoky Canyon Dump Seep D-P10	UNF					300						0.51					
DS029	Smoky Canyon Dump Seep D-P7	F	480						6.7		1.2				0.01		BDL	U (0.25)
DS029	Smoky Canyon Dump Seep D-P7	UNF					29						0.35					
SP003	Mountain Fuel Mine Stock Pond	F	130						4.4		1.5				0.022		BDL	U (0.25)
SP003	Mountain Fuel Mine Stock Pond	UNF			41		4.6						0.3					
SP003	Mountain Fuel Mine Stock Pond	F	130						4.2		1.4				0.025		BDL	U (0.25)
SP003	Mountain Fuel Mine Stock Pond	UNF			38		4.5						0.33					
SP003	Mountain Fuel Mine Stock Pond	F	130						4.4		1.5				0.032		BDL	U (0.25)
SP003	Mountain Fuel Mine Stock Pond	UNF			37		4.5						0.31					
SP004	Mountain Fuel Mine Spring #2	F	150						10		3.8				BDL	U (0.01)	BDL	U (0.25)
SP004	Mountain Fuel Mine Spring #2	UNF			7		1.3						0.49					
SP005	Mountain Fuel Mine Spring #3	F	63						5.6		1.6				BDL	U (0.01)	BDL	U (0.25)
SP005	Mountain Fuel Mine Spring #3	UNF					1.2						0.31					
SP007	Wooley Valley Mine Unit III Shop Pond	F	29						5.7		1.6				0.033		BDL	U (0.25)
SP007	Wooley Valley Mine Unit III Shop Pond	UNF					4.4						0.27					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Calcium		Carbonate Alkalinity		Chloride		Chromium		Copper		Fluoride		Iron		Lead	
			(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP008	Wooley Valley Mine Unit III Overburden Pond	F	53						4.3		0.85				0.021		0.33	
SP008	Wooley Valley Mine Unit III Overburden Pond	UNF			22		28						0.14					
SP009	Lanes Creek Mine Pond	F	24						BDL	U (0.5)	4.4				0.016		BDL	U (0.25)
SP009	Lanes Creek Mine Pond	UNF					1.8						0.34					
SP010	Ballard Mine Dredge Pond	F	240						23		4.3				BDL	U (0.01)	BDL	U (0.25)
SP010	Ballard Mine Dredge Pond	UNF					3.1						0.92					
SP011	Ballard Mine Upper Elk Pond	F	28						6.4		4.1				BDL	U (0.01)	BDL	U (0.25)
SP011	Ballard Mine Upper Elk Pond	UNF			9		1						0.33					
SP012	Ballard Mine Lower Elk Pond	F	32						10		3.4				BDL	U (0.01)	BDL	U (0.25)
SP012	Ballard Mine Lower Elk Pond	UNF					1.1						0.37					
SP014	Henry Mine Henry Pond	F	90						6.6		1.3				BDL	U (0.01)	BDL	U (0.25)
SP014	Henry Mine Henry Pond	UNF					5.1						0.51					
SP015	Henry Mine Smith Pond	F	120						12		2				BDL	U (0.01)	BDL	U (0.25)
SP015	Henry Mine Smith Pond	UNF					4.9						0.46					
SP016	Henry Mine Center Henry Pond	F	91						8.7		1.1				BDL	U (0.01)	BDL	U (0.25)
SP016	Henry Mine Center Henry Pond	UNF					6.5						0.15					
SP017	Enoch Valley Mine South Pond	F	250						5		2.4				BDL	U (0.01)	BDL	U (0.25)
SP017	Enoch Valley Mine South Pond	UNF					49						0.48					
SP018	Enoch Valley Mine Keyhole Pond	F	390						6.3		3				BDL	U (0.01)	BDL	U (0.25)
SP018	Enoch Valley Mine Keyhole Pond	UNF					3.8						3.8					
SP019	Enoch Valley Mine Bat Cave Pond	F	99						2.9		2.1				BDL	U (0.01)	BDL	U (0.25)
SP019	Enoch Valley Mine Bat Cave Pond	UNF			69		3.6						0.35					
SP020	Enoch Valley Mine West Pond	F	62						1.3		1.2				BDL	U (0.01)	BDL	U (0.25)
SP020	Enoch Valley Mine West Pond	UNF			34		3.5						0.33					
SP021	Enoch Valley Mine Stock Pond	F	180						5.5		1.6				BDL	U (0.01)	BDL	U (0.25)
SP021	Enoch Valley Mine Stock Pond	UNF					29						0.81					
SP022	Enoch Valley Mine Tipple Pond	F	140						2.4		1.3				BDL	U (0.01)	BDL	U (0.25)
SP022	Enoch Valley Mine Tipple Pond	UNF			17		140						3.1					
SP023	Enoch Valley Mine Haul Road Pond	F	120						6.3		2				BDL	U (0.01)	BDL	U (0.25)
SP023	Enoch Valley Mine Haul Road Pond	UNF			4		210						2.6					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Calcium		Carbonate Alkalinity		Chloride		Chromium		Copper		Fluoride		Iron		Lead	
			(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP025	W Pit Pond	F	31						3.9		1.6				BDL	U (0.01)	BDL	U (0.25)
SP025	W Pit Pond	UNF			22		17						0.45					
SP026	Z Pit Pond	F	37						BDL	U (0.5)	0.62				BDL	U (0.01)	BDL	U (0.25)
SP026	Z Pit Pond	UNF					46						0.32					
SP027	South 40 Pit Pond	F	68						3.3		1.8				BDL	U (0.01)	BDL	U (0.25)
SP027	South 40 Pit Pond	UNF			BDL	U (3)	140						0.4					
SP027	South 40 Pit Pond	F	70						3.4		2.2				BDL	U (0.01)	BDL	U (0.25)
SP027	South 40 Pit Pond	UNF			9		130						0.4					
SP027	South 40 Pit Pond	F	70						3.7		1.7				BDL	U (0.01)	BDL	U (0.25)
SP027	South 40 Pit Pond	UNF			BDL	U (3)	130						0.4					
SP030	Dredge Pond	F	32						BDL	U (0.5)	0.56				BDL	U (0.01)	BDL	U (0.25)
SP030	Dredge Pond	UNF			18		4.9						0.22					
SP030	Dredge Pond	F	30						2.2		0.5				BDL	U (0.01)	BDL	U (0.25)
SP030	Dredge Pond	UNF			27		5						0.22					
SP030	Dredge Pond	F	31						BDL	U (0.5)	0.56				0.017		BDL	U (0.25)
SP030	Dredge Pond	UNF			22		4.9						0.23					
SP031	Enoch Valley Mine Shop Pond	F	83						6.5		2.1				0.079		BDL	U (0.25)
SP031	Enoch Valley Mine Shop Pond	UNF			17		210						0.8					
SP032	Wooley Valley Mine Large Haul Road Pond	F	120						BDL	U (0.5)	1.2				BDL	U (0.01)	BDL	U (0.25)
SP032	Wooley Valley Mine Large Haul Road Pond	UNF					91						0.31					
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	120						BDL	U (0.5)	0.72				BDL	U (0.01)	BDL	U (0.25)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF					3.2						BDL	U (0.1)				
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	130						BDL	U (0.5)	0.67				BDL	U (0.01)	BDL	U (0.25)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF					2						BDL	U (0.1)				
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	130						BDL	U (0.5)	0.76				BDL	U (0.01)	BDL	U (0.25)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF					2.1						BDL	U (0.1)				
SP034	Conda Mine Hoorah Hollow Pond	F	49						3.1		0.49				BDL	U (0.01)	0.33	
SP034	Conda Mine Hoorah Hollow Pond	UNF					4.9						0.12					
SP035	Conda Mine NL4 Pond	F	100						4.1		1.1				BDL	U (0.01)	BDL	U (0.25)
SP035	Conda Mine NL4 Pond	UNF					1.1						0.73					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Calcium		Carbonate Alkalinity		Chloride		Chromium		Copper		Fluoride		Iron		Lead	
			(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP036	Gay Mine Pond #1 above A-12 Pit	F	140						3.7		1.4				0.021		BDL	U (0.25)
SP036	Gay Mine Pond #1 above A-12 Pit	UNF					310						0.44					
SP037	Gay Mine Pond #2 above A-12 Pit	F	140						3.2		1.5				0.022		BDL	U (0.25)
SP037	Gay Mine Pond #2 above A-12 Pit	UNF					290						0.38					
SP038	Gay Mine A-12 Lake in A-12 Pit	F	140						1.7		1.8				BDL	U (0.01)	BDL	U (0.25)
SP038	Gay Mine A-12 Lake in A-12 Pit	UNF			9		260						0.65					
SP041	Gay Mine East Limb North Pond	F	100						1.9		0.78				BDL	U (0.01)	BDL	U (0.25)
SP041	Gay Mine East Limb North Pond	UNF					150						BDL	U (0.1)				
SP044	North Maybe Mine Pit Pond	F	41						38		1				BDL	U (0.01)	BDL	U (0.25)
SP044	North Maybe Mine Pit Pond	UNF			9		0.43						0.88					
SP045	Champ Mine Pit Pond	F	200						4.2		1.3				BDL	U (0.01)	BDL	U (0.25)
SP045	Champ Mine Pit Pond	UNF					6.5						0.64					
SP045	Champ Mine Pit Pond	F	190						3.7		1.2				BDL	U (0.01)	BDL	U (0.25)
SP045	Champ Mine Pit Pond	UNF					6.6						0.66					
SP045	Champ Mine Pit Pond	F	190						2.7		1.3				BDL	U (0.01)	BDL	U (0.25)
SP045	Champ Mine Pit Pond	UNF					6.6						0.67					
SP046	Champ Mine Extension Pit Pond	F	26						3.5		2.4				BDL	U (0.01)	BDL	U (0.25)
SP046	Champ Mine Extension Pit Pond	UNF					2.6						0.18					
SP047	Mountain Fuel Mine North Pit Pond	F	75						2.8		0.9				BDL	U (0.01)	BDL	U (0.25)
SP047	Mountain Fuel Mine North Pit Pond	UNF					1.3						0.93					
SP048	Mountain Fuel Mine East Limb Pit Pond	F	130						6.2		1.5				BDL	U (0.01)	BDL	U (0.25)
SP048	Mountain Fuel Mine East Limb Pit Pond	UNF					4.3						0.62					
SP050	Wooley Valley Mine Unit III Pit Pond (South)	F	22						3.4		1				BDL	U (0.01)	BDL	U (0.25)
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF					2						0.21					
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF																
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	22						1.9		1.4				BDL	U (0.01)	BDL	U (0.25)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF			21		1.2						0.23					
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	22						6.4		1.3				BDL	U (0.01)	BDL	U (0.25)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF			13		0.89						0.24					
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	25						6.8		1.4				BDL	U (0.01)	BDL	U (0.25)

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Calcium		Carbonate Alkalinity		Chloride		Chromium		Copper		Fluoride		Iron		Lead	
			(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF			9		0.79						0.23					
SP054	Smoky Canyon Mine A Pit Pond	F	43						1.9		0.8				BDL	U (0.01)	BDL	U (0.25)
SP054	Smoky Canyon Mine A Pit Pond	UNF			4		23						0.41					
SP055	Henry Mine South Pit Pond	F	260						14		1.7				BDL	U (0.01)	BDL	U (0.25)
SP055	Henry Mine South Pit Pond	UNF					1.7						1					
SP059	Ballard Mine Pit #4 Stock Pond	F	18						8.8		2.1				BDL	U (0.01)	BDL	U (0.25)
SP059	Ballard Mine Pit #4 Stock Pond	UNF					1.5						0.53					
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	F	480						BDL	U (0.5)	3.6				0.011		BDL	U (0.25)
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	UNF					18											
SP061	Dry Valley Mine Pit B Pond	F	92						2.3		0.7				BDL	U (0.01)	BDL	U (0.25)
SP061	Dry Valley Mine Pit B Pond	UNF					9.8						0.35					

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate-N + Nitrite-N		pH		Potassium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)		Flag	(mg/L)	Flag (mg/L)
DS005	North Maybe Mine East Mill Dump Seep	F	27		BDL	U (0.002)			8.5		4.8						1.6	
DS005	North Maybe Mine East Mill Dump Seep	UNF					BDL	U (0.5)					3.8		7.6			
DS006	Champ Mine Goodheart Creek Seep	F	63		0.52				2.9		25						1.6	
DS006	Champ Mine Goodheart Creek Seep	UNF					BDL	U (0.5)					BDL	U (0.1)	8.1			
DS007	Mountain Fuel Mine Seep #1	F	38		0.013				6.4		11						1.3	
DS007	Mountain Fuel Mine Seep #1	UNF					BDL	U (0.5)					BDL	U (0.1)	7.9			
DS008	Mountain Fuel Mine Seep #2	F	33		0.011				6		3.8						4.3	
DS008	Mountain Fuel Mine Seep #2	UNF					BDL	U (0.5)					BDL	U (0.1)	8.5			
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	F	230		2.3				BDL	U (2.5)	660						3.8	
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	UNF					BDL	U (0.5)					BDL	U (0.1)	7.4			
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	F	26		0.0045				BDL	U (2.5)	4.6						0.92	
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	UNF					BDL	U (0.5)					0.27		7.9			
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	F	35		0.014				BDL	U (2.5)	5.9						1.3	
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	UNF					BDL	U (0.5)					BDL	U (0.1)	7.6			
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	F	81		17				3.7		31						2.9	
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	UNF					BDL	U (0.5)					BDL	U (0.1)	6.7			
DS015	Conda Mine Waste Dump South Woodall Seep	F	220		BDL	U (0.002)			92		160						5.2	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF					BDL	U (0.5)					1.4		7.9			
DS015	Conda Mine Waste Dump South Woodall Seep	F	230		BDL	U (0.002)			93		160						5.1	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF					BDL	U (0.5)					1.4		8			
DS015	Conda Mine Waste Dump South Woodall Seep	F	220		BDL	U (0.002)			80		160						5.2	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF					BDL	U (0.5)					1.4		8			
DS017	Conda Mine Meadow Dump Seep	F	25		0.31				BDL	U (2.5)	2.1						BDL	U (0.5)
DS017	Conda Mine Meadow Dump Seep	UNF					BDL	U (0.5)					0.15		7.4			
DS018	Conda Mine Dump Seep #4	F	100		0.0068				7.5		120						4.1	
DS018	Conda Mine Dump Seep #4	UNF					BDL	U (0.5)					BDL	U (0.1)	8			
DS019	Conda Mine Dump Seep #7	F	120		0.51				31		310						2.4	
DS019	Conda Mine Dump Seep #7	UNF					BDL	U (0.5)					BDL	U (0.1)	7.6			
DS020	Mountain Fuel New Spring #1	F	80		1.1				78		97						2.4	
DS020	Mountain Fuel New Spring #1	UNF					BDL	U (0.5)					BDL	U (0.1)	7.6			

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate-N + Nitrite-N		pH		Potassium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)		Flag	(mg/L)	Flag (mg/L)
DS021	Conda Mine French Drain	F	50		0.045				4.5		16						1	
DS021	Conda Mine French Drain	UNF					BDL	U (0.5)					BDL	U (0.1)	7.7			
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	F	44		0.027				BDL	U (2.5)	5.4						0.88	
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	UNF					BDL	U (0.5)					BDL	U (0.1)	8			
DS023	Conda Mine Dump Seep #2	F	48		0.032				BDL	U (2.5)	4.5						2.1	
DS023	Conda Mine Dump Seep #2	UNF					BDL	U (0.5)					0.23		7.5			
DS024	Conda Mine Dump Seep #3	F	140		0.043				BDL	U (2.5)	24						2.1	
DS024	Conda Mine Dump Seep #3	UNF					BDL	U (0.5)					0.45		7			
DS025	Enoch Valley West Dump Seep	F	64		5				3.3		170						3	
DS025	Enoch Valley West Dump Seep	UNF					BDL	U (0.5)					BDL	U (0.1)	7.2			
DS026	Enoch Valley South Dump Seep	F	79		0.77				BDL	U (2.5)	20						1.6	
DS026	Enoch Valley South Dump Seep	UNF					BDL	U (0.5)					0.17		7.9			
DS027	Ballard Mine Garden Hose Dump Seep	F	16		BDL	U (0.002)			BDL	U (2.5)	1.1						2.3	
DS027	Ballard Mine Garden Hose Dump Seep	UNF					BDL	U (0.5)					5		8.2			
DS028	Smoky Canyon Dump Seep D-P10	F	60		0.012				50		26						3.3	
DS028	Smoky Canyon Dump Seep D-P10	UNF					BDL	U (0.5)					3.8		7.8			
DS029	Smoky Canyon Dump Seep D-P7	F	58		0.38				21		90						2.4	
DS029	Smoky Canyon Dump Seep D-P7	UNF					BDL	U (0.5)					1.9		7.5			
SP003	Mountain Fuel Mine Stock Pond	F	46		0.028				20		8						6.9	
SP003	Mountain Fuel Mine Stock Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	9.3			
SP003	Mountain Fuel Mine Stock Pond	F	46		0.029				20		8.2						6.8	
SP003	Mountain Fuel Mine Stock Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	9.3			
SP003	Mountain Fuel Mine Stock Pond	F	45		0.028				20		8.2						6.9	
SP003	Mountain Fuel Mine Stock Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	9.3			
SP004	Mountain Fuel Mine Spring #2	F	30		0.0032				75		18						6.2	
SP004	Mountain Fuel Mine Spring #2	UNF					BDL	U (0.5)					BDL	U (0.1)	8.4			
SP005	Mountain Fuel Mine Spring #3	F	14		0.073				23		4.4						4.6	
SP005	Mountain Fuel Mine Spring #3	UNF					BDL	U (0.5)					BDL	U (0.1)	8.3			
SP007	Wooley Valley Mine Unit III Shop Pond	F	12		0.015				5.1		6.1						4.1	
SP007	Wooley Valley Mine Unit III Shop Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8			

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate-N + Nitrite-N		pH		Potassium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)		Flag	(mg/L)	Flag (mg/L)
SP008	Wooley Valley Mine Unit III Overburden Pond	F	43		0.1				BDL	U (2.5)	6.2						BDL	U (0.5)
SP008	Wooley Valley Mine Unit III Overburden Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.9			
SP009	Lanes Creek Mine Pond	F	6.9		0.025				11		13						4.8	
SP009	Lanes Creek Mine Pond	UNF					BDL	U (0.5)					2.4		7.8			
SP010	Ballard Mine Dredge Pond	F	57		0.024				46		31						9.8	
SP010	Ballard Mine Dredge Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8			
SP011	Ballard Mine Upper Elk Pond	F	6		0.0036				19		9.1						3.6	
SP011	Ballard Mine Upper Elk Pond	UNF					BDL	U (0.5)					0.3		8.4			
SP012	Ballard Mine Lower Elk Pond	F	8.2		0.0021				25		8						2.3	
SP012	Ballard Mine Lower Elk Pond	UNF					BDL	U (0.5)					0.12		8.2			
SP014	Henry Mine Henry Pond	F	56		0.017				4		3.1						6.6	
SP014	Henry Mine Henry Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.1			
SP015	Henry Mine Smith Pond	F	35		0.18				7.2		6						3.1	
SP015	Henry Mine Smith Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.2			
SP016	Henry Mine Center Henry Pond	F	33		0.0077				BDL	U (2.5)	4.6						1.8	
SP016	Henry Mine Center Henry Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8			
SP017	Enoch Valley Mine South Pond	F	78		0.42				4		16						3.4	
SP017	Enoch Valley Mine South Pond	UNF					BDL	U (0.5)					0.14		7.9			
SP018	Enoch Valley Mine Keyhole Pond	F	140		3.4				22		1500						2.8	
SP018	Enoch Valley Mine Keyhole Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	7.7			
SP019	Enoch Valley Mine Bat Cave Pond	F	29		BDL	U (0.002)			8.6		11						3.9	
SP019	Enoch Valley Mine Bat Cave Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	9.5			
SP020	Enoch Valley Mine West Pond	F	12		0.0085				4.7		11						BDL	U (0.5)
SP020	Enoch Valley Mine West Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	10			
SP021	Enoch Valley Mine Stock Pond	F	51		BDL	U (0.002)			15		69						1.6	
SP021	Enoch Valley Mine Stock Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.1			
SP022	Enoch Valley Mine Tipple Pond	F	26		BDL	U (0.002)			8.6		3.2						2.4	
SP022	Enoch Valley Mine Tipple Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.8			
SP023	Enoch Valley Mine Haul Road Pond	F	47		BDL	U (0.002)			24		2.7						3.5	
SP023	Enoch Valley Mine Haul Road Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.7			

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate-N + Nitrite-N		pH		Potassium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)		Flag	(mg/L)	Flag (mg/L)
SP025	W Pit Pond	F	63		0.02				5.8		7						19	
SP025	W Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.8			
SP026	Z Pit Pond	F	30		0.012				13		7.9						3.1	
SP026	Z Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.2			
SP027	South 40 Pit Pond	F	41		BDL	U (0.002)			11		4.6						1.5	
SP027	South 40 Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.4			
SP027	South 40 Pit Pond	F	42		BDL	U (0.002)			11		4.6						1.5	
SP027	South 40 Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.4			
SP027	South 40 Pit Pond	F	42		BDL	U (0.002)			11		4.6						1.4	
SP027	South 40 Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.5			
SP030	Dredge Pond	F	8.6		0.053				BDL	U (2.5)	0.91						1.9	
SP030	Dredge Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	9			
SP030	Dredge Pond	F	8.4		0.012				BDL	U (2.5)	0.66						1.8	
SP030	Dredge Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	9.1			
SP030	Dredge Pond	F	8.4		0.064				BDL	U (2.5)	0.69						1.9	
SP030	Dredge Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	9.1			
SP031	Enoch Valley Mine Shop Pond	F	18		0.036				9.3		22						6.9	
SP031	Enoch Valley Mine Shop Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.7			
SP032	Wooley Valley Mine Large Haul Road Pond	F	41		0.15				BDL	U (2.5)	6.5						1.4	
SP032	Wooley Valley Mine Large Haul Road Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.2			
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	38		0.076				BDL	U (2.5)	2.1						1.2	
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF					BDL	U (0.5)					0.24		7.9			
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	40		0.078				BDL	U (2.5)	2.2						1.3	
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF					BDL	U (0.5)					BDL	U (0.1)	7.9			
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F	40		0.077				BDL	U (2.5)	2.2						1.3	
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF					BDL	U (0.5)					BDL	U (0.1)	8			
SP034	Conda Mine Hoorah Hollow Pond	F	19		BDL	U (0.002)			BDL	U (2.5)	0.81						BDL	U (0.5)
SP034	Conda Mine Hoorah Hollow Pond	UNF					BDL	U (0.5)					1.2		8.3			
SP035	Conda Mine NL4 Pond	F	12		BDL	U (0.002)			50		16						2	
SP035	Conda Mine NL4 Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8			

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate-N + Nitrite-N		pH		Potassium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)		Flag	(mg/L)	Flag (mg/L)
SP036	Gay Mine Pond #1 above A-12 Pit	F	74		1.2				5		3.2						4	
SP036	Gay Mine Pond #1 above A-12 Pit	UNF					BDL	U (0.5)					BDL	U (0.1)	8.1			
SP037	Gay Mine Pond #2 above A-12 Pit	F	69		0.49				5.5		3.2						4.2	
SP037	Gay Mine Pond #2 above A-12 Pit	UNF					BDL	U (0.5)					BDL	U (0.1)	8.2			
SP038	Gay Mine A-12 Lake in A-12 Pit	F	69		BDL	U (0.002)			29		9.8						2.6	
SP038	Gay Mine A-12 Lake in A-12 Pit	UNF					BDL	U (0.5)					BDL	U (0.1)	8.4			
SP041	Gay Mine East Limb North Pond	F	37		0.082				BDL	U (2.5)	3.1						5	
SP041	Gay Mine East Limb North Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	7.8			
SP044	North Maybe Mine Pit Pond	F	11		BDL	U (0.002)			27		5.9						BDL	U (0.5)
SP044	North Maybe Mine Pit Pond	UNF					BDL	U (0.5)					0.54		9.1			
SP045	Champ Mine Pit Pond	F	29		0.0048				42		49						1.4	
SP045	Champ Mine Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.3			
SP045	Champ Mine Pit Pond	F	30		0.0056				41		48						1.5	
SP045	Champ Mine Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	4.3			
SP045	Champ Mine Pit Pond	F	31		0.0062				44		50						1.6	
SP045	Champ Mine Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.3			
SP046	Champ Mine Extension Pit Pond	F	4.6		BDL	U (0.002)			4.1		3.6						0.6	
SP046	Champ Mine Extension Pit Pond	UNF					BDL	U (0.5)					0.78		7.9			
SP047	Mountain Fuel Mine North Pit Pond	F	21		BDL	U (0.002)			29		57						0.89	
SP047	Mountain Fuel Mine North Pit Pond	UNF					BDL	U (0.5)					0.18		8.3			
SP048	Mountain Fuel Mine East Limb Pit Pond	F	33		0.054				23		34						1.2	
SP048	Mountain Fuel Mine East Limb Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.1			
SP050	Wooley Valley Mine Unit III Pit Pond (South)	F	5.8		BDL	U (0.002)			BDL	U (2.5)	1.4						0.59	
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF					BDL	U (0.5)					BDL	U (0.1)	8.2			
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF																
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	7.3		BDL	U (0.002)			BDL	U (2.5)	1.2						0.55	
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF					BDL	U (0.5)					0.1		8.6			
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	7.4		BDL	U (0.002)			BDL	U (2.5)	1.1						0.54	
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF					BDL	U (0.5)					BDL	U (0.1)	8.7			
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F	7.5		BDL	U (0.002)			BDL	U (2.5)	1						0.53	

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Magnesium		Manganese		Mercury		Molybdenum		Nickel		Nitrate-N + Nitrite-N		pH		Potassium	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)		Flag	(mg/L)	Flag (mg/L)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF					BDL	U (0.5)					0.11		8.7			
SP054	Smoky Canyon Mine A Pit Pond	F	11		BDL	U (0.002)			45		8.7						1.3	
SP054	Smoky Canyon Mine A Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8.5			
SP055	Henry Mine South Pit Pond	F	63		BDL	U (0.002)			36		960						1	
SP055	Henry Mine South Pit Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	8			
SP059	Ballard Mine Pit #4 Stock Pond	F	5.3		0.0045				9		9.8						2.9	
SP059	Ballard Mine Pit #4 Stock Pond	UNF					BDL	U (0.5)					BDL	U (0.1)	7.6			
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	F	180		1.1				BDL	U (2.5)	58						2.9	
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	UNF					BDL	U (0.5)					0.42		7.7			
SP061	Dry Valley Mine Pit B Pond	F	19		0.018				31		220						0.89	
SP061	Dry Valley Mine Pit B Pond	UNF					BDL	U (0.5)					2.4		8			

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MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Selenium		Silver		Sodium		Sulfate		Thallium		Total Alkalinity		Total Dissolved Solids		Total Phosphorous	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS005	North Maybe Mine East Mill Dump Seep	F			BDL	U (0.25)	4.6				BDL	U (2.5)						
DS005	North Maybe Mine East Mill Dump Seep	UNF	490						150				200		500		0.2	
DS006	Champ Mine Goodheart Creek Seep	F			BDL	U (0.25)	14				BDL	U (2.5)						
DS006	Champ Mine Goodheart Creek Seep	UNF	41						650				290		1300		0.089	
DS007	Mountain Fuel Mine Seep #1	F			BDL	U (0.25)	8.7				BDL	U (2.5)						
DS007	Mountain Fuel Mine Seep #1	UNF	12						200				220		580		0.043	
DS008	Mountain Fuel Mine Seep #2	F			BDL	U (0.25)	9.2				BDL	U (2.5)						
DS008	Mountain Fuel Mine Seep #2	UNF	BDL	U (1)					18				220		260		0.014	
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	F			BDL	U (0.25)	20				BDL	U (2.5)						
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	UNF	78						1700				170		2800		0.071	
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	F			BDL	U (0.25)	7.2				BDL	U (2.5)						
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	UNF	13						160				250		530		0.26	
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	F			BDL	U (0.25)	8.6				BDL	U (2.5)						
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	UNF	6.5						160				300		570		0.63	
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	F			BDL	U (0.25)	13				BDL	U (2.5)						
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	UNF	2.8						97				340		1800		0.017	
DS015	Conda Mine Waste Dump South Woodall Seep	F			BDL	U (0.25)	22				BDL	U (2.5)						
DS015	Conda Mine Waste Dump South Woodall Seep	UNF	1700						1900				210		3100		0.23	
DS015	Conda Mine Waste Dump South Woodall Seep	F			BDL	U (0.25)	28				BDL	U (2.5)						
DS015	Conda Mine Waste Dump South Woodall Seep	UNF	1800						2000				200		3100		0.2	
DS015	Conda Mine Waste Dump South Woodall Seep	F			BDL	U (0.25)	22				BDL	U (2.5)						
DS015	Conda Mine Waste Dump South Woodall Seep	UNF	1900						2000				210		3000		0.31	
DS017	Conda Mine Meadow Dump Seep	F			BDL	U (0.25)	11				BDL	U (2.5)						
DS017	Conda Mine Meadow Dump Seep	UNF	4.1						160				210		440		0.044	
DS018	Conda Mine Dump Seep #4	F			BDL	U (0.25)	15				BDL	U (2.5)						
DS018	Conda Mine Dump Seep #4	UNF	420						990				390		1900		0.15	
DS019	Conda Mine Dump Seep #7	F			BDL	U (0.25)	16				BDL	U (2.5)						
DS019	Conda Mine Dump Seep #7	UNF	2200						1400				290		2200		1.4	
DS020	Mountain Fuel New Spring #1	F			BDL	U (0.25)	15				BDL	U (2.5)						
DS020	Mountain Fuel New Spring #1	UNF	340						620				350		1400		0.26	

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Selenium		Silver		Sodium		Sulfate		Thallium		Total Alkalinity		Total Dissolved Solids		Total Phosphorous	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS021	Conda Mine French Drain	F			BDL	U (0.25)	16				BDL	U (2.5)						
DS021	Conda Mine French Drain	UNF	88						290				340		760		0.11	
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	F			BDL	U (0.25)	15				BDL	U (2.5)						
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	UNF	BDL	U (1)					76				410		530		0.036	
DS023	Conda Mine Dump Seep #2	F			BDL	U (0.25)	14				BDL	U (2.5)						
DS023	Conda Mine Dump Seep #2	UNF	23						600				34		960		0.051	
DS024	Conda Mine Dump Seep #3	F			BDL	U (0.25)	12				BDL	U (2.5)						
DS024	Conda Mine Dump Seep #3	UNF	67						1500				320		2400		0.92	
DS025	Enoch Valley West Dump Seep	F			BDL	U (0.25)	12				BDL	U (2.5)						
DS025	Enoch Valley West Dump Seep	UNF	2.6						700				200		1300		1.7	
DS026	Enoch Valley South Dump Seep	F			BDL	U (0.25)	16				BDL	U (2.5)						
DS026	Enoch Valley South Dump Seep	UNF	49						640				320		1300		0.27	
DS027	Ballard Mine Garden Hose Dump Seep	F			BDL	U (0.25)	9.8				BDL	U (2.5)						
DS027	Ballard Mine Garden Hose Dump Seep	UNF	440						160				270		520		0.031	
DS028	Smoky Canyon Dump Seep D-P10	F			BDL	U (0.25)	55				BDL	U (2.5)						
DS028	Smoky Canyon Dump Seep D-P10	UNF	530						310				72		1300		0.21	
DS029	Smoky Canyon Dump Seep D-P7	F			BDL	U (0.25)	11				BDL	U (2.5)						
DS029	Smoky Canyon Dump Seep D-P7	UNF	860						930				350		1800		0.13	
SP003	Mountain Fuel Mine Stock Pond	F			BDL	U (0.25)	7.8				BDL	U (2.5)						
SP003	Mountain Fuel Mine Stock Pond	UNF	5.4						370				88		740		0.28	
SP003	Mountain Fuel Mine Stock Pond	F			BDL	U (0.25)	6.8				BDL	U (2.5)						
SP003	Mountain Fuel Mine Stock Pond	UNF	6.9						380				90		720		0.28	
SP003	Mountain Fuel Mine Stock Pond	F			BDL	U (0.25)	7.6				BDL	U (2.5)						
SP003	Mountain Fuel Mine Stock Pond	UNF	7.6						470				90		620		0.29	
SP004	Mountain Fuel Mine Spring #2	F			BDL	U (0.25)	2.1				BDL	U (2.5)						
SP004	Mountain Fuel Mine Spring #2	UNF	26						350				100		700		0.18	
SP005	Mountain Fuel Mine Spring #3	F			BDL	U (0.25)	BDL	U (2)			BDL	U (2.5)						
SP005	Mountain Fuel Mine Spring #3	UNF	3.7						69				91		310		0.096	
SP007	Wooley Valley Mine Unit III Shop Pond	F			BDL	U (0.25)	6.4				BDL	U (2.5)						
SP007	Wooley Valley Mine Unit III Shop Pond	UNF	6.7						26				110		200		0.25	

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Selenium		Silver		Sodium		Sulfate		Thallium		Total Alkalinity		Total Dissolved Solids		Total Phosphorous	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP008	Wooley Valley Mine Unit III Overburden Pond	F			BDL	U (0.25)	10				BDL	U (2.5)						
SP008	Wooley Valley Mine Unit III Overburden Pond	UNF	BDL	U (1)					210				74		460		0.017	
SP009	Lanes Creek Mine Pond	F			BDL	U (0.25)	2.2				BDL	U (2.5)						
SP009	Lanes Creek Mine Pond	UNF	55						11				85		100		0.53	
SP010	Ballard Mine Dredge Pond	F			BDL	U (0.25)	12				BDL	U (2.5)						
SP010	Ballard Mine Dredge Pond	UNF	580						630				230		1200		0.18	
SP011	Ballard Mine Upper Elk Pond	F			BDL	U (0.25)	2.3				BDL	U (2.5)						
SP011	Ballard Mine Upper Elk Pond	UNF	94						13				86		150		0.098	
SP012	Ballard Mine Lower Elk Pond	F			BDL	U (0.25)	BDL	U (2)			BDL	U (2.5)						
SP012	Ballard Mine Lower Elk Pond	UNF	220						42				80		160		0.038	
SP014	Henry Mine Henry Pond	F			BDL	U (0.25)	14				BDL	U (2.5)						
SP014	Henry Mine Henry Pond	UNF	4.2						430				110		700		0.054	
SP015	Henry Mine Smith Pond	F			BDL	U (0.25)	9.6				BDL	U (2.5)						
SP015	Henry Mine Smith Pond	UNF	130						500				250		680		0.13	
SP016	Henry Mine Center Henry Pond	F			BDL	U (0.25)	9.6				BDL	U (2.5)						
SP016	Henry Mine Center Henry Pond	UNF	62						230				150		520		0.074	
SP017	Enoch Valley Mine South Pond	F			BDL	U (0.25)	9.7				BDL	U (2.5)						
SP017	Enoch Valley Mine South Pond	UNF	220						700				110		1200		0.1	
SP018	Enoch Valley Mine Keyhole Pond	F			BDL	U (0.25)	15				BDL	U (2.5)						
SP018	Enoch Valley Mine Keyhole Pond	UNF	200						1500				130		2100		0.1	
SP019	Enoch Valley Mine Bat Cave Pond	F			BDL	U (0.25)	4.7				BDL	U (2.5)						
SP019	Enoch Valley Mine Bat Cave Pond	UNF	25						220				99		430		0.18	
SP020	Enoch Valley Mine West Pond	F			BDL	U (0.25)	3.4				BDL	U (2.5)						
SP020	Enoch Valley Mine West Pond	UNF	37						280				43		280		0.12	
SP021	Enoch Valley Mine Stock Pond	F			BDL	U (0.25)	7.9				BDL	U (2.5)						
SP021	Enoch Valley Mine Stock Pond	UNF	110						480				120		850		0.2	
SP022	Enoch Valley Mine Tipple Pond	F			BDL	U (0.25)	9.4				BDL	U (2.5)						
SP022	Enoch Valley Mine Tipple Pond	UNF	40						320				73		710		0.22	
SP023	Enoch Valley Mine Haul Road Pond	F			BDL	U (0.25)	5.3				BDL	U (2.5)						
SP023	Enoch Valley Mine Haul Road Pond	UNF	24						160				56		800		0.42	

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Selenium		Silver		Sodium		Sulfate		Thallium		Total Alkalinity		Total Dissolved Solids		Total Phosphorous	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP025	W Pit Pond	F			BDL	U (0.25)	46				BDL	U (2.5)						
SP025	W Pit Pond	UNF	BDL	U (1)					150				200		240		0.3	
SP026	Z Pit Pond	F			BDL	U (0.25)	30				BDL	U (2.5)						
SP026	Z Pit Pond	UNF	3						94				65		200		0.11	
SP027	South 40 Pit Pond	F			BDL	U (0.25)	43				BDL	U (2.5)						
SP027	South 40 Pit Pond	UNF	33						79				100		460		0.24	
SP027	South 40 Pit Pond	F			BDL	U (0.25)	41				BDL	U (2.5)						
SP027	South 40 Pit Pond	UNF	33						75				110		440		0.21	
SP027	South 40 Pit Pond	F			BDL	U (0.25)	39				BDL	U (2.5)						
SP027	South 40 Pit Pond	UNF	32						75				100		450		0.19	
SP030	Dredge Pond	F			BDL	U (0.25)	5.1				BDL	U (2.5)						
SP030	Dredge Pond	UNF	7.8						11				100		130		0.18	
SP030	Dredge Pond	F			BDL	U (0.25)	5.7				BDL	U (2.5)						
SP030	Dredge Pond	UNF	7.7						11				100		94		0.18	
SP030	Dredge Pond	F			BDL	U (0.25)	5.3				BDL	U (2.5)						
SP030	Dredge Pond	UNF	8.2						11				110		84		0.19	
SP031	Enoch Valley Mine Shop Pond	F			BDL	U (0.25)	90				BDL	U (2.5)						
SP031	Enoch Valley Mine Shop Pond	UNF	2.5						120				91		620		0.089	
SP032	Wooley Valley Mine Large Haul Road Pond	F			BDL	U (0.25)	18				BDL	U (2.5)						
SP032	Wooley Valley Mine Large Haul Road Pond	UNF	7.4						260				100		740		0.067	
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F			BDL	U (0.25)	8				BDL	U (2.5)						
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF	1.9						260				160		660		0.086	
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F			BDL	U (0.25)	8.3				BDL	U (2.5)						
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF	1.9						240				170		540		0.039	
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F			BDL	U (0.25)	8.5				BDL	U (2.5)						
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF	2.5						270				180		620		0.058	
SP034	Conda Mine Hoorah Hollow Pond	F			BDL	U (0.25)	7.1				BDL	U (2.5)						
SP034	Conda Mine Hoorah Hollow Pond	UNF	1.4						19				180		200		0.031	
SP035	Conda Mine NL4 Pond	F			BDL	U (0.25)	3.2				BDL	U (2.5)						
SP035	Conda Mine NL4 Pond	UNF	96						210				65		370		0.19	

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Selenium		Silver		Sodium		Sulfate		Thallium		Total Alkalinity		Total Dissolved Solids		Total Phosphorous	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP036	Gay Mine Pond #1 above A-12 Pit	F			BDL	U (0.25)	100				BDL	U (2.5)						
SP036	Gay Mine Pond #1 above A-12 Pit	UNF	1.3						160				160		1000		0.074	
SP037	Gay Mine Pond #2 above A-12 Pit	F			BDL	U (0.25)	80				BDL	U (2.5)						
SP037	Gay Mine Pond #2 above A-12 Pit	UNF	BDL	U (1)					210				140		1000		0.054	
SP038	Gay Mine A-12 Lake in A-12 Pit	F			BDL	U (0.25)	80				BDL	U (2.5)						
SP038	Gay Mine A-12 Lake in A-12 Pit	UNF	62						250				80		920		0.016	
SP041	Gay Mine East Limb North Pond	F			BDL	U (0.25)	49				BDL	U (2.5)						
SP041	Gay Mine East Limb North Pond	UNF	BDL	U (1)					87				150		230		0.04	
SP044	North Maybe Mine Pit Pond	F			BDL	U (0.25)	BDL	U (2)			BDL	U (2.5)						
SP044	North Maybe Mine Pit Pond	UNF	170						67				67		190		0.14	
SP045	Champ Mine Pit Pond	F			BDL	U (0.25)	10				BDL	U (2.5)						
SP045	Champ Mine Pit Pond	UNF	12						460				110		780		0.11	
SP045	Champ Mine Pit Pond	F			BDL	U (0.25)	11				BDL	U (2.5)						
SP045	Champ Mine Pit Pond	UNF	11						430						850		0.1	
SP045	Champ Mine Pit Pond	F			BDL	U (0.25)	10				BDL	U (2.5)						
SP045	Champ Mine Pit Pond	UNF	36						440				110		820		0.11	
SP046	Champ Mine Extension Pit Pond	F			BDL	U (0.25)	4.2				BDL	U (2.5)						
SP046	Champ Mine Extension Pit Pond	UNF	10						22				63		89		0.14	
SP047	Mountain Fuel Mine North Pit Pond	F			BDL	U (0.25)	2.6				BDL	U (2.5)						
SP047	Mountain Fuel Mine North Pit Pond	UNF	12						180				81		360		0.13	
SP048	Mountain Fuel Mine East Limb Pit Pond	F			BDL	U (0.25)	7.3				BDL	U (2.5)						
SP048	Mountain Fuel Mine East Limb Pit Pond	UNF	69						370				91		660		0.17	
SP050	Wooley Valley Mine Unit III Pit Pond (South)	F			BDL	U (0.25)	2.7				BDL	U (2.5)						
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF							34				46		150		0.32	
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF	56															
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F			BDL	U (0.25)	BDL	U (2)			BDL	U (2.5)						
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF	16						25				69		150		0.082	
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F			BDL	U (0.25)	BDL	U (2)			BDL	U (2.5)						
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF	15						25				64		59		0.08	
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F			BDL	U (0.25)	BDL	U (2)			BDL	U (2.5)						

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS															
			Selenium		Silver		Sodium		Sulfate		Thallium		Total Alkalinity		Total Dissolved Solids		Total Phosphorous	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	($CaCO_3$/L)	Flag ($CaCO_3$/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF	14						25				65		87		0.086	
SP054	Smoky Canyon Mine A Pit Pond	F			BDL	U (0.25)	6.4				BDL	U (2.5)						
SP054	Smoky Canyon Mine A Pit Pond	UNF	85						60				58		220		0.43	
SP055	Henry Mine South Pit Pond	F			BDL	U (0.25)	5.6				BDL	U (2.5)						
SP055	Henry Mine South Pit Pond	UNF	670						700				140		1200		0.3	
SP059	Ballard Mine Pit #4 Stock Pond	F			BDL	U (0.25)	BDL	U (2)			BDL	U (2.5)						
SP059	Ballard Mine Pit #4 Stock Pond	UNF	24						13				60		320		3.3	
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	F			BDL	U (0.25)	22				BDL	U (2.5)						
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	UNF	44						1800				120		2600		0.041	
SP061	Dry Valley Mine Pit B Pond	F			BDL	U (0.25)	7.8				BDL	U (2.5)						
SP061	Dry Valley Mine Pit B Pond	UNF	160						190				110		460		0.078	

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS							
			Total Suspended Solids		Uranium		Vanadium		Zinc	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS005	North Maybe Mine East Mill Dump Seep	F			2		7.8		0.024	
DS005	North Maybe Mine East Mill Dump Seep	UNF	BDL	U (4)						
DS006	Champ Mine Goodheart Creek Seep	F			4		3		0.034	
DS006	Champ Mine Goodheart Creek Seep	UNF	7							
DS007	Mountain Fuel Mine Seep #1	F			5		2.2		BDL	U (0.01)
DS007	Mountain Fuel Mine Seep #1	UNF	BDL	U (4)						
DS008	Mountain Fuel Mine Seep #2	F			2.8		BDL	U (0.25)	BDL	U (0.01)
DS008	Mountain Fuel Mine Seep #2	UNF	BDL	U (4)						
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	F			10		BDL	U (0.25)	1.8	
DS009	Rasmussen Ridge Mine Unit I Overburden Dump Seep	UNF	280							
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	F			1.2		5.6		0.011	
DS010	Wooley Valley Mine Unit I Overburden Dump Seep	UNF	33							
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	F			5.7		9.8		0.014	
DS011	Wooley Valley Mine Unit III Overburden Dump Seep	UNF	61							
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	F			2		BDL	U (0.25)	0.02	
DS012	Wooley Valley Mine Unit IV Overburden Dump Seep	UNF	72							
DS015	Conda Mine Waste Dump South Woodall Seep	F			17		15		0.4	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF	BDL	U (4)						
DS015	Conda Mine Waste Dump South Woodall Seep	F			16		15		0.4	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF	BDL	U (4)						
DS015	Conda Mine Waste Dump South Woodall Seep	F			15		15		0.31	
DS015	Conda Mine Waste Dump South Woodall Seep	UNF	BDL	U (4)						
DS017	Conda Mine Meadow Dump Seep	F			1.2		1.9		BDL	U (0.01)
DS017	Conda Mine Meadow Dump Seep	UNF	BDL	U (4)						
DS018	Conda Mine Dump Seep #4	F			15		9.6		0.35	
DS018	Conda Mine Dump Seep #4	UNF	68							
DS019	Conda Mine Dump Seep #7	F			35		21		0.56	
DS019	Conda Mine Dump Seep #7	UNF	88							
DS020	Mountain Fuel New Spring #1	F			14		3000		0.23	
DS020	Mountain Fuel New Spring #1	UNF	4							

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS							
			Total Suspended Solids		Uranium		Vanadium		Zinc	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
DS021	Conda Mine French Drain	F			4.4		7.4		0.05	
DS021	Conda Mine French Drain	UNF	6							
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	F			8		3.6		0.01	
DS022	Henry Mine South Pit Overburden Dump Limestone Drain	UNF	39							
DS023	Conda Mine Dump Seep #2	F			0.32		1		0.017	
DS023	Conda Mine Dump Seep #2	UNF	BDL	U (4)						
DS024	Conda Mine Dump Seep #3	F			10		5.5		0.14	
DS024	Conda Mine Dump Seep #3	UNF	73							
DS025	Enoch Valley West Dump Seep	F			2.3		2.8		0.14	
DS025	Enoch Valley West Dump Seep	UNF	130							
DS026	Enoch Valley South Dump Seep	F			73		1.6		0.047	
DS026	Enoch Valley South Dump Seep	UNF	11							
DS027	Ballard Mine Garden Hose Dump Seep	F			2.2		2.8		0.016	
DS027	Ballard Mine Garden Hose Dump Seep	UNF	BDL	U (4)						
DS028	Smoky Canyon Dump Seep D-P10	F			11		2.5		0.045	
DS028	Smoky Canyon Dump Seep D-P10	UNF	9							
DS029	Smoky Canyon Dump Seep D-P7	F			28		9.2		0.23	
DS029	Smoky Canyon Dump Seep D-P7	UNF	6							
SP003	Mountain Fuel Mine Stock Pond	F			2.1		11		BDL	U (0.01)
SP003	Mountain Fuel Mine Stock Pond	UNF	7							
SP003	Mountain Fuel Mine Stock Pond	F			2		11		BDL	U (0.01)
SP003	Mountain Fuel Mine Stock Pond	UNF	8							
SP003	Mountain Fuel Mine Stock Pond	F			2		11		BDL	U (0.01)
SP003	Mountain Fuel Mine Stock Pond	UNF	7							
SP004	Mountain Fuel Mine Spring #2	F			12		26		0.014	
SP004	Mountain Fuel Mine Spring #2	UNF	BDL	U (4)						
SP005	Mountain Fuel Mine Spring #3	F			1.7		5.1		BDL	U (0.01)
SP005	Mountain Fuel Mine Spring #3	UNF	BDL	U (4)						
SP007	Wooley Valley Mine Unit III Shop Pond	F			5.5		7.3		BDL	U (0.01)
SP007	Wooley Valley Mine Unit III Shop Pond	UNF	6							

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MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS							
			Total Suspended Solids		Uranium		Vanadium		Zinc	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP008	Wooley Valley Mine Unit III Overburden Pond	F			6.7		1.7		BDL	U (0.01)
SP008	Wooley Valley Mine Unit III Overburden Pond	UNF	BDL	U (4)						
SP009	Lanes Creek Mine Pond	F			0.61		12		BDL	U (0.01)
SP009	Lanes Creek Mine Pond	UNF	10							
SP010	Ballard Mine Dredge Pond	F			59		12		0.025	
SP010	Ballard Mine Dredge Pond	UNF	10							
SP011	Ballard Mine Upper Elk Pond	F			1.1		48		BDL	U (0.01)
SP011	Ballard Mine Upper Elk Pond	UNF	7							
SP012	Ballard Mine Lower Elk Pond	F			1.7		40		0.01	
SP012	Ballard Mine Lower Elk Pond	UNF	5							
SP014	Henry Mine Henry Pond	F			2.9		2.3		BDL	U (0.01)
SP014	Henry Mine Henry Pond	UNF	BDL	U (4)						
SP015	Henry Mine Smith Pond	F			3.5		6.9		0.012	
SP015	Henry Mine Smith Pond	UNF	6							
SP016	Henry Mine Center Henry Pond	F			2.9		4.1		BDL	U (0.01)
SP016	Henry Mine Center Henry Pond	UNF	6							
SP017	Enoch Valley Mine South Pond	F			11		2.7		0.019	
SP017	Enoch Valley Mine South Pond	UNF	5							
SP018	Enoch Valley Mine Keyhole Pond	F			10		61		6.6	
SP018	Enoch Valley Mine Keyhole Pond	UNF	4							
SP019	Enoch Valley Mine Bat Cave Pond	F			4.1		19		BDL	U (0.01)
SP019	Enoch Valley Mine Bat Cave Pond	UNF	6							
SP020	Enoch Valley Mine West Pond	F			1.8		13		BDL	U (0.01)
SP020	Enoch Valley Mine West Pond	UNF	6							
SP021	Enoch Valley Mine Stock Pond	F			8.4		22		0.16	
SP021	Enoch Valley Mine Stock Pond	UNF	BDL	U (4)						
SP022	Enoch Valley Mine Tipple Pond	F			6.7		24		BDL	U (0.01)
SP022	Enoch Valley Mine Tipple Pond	UNF	19							
SP023	Enoch Valley Mine Haul Road Pond	F			11		26		BDL	U (0.01)
SP023	Enoch Valley Mine Haul Road Pond	UNF	10							

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MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS							
			Total Suspended Solids		Uranium		Vanadium		Zinc	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP025	W Pit Pond	F			1.8		0.99		BDL	U (0.01)
SP025	W Pit Pond	UNF	36							
SP026	Z Pit Pond	F			2.5		1.9		BDL	U (0.01)
SP026	Z Pit Pond	UNF	21							
SP027	South 40 Pit Pond	F			5		18		BDL	U (0.01)
SP027	South 40 Pit Pond	UNF	15							
SP027	South 40 Pit Pond	F			4.8		19		BDL	U (0.01)
SP027	South 40 Pit Pond	UNF	13							
SP027	South 40 Pit Pond	F			4.7		20		BDL	U (0.01)
SP027	South 40 Pit Pond	UNF	18							
SP030	Dredge Pond	F			0.79		3		BDL	U (0.01)
SP030	Dredge Pond	UNF	12							
SP030	Dredge Pond	F			0.78		3		BDL	U (0.01)
SP030	Dredge Pond	UNF	11							
SP030	Dredge Pond	F			0.81		2.8		BDL	U (0.01)
SP030	Dredge Pond	UNF	12							
SP031	Enoch Valley Mine Shop Pond	F			2.1		7.9		0.025	
SP031	Enoch Valley Mine Shop Pond	UNF	5							
SP032	Wooley Valley Mine Large Haul Road Pond	F			2.9		BDL	U (0.25)	BDL	U (0.01)
SP032	Wooley Valley Mine Large Haul Road Pond	UNF	14							
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F			2.5		BDL	U (0.25)	BDL	U (0.01)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF	BDL	U (4)						
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F			2.2		BDL	U (0.25)	BDL	U (0.01)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF	22							
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	F			2.7		BDL	U (0.25)	BDL	U (0.01)
SP033	Wooley Valley Mine Upper Angus Creek Reservoir	UNF	BDL	U (4)						
SP034	Conda Mine Hoorah Hollow Pond	F			0.87		3.6		BDL	U (0.01)
SP034	Conda Mine Hoorah Hollow Pond	UNF	BDL	U (4)						
SP035	Conda Mine NL4 Pond	F			6		110		0.012	
SP035	Conda Mine NL4 Pond	UNF	4							

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MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS							
			Total Suspended Solids		Uranium		Vanadium		Zinc	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP036	Gay Mine Pond #1 above A-12 Pit	F			2.5		2.9		BDL	U (0.01)
SP036	Gay Mine Pond #1 above A-12 Pit	UNF	9							
SP037	Gay Mine Pond #2 above A-12 Pit	F			2.9		2.2		0.01	
SP037	Gay Mine Pond #2 above A-12 Pit	UNF	5							
SP038	Gay Mine A-12 Lake in A-12 Pit	F			8.7		14		0.013	
SP038	Gay Mine A-12 Lake in A-12 Pit	UNF	7							
SP041	Gay Mine East Limb North Pond	F			0.76		BDL	U (0.25)	BDL	U (0.01)
SP041	Gay Mine East Limb North Pond	UNF	40							
SP044	North Maybe Mine Pit Pond	F			2.6		170		BDL	U (0.01)
SP044	North Maybe Mine Pit Pond	UNF	BDL	U (4)						
SP045	Champ Mine Pit Pond	F			4.9		18		0.064	
SP045	Champ Mine Pit Pond	UNF	BDL	U (4)						
SP045	Champ Mine Pit Pond	F			4.9		17		0.067	
SP045	Champ Mine Pit Pond	UNF	4							
SP045	Champ Mine Pit Pond	F			4.8		18		0.066	
SP045	Champ Mine Pit Pond	UNF	BDL	U (4)						
SP046	Champ Mine Extension Pit Pond	F			0.92		12		BDL	U (0.01)
SP046	Champ Mine Extension Pit Pond	UNF	BDL	U (4)						
SP047	Mountain Fuel Mine North Pit Pond	F			1.8		36		0.077	
SP047	Mountain Fuel Mine North Pit Pond	UNF	5							
SP048	Mountain Fuel Mine East Limb Pit Pond	F			5		72		0.058	
SP048	Mountain Fuel Mine East Limb Pit Pond	UNF	8							
SP050	Wooley Valley Mine Unit III Pit Pond (South)	F			0.93		0.44		BDL	U (0.01)
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF	39							
SP050	Wooley Valley Mine Unit III Pit Pond (South)	UNF								
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F			2.5		2.2		BDL	U (0.01)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF	8							
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F			1.9		3.3		BDL	U (0.01)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF	8							
SP051	Wooley Valley Mine Unit III Pit Pond (North)	F			1.7		3.5		BDL	U (0.01)

TABLE H-18

MONTGOMERY WATSON 2001 SURFACE WATER ANALYTICAL RESULTS

STATION ID	STATION NAME	SAMPLE TYPE[1]	ANALYTICAL RESULTS							
			Total Suspended Solids		Uranium		Vanadium		Zinc	
			(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)	(mg/L)	Flag (mg/L)
SP051	Wooley Valley Mine Unit III Pit Pond (North)	UNF	8							
SP054	Smoky Canyon Mine A Pit Pond	F			3.9		23		BDL	U (0.01)
SP054	Smoky Canyon Mine A Pit Pond	UNF	12							
SP055	Henry Mine South Pit Pond	F			3		38		4	
SP055	Henry Mine South Pit Pond	UNF	10							
SP059	Ballard Mine Pit #4 Stock Pond	F			0.28		7.8		BDL	U (0.01)
SP059	Ballard Mine Pit #4 Stock Pond	UNF	180							
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	F			2.1		BDL	U (0.25)	0.1	
SP060	Rasmussen Ridge Mine Unit I Overburden Runoff Pond #4	UNF	300							
SP061	Dry Valley Mine Pit B Pond	F			1.5		27		0.83	
SP061	Dry Valley Mine Pit B Pond	UNF	BDL	U (4)						

Notes:

[1] F = Filtered, UNF = Unfiltered

BDL Below detection limit
mg $CaCO_3$/L Miiligram calcium carbonate per liter
mg/L Milligram per liter
µg/L Microgram per liter

Flag columns present data qualifiers reported by analytical laboratory.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
U Analyte was analyzed for but not detected at the indicated MDL

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Clay	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)
BB004	Phosphoria Outcrop near Wood Canyon Road	11000		0.96		6.4		120		0.49		BDL	U (2)	1		23		4.6	
BB004	Phosphoria Outcrop near Wood Canyon Road	11000		1		6.2		110		0.47		BDL	U (2)	0.76		21		1.6	
BB004	Phosphoria Outcrop near Wood Canyon Road	12000		0.71		6.6		130		0.48		BDL	U (2)	0.87		22		1.6	
BB005	Phosphoria Outcrop west of Slug Valley	29000		0.79		8.5		270		1.3		15		0.71		44		30	
BB005	Phosphoria Outcrop west of Slug Valley	31000		0.96		9		280		1.5		BDL	U (2)	0.71		40		28.3	
BB005	Phosphoria Outcrop west of Slug Valley	30000		1.1		9.8		240		1.2		BDL	U (2)	0.57		38		27.6	
BB006	Phosphoria Outcrop near Stewart Creek	25000		0.61		8.5		240		1		BDL	U (2)	0.69		35		25.4	
BB006	Phosphoria Outcrop near Stewart Creek	26000		0.59		8.1		250		1		BDL	U (2)	0.73		35		23.9	
BB006	Phosphoria Outcrop near Stewart Creek	25000		1		7.8		220		0.97		BDL	U (2)	0.69		33		23.2	
BB007	Phosphoria Outcrop near Timber Creek	35000		1.4		8.4		280		1.3		BDL	U (2)	13		130		25.5	
BB007	Phosphoria Outcrop near Timber Creek	31000		0.97		8.7		270		1.2		BDL	U (2)	13		98		27.9	
BB007	Phosphoria Outcrop near Timber Creek	31000		1.2		7		270		1.1		BDL	U (2)	14		100		4.6	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	6500		0.5		3		82		0.41		BDL	U (2)	0.97		26		1.6	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	10000		0.74		3.2		110		0.63		BDL	U (2)	1		21		23.4	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	7100		0.57		2.9		99		0.49		BDL	U (2)	0.82		16		1.6	
ST049	Little Blackfoot River Upstream of Reese Creek	28000		BDL	U (0.38)	7.9		300		1.1		BDL	U (2)	1.4		66		30.9	
ST049	Little Blackfoot River Upstream of Reese Creek	28000		BDL	U (0.38)	6.3		190		0.65		4		1.1		50		25.4	
ST049	Little Blackfoot River Upstream of Reese Creek	36000		BDL	U (0.38)	2.7		100		0.1		13		0.44		53		31.2	
ST076	Trail Creek Upstream of Blackfoot River	26000		BDL	U (0.38)	11		460		1.9		29		2.4		45		29.5	
ST076	Trail Creek Upstream of Blackfoot River	27000		BDL	U (0.38)	10		470		1.9		15		2.4		49		29.1	
ST076	Trail Creek Upstream of Blackfoot River	35000		BDL	U (0.38)	6.4		270		1.1		11		1.4		50		29	
ST130	Angus Creek, below Upper Angus Creek Reservoir	36000		0.84		9.3		210		1.8		18		4.1		86		33.9	
ST130	Angus Creek, below Upper Angus Creek Reservoir	33000		0.93		7.9		230		1.7		5.7		3.1		63		28.7	
ST130	Angus Creek, below Upper Angus Creek Reservoir	31000		0.76		7.7		190		1.8		19		2.8		65		8.6	
ST153	Diamond Creek Upstream of Kendall Creek	18000		0.9		5.9		110		0.76		BDL	U (2)	1.1		39		3.6	
ST153	Diamond Creek Upstream of Kendall Creek	11000		0.96		6.4		120		0.49		BDL	U (2)	1		23		4.6	
ST153	Diamond Creek Upstream of Kendall Creek	11000		1		6.2		110		0.47		BDL	U (2)	0.76		21		1.6	
ST227	East Mill Creek At Fish Sampling Reach	12000		0.71		6.6		130		0.48		BDL	U (2)	0.87		22		1.6	
ST227	East Mill Creek At Fish Sampling Reach	29000		0.79		8.5		270		1.3		15		0.71		44		30	
ST227	East Mill Creek At Fish Sampling Reach	31000		0.96		9		280		1.5		BDL	U (2)	0.71		40		28.3	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Clay	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)
ST235	Meadow Creek, above Blackfoot Reservoir	18000		0.4		6.3		150		0.81		2.6		0.5		43		3.6	
ST235	Meadow Creek, above Blackfoot Reservoir	36000		0.56		9.2		290		1.4		BDL	U (2)	0.85		73		3.6	
ST235	Meadow Creek, above Blackfoot Reservoir	12000		0.79		5.6		100		0.57		BDL	U (2)	0.42		30		3.6	
ST237	Timber Creek, above Diamond Creek	24000		0.64		7.2		150		1		BDL	U (2)	0.82		40		24.9	
ST237	Timber Creek, above Diamond Creek	25000		0.76		8.8		160		1		BDL	U (2)	0.91		41		23	
ST237	Timber Creek, above Diamond Creek	24000		0.75		8		160		1		BDL	U (2)	0.87		39		23.8	
WD001	Dry Valley Mine A Dump			13		43		110		1.8		33		68		1000		23.4	
WD002	Dry Valley Mine North B Dump			BDL	U (7.5)	38		110		1.2		28		26		420		27.6	
WD003	Dry Valley Mine South B Dump			8.4		25		68		0.97		47		26		700		10.8	
WD013	Gay Mine Mill Shale Pile 19			14		55		77		1.4		2.2		72		830		12.8	
WD021	Gay Mine North Limb Dump 25			9.7		59		180		1.5		4.8		47		530		14.8	
WD024	Gay Mine East Limb Main Fill			13		45		100		1.4		33		99		830		43.9	
WD044	Georgetown Canyon Mine Dump #1			7.6		34		75		1.2		39		70		760		20.4	
WD045	Georgetown Canyon Mine Dump #2			12		50		76		1.6		32		67		1200		26.9	
WD047	Georgetown Canyon Mine Dump #4			14		40		71		1.5		46		40		1200		27.5	
WD050	Central Farmers Plant Ore Stockpile			14		48		85		1.7		31		78		1100		26.5	
WD051	North Maybe Mine Waste Dump			12		42		83		1.7		50		38		1100		26.4	
WD051	North Maybe Mine Waste Dump			18		47		88		1.8		33		44		1300		27.6	
WD051	North Maybe Mine Waste Dump			13		39		78		1.6		30		27		1100		28.6	
WD052	Champ Mine Dump			BDL	U (7.5)	31		120		1.3		14		28		350		18.5	
WD052	Champ Mine Dump			9		51		76		1.3		BDL	U (2)	17		670		18.7	
WD053	Champ Mine Extension Dump			BDL	U (7.5)	17		62		0.78		20		30		310		7.8	
WD053	Champ Mine Extension Dump	8600		0.73		16		48		0.92		12		1.8		40		14.6	
WD053	Champ Mine Extension Dump	11000		0.51		15		53		1		BDL	U (2)	2.8		50		15.6	
WD053	Champ Mine Extension Dump	8600		0.63		15		43		0.85		BDL	U (2)	1.5		39		14.6	
WD055	Mountain Fuel Mine Saddle Dump			22		58		110		1.7		46		8.3		1500		22.8	
WD056	Mountain Fuel Mine Valley Dump			14		77		100		1.5		52		25		930		25	
WD057	Mountain Fuel Mine East Limb Dump			BDL	U (7.5)	38		48		0.77		BDL	U (2)	49		380		18.1	
WD058	Rasmussen Ridge Mine South Pit Dump			15		27		70		1.9		76		94		1200		20.6	
WD058	Rasmussen Ridge Mine South Pit Dump			12		26		64		1.5		25		40		810		23.6	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Clay	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)
WD058	Rasmussen Ridge Mine South Pit Dump			9		33		88		1.6		23		47		740		34	
WD059	Wooley Valley Mine Unit I Overburden Dump			10		59		56		1.2		BDL	U (2)	69		560		13.8	
WD060	Wooley Valley Mine Unit III Overburden Dump			8.6		39		81		1.8		6.6		100		980		14.7	
WD061	Wooley Valley Mine Unit IV Overburden Dump			12		56		65		1.3		21		62		730		19.3	
WD062	Conda Mine Middle Limb North Waste Dump	12000		3.2		38		85		2.6		5.8		24		560		26	
WD062	Conda Mine Middle Limb North Waste Dump	14000		1.7		34		90		2.4		12		28		670		25.6	
WD062	Conda Mine Middle Limb North Waste Dump	15000		1.7		41		91		2.3		12		21		670		25.1	
WD068	Conda Mine West Limb Waste Dump			BDL	U (7.5)	54		72		1.1		26		13		360		20.8	
WD069	Conda Mine North Trail Waste Dump			19		62		130		1.9		34		92		1300		34.2	
WD072	Conda Mine Woodall Waste Dump			BDL	U (7.5)	41		66		1.1		53		9.9		1100		25.1	
WD073	Lanes Creek Mine Waste Dump			15		31		51		1.7		54		79		470		30.9	
WD073	Lanes Creek Mine Waste Dump			19		42		81		1.7		48		30		1100		35.6	
WD073	Lanes Creek Mine Waste Dump			21		50		100		2.1		54		56		1300		35	
WD074	Smoky Canyon Mine Waste Dump A1			11		47		52		1.5		41		79		940		14.3	
WD075	Smoky Canyon Mine Pit A Backfill			BDL	U (7.5)	21		28		0.6		BDL	U (2)	10		320		16.8	
WD076	Smoky Canyon Mine Pole Canyon Waste Dump			12		47		80		1.5		BDL	U (2)	41		920		23.8	
WD080	Ballard Mine Pit #1 Overburden Dump #1			13		43		100		1.8		41		120		1100		23.5	
WD081	Ballard Mine Pit #1 Overburden Dump #2			BDL	U (7.5)	22		39		0.62		20		5.8		260		16.8	
WD081	Ballard Mine Pit #1 Overburden Dump #2	19000		3.4		21		140		1.7		BDL	U (2)	44		530		22.9	
WD081	Ballard Mine Pit #1 Overburden Dump #2	14000		3.4		23		110		1.6		BDL	U (2)	48		630		20.1	
WD081	Ballard Mine Pit #1 Overburden Dump #2	17000		3.5		23		110		1.4		4.9		41		640		12.6	
WD085	Henry Mine North Pit Overburden Dump			15		37		94		1.5		21		31		1000		53.5	
WD086	Henry Mine Center Pit #1 Overburden Dump			17		50		110		1.6		5.7		19		1100		21.2	
WD086	Henry Mine Center Pit #1 Overburden Dump	8800		6.9		33		100		1.9		BDL	U (2)	29		770		23.8	
WD086	Henry Mine Center Pit #1 Overburden Dump	11000		4.5		32		120		1.8		21		28		740		22.6	
WD086	Henry Mine Center Pit #1 Overburden Dump	13000		4.1		31		110		1.7		15		35		750		14	
WD090	Henry Mine South Pit Overburden Dump			12		49		75		1.2		34		21		800		49.9	
WD091	Enoch Valley Mine Overburden Dump			23		40		170		1.7		10		42		1300		25.2	
WD091	Enoch Valley Mine Overburden Dump			14		22		110		2		17		37		1400		48.4	
WD092	Enoch Valley Mine Canyon Fill Dump			16		57		75		1.5		23		31		940		56.8	
WD093	Ballard Mine Pit #2 Overburden Dump			BDL	U (7.5)	28		91		1.3		10		18		520		17.8	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Copper		Electrical Conductivity		Fluoride		Lead		Manganese		Mercury		Molybdenum		Nickel		Organic Carbon	
		(mg/kg)	Flag (mg/kg)	(dS/m)	Flag (dS/m)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)
BB004	Phosphoria Outcrop near Wood Canyon Road	10		0.23		110		13		630		22				12		2.7	
BB004	Phosphoria Outcrop near Wood Canyon Road	9.6		0.2		140		10		520		27				12		2.3	
BB004	Phosphoria Outcrop near Wood Canyon Road	9.8		0.22		65		12		570		21				13		2.4	
BB005	Phosphoria Outcrop west of Slug Valley	31		0.37		180		17		2600		44				30		3.5	
BB005	Phosphoria Outcrop west of Slug Valley	28		0.37		170		17		2500		28				31		3	
BB005	Phosphoria Outcrop west of Slug Valley	32		0.48		160		22		2400		25				24		3	
BB006	Phosphoria Outcrop near Stewart Creek	21		0.3		130		21		3200		46				22		3.5	
BB006	Phosphoria Outcrop near Stewart Creek	18		0.23		98		24		3400		42				21		3.6	
BB006	Phosphoria Outcrop near Stewart Creek	19		0.31		69		22		2900		42				21		3.1	
BB007	Phosphoria Outcrop near Timber Creek	17		0.23		500		23		800		43				47		4.6	
BB007	Phosphoria Outcrop near Timber Creek	16		0.19		290		22		830		46				46		5	
BB007	Phosphoria Outcrop near Timber Creek	15		0.19		310		16		630		28				40		2.3	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	6.2		0.87		240		3.8		190		77				16		1.5	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	9.2		1.7		190		6.4		240		BDL	U (75)			14		3	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	7.1		1.2		200		4.7		250		BDL	U (75)			11		1.9	
ST049	Little Blackfoot River Upstream of Reese Creek	19		0.45		90		16		1800		34				26		4.7	
ST049	Little Blackfoot River Upstream of Reese Creek	17		0.58		110		12		1500		40				15		5.8	
ST049	Little Blackfoot River Upstream of Reese Creek	19		0.31		59		6.5		1000		38				5.8		4.9	
ST076	Trail Creek Upstream of Blackfoot River	17		0.67		74		28		600		34				35		5.8	
ST076	Trail Creek Upstream of Blackfoot River	18		0.62		150		29		610		38				38		6	
ST076	Trail Creek Upstream of Blackfoot River	18		0.54		130		17		380		41				22		6.2	
ST130	Angus Creek, below Upper Angus Creek Reservoir	31		0.65		79		17		1800		56				48		3.5	
ST130	Angus Creek, below Upper Angus Creek Reservoir	29		1.6		69		19		2300		37				180		4	
ST130	Angus Creek, below Upper Angus Creek Reservoir	25		0.8		320		17		1600		38				59		1.7	
ST153	Diamond Creek Upstream of Kendall Creek	14		0.59		360		11		750		21				19		2.1	
ST153	Diamond Creek Upstream of Kendall Creek	14		0.71		390		9.4		1100		15				20		1.3	
ST153	Diamond Creek Upstream of Kendall Creek	18		0.52		300		11		1100		23				24		2.1	
ST227	East Mill Creek At Fish Sampling Reach	24		0.48		180		15		1100		51				34		4.8	
ST227	East Mill Creek At Fish Sampling Reach	24		0.82		280		15		1300		50				30		5.6	
ST227	East Mill Creek At Fish Sampling Reach	38		0.73		380		13		1000		130				72		4	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Copper		Electrical Conductivity		Fluoride		Lead		Manganese		Mercury		Molybdenum		Nickel		Organic Carbon	
		(mg/kg)	Flag (mg/kg)	(dS/m)	Flag (dS/m)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)
ST235	Meadow Creek, above Blackfoot Reservoir	12		0.65		66		11		460		20				18		2	
ST235	Meadow Creek, above Blackfoot Reservoir	19		0.56		120		19		800		14				30		1.1	
ST235	Meadow Creek, above Blackfoot Reservoir	6.8		0.76		130		8.1		270		12				13		0.84	
ST237	Timber Creek, above Diamond Creek	20		0.7		200		14		620		30				24		5.2	
ST237	Timber Creek, above Diamond Creek	19		0.6		130		14		1100		36				25		3.5	
ST237	Timber Creek, above Diamond Creek	19		0.59		250		15		910		33				24		4.4	
WD001	Dry Valley Mine A Dump	160		0.21		500		9.1		24		680		16		160		4.1	
WD002	Dry Valley Mine North B Dump	76		2.1		960		BDL	U (7.5)	270		340		20		240		4.7	
WD003	Dry Valley Mine South B Dump	55		2.6		1200		9		94		250		14		320		2	
WD013	Gay Mine Mill Shale Pile 19	90		0.46		1100		10		220		450		37		260		2.2	
WD021	Gay Mine North Limb Dump 25	64		0.42		1300		8		560		310		9.8		94		0.98	
WD024	Gay Mine East Limb Main Fill	130		0.54		300		7.7		130		600		26		270		3.6	
WD044	Georgetown Canyon Mine Dump #1	74		0.46		250		BDL	U (7.5)	110		400		36		230		2.9	
WD045	Georgetown Canyon Mine Dump #2	120		0.5		770		BDL	U (7.5)	67		590		29		250		6.6	
WD047	Georgetown Canyon Mine Dump #4	130		0.92		590		BDL	U (7.5)	92		610		27		260		6.4	
WD050	Central Farmers Plant Ore Stockpile	120		1.2		620		BDL	U (7.5)	140		620		35		240		4.4	
WD051	North Maybe Mine Waste Dump	150		0.36		420		BDL	U (7.5)	71		1000		6		200		11	
WD051	North Maybe Mine Waste Dump	130		0.69		840		8.6		130		720		27		380		4	
WD051	North Maybe Mine Waste Dump	130		0.45		1100		BDL	U (7.5)	100		750		16		300		6.1	
WD052	Champ Mine Dump	90		0.74		960		BDL	U (7.5)	36		540		20		340		3.3	
WD052	Champ Mine Dump	89		2.6		1100		BDL	U (7.5)	240		460		39		280		7.1	
WD053	Champ Mine Extension Dump	30		0.6		1200		BDL	U (7.5)	290		180		5.7		110		1.1	
WD053	Champ Mine Extension Dump	27		0.4		130		7.5		290		130				68		0.28	
WD053	Champ Mine Extension Dump	30		0.31		120		7.1		310		170				79		0.34	
WD053	Champ Mine Extension Dump	30		0.28		200		7.1		270		120				67		0.26	
WD055	Mountain Fuel Mine Saddle Dump	140		0.39		770		BDL	U (7.5)	160		850		31		380		2.6	
WD056	Mountain Fuel Mine Valley Dump	100		2.8		270		BDL	U (7.5)	77		560		37		340		5.9	
WD057	Mountain Fuel Mine East Limb Dump	54		2.6		220		BDL	U (7.5)	150		260		31		190		3.8	
WD058	Rasmussen Ridge Mine South Pit Dump	150		2.6		630		8.8		36		770		44		220		10	
WD058	Rasmussen Ridge Mine South Pit Dump	120		2.8		860		BDL	U (7.5)	42		550		12		190		5.6	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Copper		Electrical Conductivity		Fluoride		Lead		Manganese		Mercury		Molybdenum		Nickel		Organic Carbon	
		(mg/kg)	Flag (mg/kg)	(dS/m)	Flag (dS/m)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(%)	Flag (%)
WD058	Rasmussen Ridge Mine South Pit Dump	130		1.9		780		7.9		180		470		20		210		4.6	
WD059	Wooley Valley Mine Unit I Overburden Dump	66		0.29		540		BDL	U (7.5)	190		420		17		350		2.1	
WD060	Wooley Valley Mine Unit III Overburden Dump	100		0.34		440		BDL	U (7.5)	27		540		7.4		170		5.2	
WD061	Wooley Valley Mine Unit IV Overburden Dump	210		0.74		910		7.8		99		850		45		460		11	
WD062	Conda Mine Middle Limb North Waste Dump	86		0.68		960		9.3		160		490				210		3.4	
WD062	Conda Mine Middle Limb North Waste Dump	89		0.68		850		9.1		150		510				220		3.9	
WD062	Conda Mine Middle Limb North Waste Dump	86		0.69		640		8.8		140		520				200		3.7	
WD068	Conda Mine West Limb Waste Dump	69		0.43		1000		7.5		220		400		20		160		1.5	
WD069	Conda Mine North Trail Waste Dump	140		0.5		930		7.7		73		580		65		350		8.8	
WD072	Conda Mine Woodall Waste Dump	83		2.9		680		9.4		170		390		15		410		4.6	
WD073	Lanes Creek Mine Waste Dump	140		1.9		480		BDL	U (7.5)	25		780		8.4		230		7.8	
WD073	Lanes Creek Mine Waste Dump	170		0.3		480		BDL	U (7.5)	27		930		12		280		7.3	
WD073	Lanes Creek Mine Waste Dump	180		0.23		440		BDL	U (7.5)	34		910		10		290		4	
WD074	Smoky Canyon Mine Waste Dump A1	130		0.28		290		BDL	U (7.5)	63		490		29		190		6	
WD075	Smoky Canyon Mine Pit A Backfill	38		0.49		1000		BDL	U (7.5)	220		220		13		180		1.4	
WD076	Smoky Canyon Mine Pole Canyon Waste Dump	110		2.2		740		BDL	U (7.5)	350		540		25		330		3.7	
WD080	Ballard Mine Pit #1 Overburden Dump #1	150		0.44		420		10		100		560		27		270		5.5	
WD081	Ballard Mine Pit #1 Overburden Dump #2	87		0.33		1100		9.8		99		210		15		160		0.98	
WD081	Ballard Mine Pit #1 Overburden Dump #2	79		1.1		1000		33		380		360				180		3	
WD081	Ballard Mine Pit #1 Overburden Dump #2	84		0.68		740		29		290		380				200		3.5	
WD081	Ballard Mine Pit #1 Overburden Dump #2	87		0.59		1000		17		410		390				200		2.8	
WD085	Henry Mine North Pit Overburden Dump	140		0.17		910		11		280		570		11		230		3	
WD086	Henry Mine Center Pit #1 Overburden Dump	120		0.23		810		BDL	U (7.5)	270		580		23		330		1.9	
WD086	Henry Mine Center Pit #1 Overburden Dump	130		0.62		1200		12		310		540				280		3.5	
WD086	Henry Mine Center Pit #1 Overburden Dump	120		0.52		750		10		480		490				320		3.3	
WD086	Henry Mine Center Pit #1 Overburden Dump	120		0.68		990		11		500		470				290		3.4	
WD090	Henry Mine South Pit Overburden Dump	120		0.56		550		BDL	U (7.5)	200		690		39		420		5.7	
WD091	Enoch Valley Mine Overburden Dump	170		0.16		1000		7.8		85		870		12		270		2.6	
WD091	Enoch Valley Mine Overburden Dump	170		0.18		1100		8.1		42		760		6.2		120		4	
WD092	Enoch Valley Mine Canyon Fill Dump	110		0.34		2300		3.8		110		470		41		400		3.8	
WD093	Ballard Mine Pit #2 Overburden Dump	50		0.22		1400		8		480		270		14		210		1	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		pH		Sand		Selenium		% Silt		Silver		Sodium		Thallium		Uranium		Vanadium	
			Flag		Flag		Flag		Flag		Flag		Flag		Flag		Flag		Flag
				(%)	(%)	(mg/kg)	(mg/kg)	(%)	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
BB004	Phosphoria Outcrop near Wood Canyon Road	6.2		53.4		0.47		42		0.053		BDL	U (100)	BDL	U (0.38)			27	
BB004	Phosphoria Outcrop near Wood Canyon Road	6		59.4		0.41		39		BDL	U (0.038)	130		BDL	U (0.38)			25	
BB004	Phosphoria Outcrop near Wood Canyon Road	5.9		53.4		0.41		45		0.047		BDL	U (100)	BDL	U (0.38)			29	
BB005	Phosphoria Outcrop west of Slug Valley	6.9		17.6		BDL	U (0.04)	52.4		0.06		BDL	U (100)	BDL	U (0.38)			51	
BB005	Phosphoria Outcrop west of Slug Valley	6.9		21.3		0.73		50.4		0.073		BDL	U (100)	BDL	U (0.38)			54	
BB005	Phosphoria Outcrop west of Slug Valley	7.2		20.3		0.85		52.1		0.16		BDL	U (100)	BDL	U (0.38)			51	
BB006	Phosphoria Outcrop near Stewart Creek	6.2		18.1		0.78		56.5		0.044		BDL	U (100)	BDL	U (0.38)			46	
BB006	Phosphoria Outcrop near Stewart Creek	6		15.3		0.61		60.8		0.041		BDL	U (100)	BDL	U (0.38)			46	
BB006	Phosphoria Outcrop near Stewart Creek	6		16.6		0.63		60.2		0.041		120		BDL	U (0.38)			44	
BB007	Phosphoria Outcrop near Timber Creek	6.6		12.9		3.3		61.6		0.15		250		0.93				82	
BB007	Phosphoria Outcrop near Timber Creek	6.4		12.1		2.5		60		0.12		150		0.76				78	
BB007	Phosphoria Outcrop near Timber Creek	6.6		51.4		2.8		44		0.18		180		0.64				100	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	7.7		67.4		1.5		31		0.082		140		BDL	U (0.38)			15	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	7.5		32.4		1		44.2		0.078		100		BDL	U (0.38)			22	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	7.6		66.4		3.6		32		0.064		BDL	U (100)	BDL	U (0.38)			16	
ST049	Little Blackfoot River Upstream of Reese Creek	6.8		17.1		0.6		52		0.095		140		BDL	U (0.38)			58	
ST049	Little Blackfoot River Upstream of Reese Creek	6.8		24.1		1.3		50.5		0.041		BDL	U (100)	BDL	U (0.38)			52	
ST049	Little Blackfoot River Upstream of Reese Creek	6.6		15.9		1.2		52.9		BDL	U (0.038)	100		BDL	U (0.38)			57	
ST076	Trail Creek Upstream of Blackfoot River	7.6		13		1.3		57.5		0.13		170		0.68				51	
ST076	Trail Creek Upstream of Blackfoot River	7.4		14.2		1.5		56.7		0.11		120		0.71				50	
ST076	Trail Creek Upstream of Blackfoot River	7.6		12.5		1.7		58.5		BDL	U (0.038)	120		0.42				54	
ST130	Angus Creek, below Upper Angus Creek Reservoir	6.8		20.4		1.3		45.7		0.22		BDL	U (100)	0.4				75	
ST130	Angus Creek, below Upper Angus Creek Reservoir	6.9		31.5		2.5		39.8		0.22		BDL	U (100)	BDL	U (0.38)			66	
ST130	Angus Creek, below Upper Angus Creek Reservoir	6.7		50.4		1.7		41		0.19		BDL	U (100)	BDL	U (0.38)			66	
ST153	Diamond Creek Upstream of Kendall Creek	6.9		51.4		0.97		45		0.13		BDL	U (100)	BDL	U (0.38)			40	
ST153	Diamond Creek Upstream of Kendall Creek	7.6		65.4		1		32		0.15		230		BDL	U (0.38)			39	
ST153	Diamond Creek Upstream of Kendall Creek	7.2		49.4		0.93		45		0.099		190		BDL	U (0.38)			48	
ST227	East Mill Creek At Fish Sampling Reach	6.8		16.8		4.7		55.3		0.26		100		BDL	U (0.38)			69	
ST227	East Mill Creek At Fish Sampling Reach	7		13.8		4.4		57.7		0.24		150		BDL	U (0.38)			66	
ST227	East Mill Creek At Fish Sampling Reach	7		21.5		29		54.4		1.3		180		0.51				140	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		pH		Sand		Selenium		% Silt		Silver		Sodium		Thallium		Uranium		Vanadium	
			Flag		Flag		Flag		Flag		Flag		Flag		Flag		Flag		Flag
				(%)	(%)	(mg/kg)	(mg/kg)	(%)	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
ST235	Meadow Creek, above Blackfoot Reservoir	7.3		50.4		0.77		46		0.062		190		BDL	U (0.38)			37	
ST235	Meadow Creek, above Blackfoot Reservoir	7.6		56.4		0.41		40		0.13		360		BDL	U (0.38)			68	
ST235	Meadow Creek, above Blackfoot Reservoir	7.4		49.4		0.36		47		0.05		160		BDL	U (0.38)			27	
ST237	Timber Creek, above Diamond Creek	7		17.6		1		57.5		0.07		220		BDL	U (0.38)			50	
ST237	Timber Creek, above Diamond Creek	7.2		19.9		2.3		57.1		0.076		240		BDL	U (0.38)			51	
ST237	Timber Creek, above Diamond Creek	7.1		19.4		1.2		56.8		0.065		140		BDL	U (0.38)			48	
WD001	Dry Valley Mine A Dump	5.4		31.8		17		44.8		11		1300		BDL	U (2)	35		610	
WD002	Dry Valley Mine North B Dump	7.3		25.1		33		47.3		5.8		1400				32		230	
WD003	Dry Valley Mine South B Dump	4.6		59.2		43		30		4		670		BDL	U (2)	28		160	
WD013	Gay Mine Mill Shale Pile 19	7.5		59.2		10		28		3.5		2200		BDL	U (2)	40		600	
WD021	Gay Mine North Limb Dump 25	7.3		53.2		6.1		32		2.1		1500		BDL	U (2)	43		780	
WD024	Gay Mine East Limb Main Fill	6.7		35.8		14		20.3		10		2000		BDL	U (2)	40		930	
WD044	Georgetown Canyon Mine Dump #1	7.5		46.3		19		33.3		2		2200				53		820	
WD045	Georgetown Canyon Mine Dump #2	7.3		38.1		200		35		6.8		2000		BDL	U (2)	51		970	
WD047	Georgetown Canyon Mine Dump #4	7.2		38		110		34.5		7.7		1400		BDL	U (2)	41		450	
WD050	Central Farmers Plant Ore Stockpile	7.3		35		34		38.5		6.4		2500		BDL	U (2)	59		900	
WD051	North Maybe Mine Waste Dump	6		41.3		320		32.3		1.9		2400		BDL	U (2)	24		610	
WD051	North Maybe Mine Waste Dump	7.1		17.5		41		54.9		9.7		2100		BDL	U (2)	38		480	
WD051	North Maybe Mine Waste Dump	6.7		26.6		140		44.8		5.5		1900		BDL	U (2)	31		320	
WD052	Champ Mine Dump	4.7		14.9		33		66.6		9.1		1000		BDL	U (2)	20		850	
WD052	Champ Mine Dump	7.2		41.4		47		39.9		4		1500				33		180	
WD053	Champ Mine Extension Dump	7.4		79.2		9.7		13		0.93		680				30		140	
WD053	Champ Mine Extension Dump	7.4		69.4		5.1		16		0.075		BDL	U (100)	0.4				34	
WD053	Champ Mine Extension Dump	7.4		66.4		5		18		0.12		BDL	U (100)	BDL	U (0.38)			42	
WD053	Champ Mine Extension Dump	7.4		70.4		5.3		15		0.062		BDL	U (100)	BDL	U (0.38)			34	
WD055	Mountain Fuel Mine Saddle Dump	6.3		45.2		20		32		2.9		2300		BDL	U (2)	34		210	
WD056	Mountain Fuel Mine Valley Dump	4.6		26		94		49		3.4		1900		BDL	U (2)	36		500	
WD057	Mountain Fuel Mine East Limb Dump	7.5		45.9		21		36		2.5		1700				14		410	
WD058	Rasmussen Ridge Mine South Pit Dump	4.2		40.2		160		39.2		12		1500		BDL	U (2)	33		600	
WD058	Rasmussen Ridge Mine South Pit Dump	4.8		27.2		83		49.2		7.1		1300		BDL	U (2)	30		340	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		pH		Sand		Selenium		% Silt		Silver		Sodium		Thallium		Uranium		Vanadium	
			Flag		Flag		Flag		Flag		Flag		Flag		Flag		Flag		Flag
				(%)	(%)	(mg/kg)	(mg/kg)	(%)	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
WD058	Rasmussen Ridge Mine South Pit Dump	4.9		28.5		74		37.5		8		1400		BDL	U (2)	28		340	
WD059	Wooley Valley Mine Unit I Overburden Dump	7.3		53.2		62		33		4.6		3300				50		660	
WD060	Wooley Valley Mine Unit III Overburden Dump	5.8		59.4		120		25.9		8.9		2700		BDL	U (2)	63		1200	
WD061	Wooley Valley Mine Unit IV Overburden Dump	7.1		43.3		98		37.4		13		2600		BDL	U (2)	62		350	
WD062	Conda Mine Middle Limb North Waste Dump	7.2		27.5		33		46.5		3.3		930		1.1				250	
WD062	Conda Mine Middle Limb North Waste Dump	7.2		29.5		28		44.9		3.1		970		1.2				290	
WD062	Conda Mine Middle Limb North Waste Dump	7.2		29.4		36		45.5		2.6		800		1.2				260	
WD068	Conda Mine West Limb Waste Dump	7.5		47.2		14		32		3.5		850		BDL	U (2)	23		170	
WD069	Conda Mine North Trail Waste Dump	7.1		23		58		42.8		13		2300		BDL	U (2)	38		920	
WD072	Conda Mine Woodall Waste Dump	7		28.3		34		46.6		5.6		1500				26		140	
WD073	Lanes Creek Mine Waste Dump	4.4		27.6		1500		41.5		7.4		1500		BDL	U (2)	20		620	
WD073	Lanes Creek Mine Waste Dump	6		15.6		1300		48.8		9.4		2300		BDL	U (2)	22		570	
WD073	Lanes Creek Mine Waste Dump	6.8		21.5		160		43.5		13		2300		BDL	U (2)	47		920	
WD074	Smoky Canyon Mine Waste Dump A1	4.8		38.5		550		47.2		6.7		1800		BDL	U (2)	21		790	
WD075	Smoky Canyon Mine Pit A Backfill	7.6		61.2		9.7		22		2.8		700		BDL	U (2)	14		95	
WD076	Smoky Canyon Mine Pole Canyon Waste Dump	7.2		36		19		40.2		6.2		2800		BDL	U (2)	30		460	
WD080	Ballard Mine Pit #1 Overburden Dump #1	7.2		34.8		67		41.7		8.9		1600		BDL	U (2)	50		800	
WD081	Ballard Mine Pit #1 Overburden Dump #2	7.1		59.2		14		24		0.53		440		BDL	U (2)	16		95	
WD081	Ballard Mine Pit #1 Overburden Dump #2	7.3		40.1		19		37		4.5		1200		1.5				450	
WD081	Ballard Mine Pit #1 Overburden Dump #2	7.4		43.7		24		36.2		3.3		1300		1.4				530	
WD081	Ballard Mine Pit #1 Overburden Dump #2	7.4		55.4		19		32		4.4		940		1.4				420	
WD085	Henry Mine North Pit Overburden Dump	6.6		22.3		34		24.2		4.4		1000		BDL	U (2)	25		310	
WD086	Henry Mine Center Pit #1 Overburden Dump	6.4		47.6		25		31.2		2		1600		BDL	U (2)	28		260	
WD086	Henry Mine Center Pit #1 Overburden Dump	6.8		26.1		14		50.1		4.2		790		1				260	
WD086	Henry Mine Center Pit #1 Overburden Dump	6.9		29.9		12		47.5		3.6		730		1.4				290	
WD086	Henry Mine Center Pit #1 Overburden Dump	6.8		46.1		17		39.9		0.87		650		1.6				330	
WD090	Henry Mine South Pit Overburden Dump	7.1		25		39		25.1		7.2		1500				39		250	
WD091	Enoch Valley Mine Overburden Dump	6		41.6		35		33.2		4.4		1200		BDL	U (2)	39		320	
WD091	Enoch Valley Mine Overburden Dump	6.3		27		38		24.6		6.2		960		BDL	U (2)	42		510	
WD092	Enoch Valley Mine Canyon Fill Dump	7.2		18.6		61		24.6		5.9		1300				27		410	
WD093	Ballard Mine Pit #2 Overburden Dump	6.6		45.2		14		37		0.59		770		BDL	U (2)	23		160	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS			
		Zinc		% > 2 mm	
		(mg/kg)	Flag (mg/kg)	(%)	Flag (%)
BB004	Phosphoria Outcrop near Wood Canyon Road	53		0	
BB004	Phosphoria Outcrop near Wood Canyon Road	40		1	
BB004	Phosphoria Outcrop near Wood Canyon Road	50		1	
BB005	Phosphoria Outcrop west of Slug Valley	100		0	
BB005	Phosphoria Outcrop west of Slug Valley	97		0	
BB005	Phosphoria Outcrop west of Slug Valley	110		0	
BB006	Phosphoria Outcrop near Stewart Creek	100		0	
BB006	Phosphoria Outcrop near Stewart Creek	100		1	
BB006	Phosphoria Outcrop near Stewart Creek	98		1	
BB007	Phosphoria Outcrop near Timber Creek	660		0	
BB007	Phosphoria Outcrop near Timber Creek	530		0	
BB007	Phosphoria Outcrop near Timber Creek	470		0	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	33		24	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	52		19	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	37		19	
ST049	Little Blackfoot River Upstream of Reese Creek	110		34	
ST049	Little Blackfoot River Upstream of Reese Creek	90		34	
ST049	Little Blackfoot River Upstream of Reese Creek	95		36	
ST076	Trail Creek Upstream of Blackfoot River	110		44	
ST076	Trail Creek Upstream of Blackfoot River	110		29	
ST076	Trail Creek Upstream of Blackfoot River	110		39	
ST130	Angus Creek, below Upper Angus Creek Reservoir	180		40	
ST130	Angus Creek, below Upper Angus Creek Reservoir	150		27	
ST130	Angus Creek, below Upper Angus Creek Reservoir	140		30	
ST153	Diamond Creek Upstream of Kendall Creek	93		28	
ST153	Diamond Creek Upstream of Kendall Creek	72		58	
ST153	Diamond Creek Upstream of Kendall Creek	100		29	
ST227	East Mill Creek At Fish Sampling Reach	140		27	
ST227	East Mill Creek At Fish Sampling Reach	150		34	
ST227	East Mill Creek At Fish Sampling Reach	370		25	

		ANALYTICAL RESULTS			
		Zinc		% > 2 mm	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST235	Meadow Creek, above Blackfoot Reservoir	62		29	
ST235	Meadow Creek, above Blackfoot Reservoir	100		26	
ST235	Meadow Creek, above Blackfoot Reservoir	39		29	
ST237	Timber Creek, above Diamond Creek	100		28	
ST237	Timber Creek, above Diamond Creek	100		30	
ST237	Timber Creek, above Diamond Creek	97		21	
WD001	Dry Valley Mine A Dump	820		45	
WD002	Dry Valley Mine North B Dump	1300		35	
WD003	Dry Valley Mine South B Dump	570		53	
WD013	Gay Mine Mill Shale Pile 19	1300		34	
WD021	Gay Mine North Limb Dump 25	660		30	
WD024	Gay Mine East Limb Main Fill	1200		27	
WD044	Georgetown Canyon Mine Dump #1	1400		51	
WD045	Georgetown Canyon Mine Dump #2	1100		30	
WD047	Georgetown Canyon Mine Dump #4	1000		34	
WD050	Central Farmers Plant Ore Stockpile	1100		31	
WD051	North Maybe Mine Waste Dump	590		53	
WD051	North Maybe Mine Waste Dump	1500		41	
WD051	North Maybe Mine Waste Dump	1000		45	
WD052	Champ Mine Dump	1700		31	
WD052	Champ Mine Dump	850		42	
WD053	Champ Mine Extension Dump	500		40	
WD053	Champ Mine Extension Dump	150		0	
WD053	Champ Mine Extension Dump	190		0	
WD053	Champ Mine Extension Dump	150		0	
WD055	Mountain Fuel Mine Saddle Dump	1100		38	
WD056	Mountain Fuel Mine Valley Dump	1400		38	
WD057	Mountain Fuel Mine East Limb Dump	990		43	
WD058	Rasmussen Ridge Mine South Pit Dump	1100		44	
WD058	Rasmussen Ridge Mine South Pit Dump	760		40	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS			
		Zinc		% > 2 mm	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
WD058	Rasmussen Ridge Mine South Pit Dump	860		48	
WD059	Wooley Valley Mine Unit I Overburden Dump	2000		39	
WD060	Wooley Valley Mine Unit III Overburden Dump	810		50	
WD061	Wooley Valley Mine Unit IV Overburden Dump	1700		33	
WD062	Conda Mine Middle Limb North Waste Dump	830		0	
WD062	Conda Mine Middle Limb North Waste Dump	860		0	
WD062	Conda Mine Middle Limb North Waste Dump	790		0	
WD068	Conda Mine West Limb Waste Dump	520		48	
WD069	Conda Mine North Trail Waste Dump	1900		41	
WD072	Conda Mine Woodall Waste Dump	1100		51	
WD073	Lanes Creek Mine Waste Dump	740		38	
WD073	Lanes Creek Mine Waste Dump	1000		35	
WD073	Lanes Creek Mine Waste Dump	1100		44	
WD074	Smoky Canyon Mine Waste Dump A1	810		48	
WD075	Smoky Canyon Mine Pit A Backfill	410		66	
WD076	Smoky Canyon Mine Pole Canyon Waste Dump	1300		34	
WD080	Ballard Mine Pit #1 Overburden Dump #1	1600		26	
WD081	Ballard Mine Pit #1 Overburden Dump #2	390		54	
WD081	Ballard Mine Pit #1 Overburden Dump #2	760		0	
WD081	Ballard Mine Pit #1 Overburden Dump #2	930		0	
WD081	Ballard Mine Pit #1 Overburden Dump #2	860		0	
WD085	Henry Mine North Pit Overburden Dump	580		24	
WD086	Henry Mine Center Pit #1 Overburden Dump	1200		49	
WD086	Henry Mine Center Pit #1 Overburden Dump	1000		1	
WD086	Henry Mine Center Pit #1 Overburden Dump	1100		0	
WD086	Henry Mine Center Pit #1 Overburden Dump	920		0	
WD090	Henry Mine South Pit Overburden Dump	1500		33	
WD091	Enoch Valley Mine Overburden Dump	1000		24	
WD091	Enoch Valley Mine Overburden Dump	350		30	
WD092	Enoch Valley Mine Canyon Fill Dump	1700		34	
WD093	Ballard Mine Pit #2 Overburden Dump	840		39	

TABLE H-19

MONTGOMERY WATSON 2001 SOIL ANALYTICAL RESULTS

Notes:

BDL	Below detection limit
mg/kg	Milligram per kilogram
µg/kg	Microgram per kilogram

Flag columns present data qualifiers reported by analytical laboratory.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:

U	Analyte was analyzed for but not detected at the indicated MDL

TABLE H-20

MONTGOMERY WATSON 2001 PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
BB004	Phosphoria Outcrop near Wood Canyon Road	86		240		210		66000		BDL	U (10)	37000		580		2500		4300	
BB004	Phosphoria Outcrop near Wood Canyon Road	68		220		180		57000		BDL	U (10)	27000		420		1700		4200	
BB004	Phosphoria Outcrop near Wood Canyon Road	74		220		210		63000		BDL	U (10)	29000		250		2000		3800	
BB005	Phosphoria Outcrop west of Slug Valley	250		BDL	U (100)	190		31000		BDL	U (10)	21000		61		550		7800	
BB005	Phosphoria Outcrop west of Slug Valley	180		BDL	U (100)	160		32000		BDL	U (10)	24000		70		630		5500	
BB005	Phosphoria Outcrop west of Slug Valley	260		BDL	U (100)	170		28000		11		20000		62		660		4200	
BB006	Phosphoria Outcrop near Stewart Creek	63		200		170		57000		BDL	U (10)	23000		98		1700		4000	
BB006	Phosphoria Outcrop near Stewart Creek	68		220		240		82000		BDL	U (10)	48000		300		1500		6400	
BB006	Phosphoria Outcrop near Stewart Creek	56		210		160		46000		BDL	U (10)	24000		110		1300		3800	
BB007	Phosphoria Outcrop near Timber Creek	89		230		230		47000		BDL	U (10)	37000		300		2000		4100	
BB007	Phosphoria Outcrop near Timber Creek	70		260		320		81000		10		32000		870		1400		7400	
BB007	Phosphoria Outcrop near Timber Creek	140		240		2100		91000		BDL	U (10)	30000		3700		1400		7900	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	290		BDL	U (100)	210		53000		BDL	U (10)	18000		270		1100		3900	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	260		150		230		73000		16		29000		170		1200		3900	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	120		BDL	U (100)	190		34000		17		64000		110		1500		5400	
ST049	Little Blackfoot River Upstream of Reese Creek	210		220		240		78000		BDL	U (10)	13000		140		1500		3800	
ST049	Little Blackfoot River Upstream of Reese Creek	480		240		320		64000		44		23000		1800		9900		3000	
ST049	Little Blackfoot River Upstream of Reese Creek	270		210		210		44000		BDL	U (10)	12000		240		1900		4300	
ST076	Trail Creek Upstream of Blackfoot River	220		220		270		71000		BDL	U (10)	15000		180		1600		4600	
ST076	Trail Creek Upstream of Blackfoot River	270		220		220		62000		16		9800		230		1600		4400	
ST076	Trail Creek Upstream of Blackfoot River	180		200		190		53000		BDL	U (10)	11000		240		1700		4800	
ST130	Angus Creek, below Upper Angus Creek Reservoir	280		BDL	U (100)	200		32000		20		46000		280		1100		5800	
ST130	Angus Creek, below Upper Angus Creek Reservoir	260		BDL	U (100)	220		30000		12		33000		180		930		4300	
ST130	Angus Creek, below Upper Angus Creek Reservoir	170		170		170		20000		16		35000		370		830		7400	
ST153	Diamond Creek Upstream of Kendall Creek	310		BDL	U (100)	220		33000		BDL	U (10)	30000		340		670		3100	
ST153	Diamond Creek Upstream of Kendall Creek	160		BDL	U (100)	170		58000		BDL	U (10)	28000		130		930		4700	
ST153	Diamond Creek Upstream of Kendall Creek	400		BDL	U (100)	310		46000		21		47000		370		1600		10000	
ST227	East Mill Creek At Fish Sampling Reach	70		250		290		37000		BDL	U (10)	65000		170		1700		3500	
ST227	East Mill Creek At Fish Sampling Reach	96		220		560		45000		BDL	U (10)	50000		250		1400		4000	
ST227	East Mill Creek At Fish Sampling Reach	120		220		860		46000		BDL	U (10)	60000		380		2800		3400	

TABLE H-20

MONTGOMERY WATSON 2001 PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST235	Meadow Creek, above Blackfoot Reservoir	400		200		230		23000		11		13000		89		1800		4000	
ST235	Meadow Creek, above Blackfoot Reservoir	350		200		230		28000		12		16000		81		2000		4000	
ST235	Meadow Creek, above Blackfoot Reservoir	430		260		280		33000		17		12000		100		2100		5000	
ST237	Timber Creek, above Diamond Creek	120		210		200		38000		BDL	U (10)	50000		270		1600		4300	
ST237	Timber Creek, above Diamond Creek	170		230		230		37000		BDL	U (10)	52000		210		1700		4100	
ST237	Timber Creek, above Diamond Creek	120		230		230		29000		BDL	U (10)	38000		350		1600		4600	
WD053-2	Champ Mine Extension Dump	89		BDL	U (100)	230		20000		BDL	U (10)	31000		370		830		5400	
WD053-2	Champ Mine Extension Dump	210		BDL	U (100)	280		19000		19		41000		1400		1600		5600	
WD053-2	Champ Mine Extension Dump	190		BDL	U (100)	320		28000		24		51000		1700		1700		5500	
WD062-1	Conda Mine Middle Limb North Waste Dump	36		BDL	U (100)	160		18000		BDL	U (10)	20000		1600		690		4000	
WD062-1	Conda Mine Middle Limb North Waste Dump	41		BDL	U (100)	190		15000		BDL	U (10)	22000		1200		740		4600	
WD062-1	Conda Mine Middle Limb North Waste Dump	31		BDL	U (100)	490		21000		BDL	U (10)	32000		1600		810		4100	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	51		BDL	U (100)	980		16000		13		38000		1300		1200		7100	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	39		BDL	U (100)	330		14000		BDL	U (10)	26000		1400		990		5000	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	44		BDL	U (100)	730		20000		BDL	U (10)	22000		1100		910		4100	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	37		BDL	U (100)	570		17000		BDL	U (10)	19000		940		740		3700	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	83		120		460		6900		14		28000		1500		5700		6800	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	58		BDL	U (100)	320		5400		12		29000		1800		3700		5900	

TABLE H-20

MONTGOMERY WATSON 2001 PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Lead		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium		Uranium	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
BB004	Phosphoria Outcrop near Wood Canyon Road	750		140000				1300		650		0.099		120		120		46	
BB004	Phosphoria Outcrop near Wood Canyon Road	720		180000				1400		370		0.052		110		110		42	
BB004	Phosphoria Outcrop near Wood Canyon Road	730		200000				1000		490		0.12		110		120		46	
BB005	Phosphoria Outcrop west of Slug Valley	760		74000		32		1200		610		0.11		BDL	U (10)	BDL	U (100)	BDL	U (40)
BB005	Phosphoria Outcrop west of Slug Valley	530		88000		34		1800		630		0.12		BDL	U (10)	BDL	U (100)	BDL	U (40)
BB005	Phosphoria Outcrop west of Slug Valley	730		100000		59		2200		610		0.1		BDL	U (10)	BDL	U (100)	BDL	U (40)
BB006	Phosphoria Outcrop near Stewart Creek	620		120000				750		240		0.2		96		100		BDL	U (40)
BB006	Phosphoria Outcrop near Stewart Creek	670		190000				610		510		0.14		110		110		43	
BB006	Phosphoria Outcrop near Stewart Creek	480		140000				690		240		0.21		100		110		BDL	U (40)
BB007	Phosphoria Outcrop near Timber Creek	1100		54000		210		980		320		0.32		130		130		47	
BB007	Phosphoria Outcrop near Timber Creek	880		100000		39		1900		500		0.42		140		140		46	
BB007	Phosphoria Outcrop near Timber Creek	1300		400000		35		1100		700		0.38		270		130		46	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	390		51000		BDL	U (75)	560		760		0.35		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	560		100000		BDL	U (75)	610		780		0.89		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	600		37000		BDL	U (75)	710		820		0.99		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST049	Little Blackfoot River Upstream of Reese Creek	670		610000				850		280		0.2		110		110		52	
ST049	Little Blackfoot River Upstream of Reese Creek	1000		260000				710		1900		0.23		93		140		840	
ST049	Little Blackfoot River Upstream of Reese Creek	720		120000				950		450		0.16		100		110		61	
ST076	Trail Creek Upstream of Blackfoot River	790		210000				1200		350		0.5		110		120		55	
ST076	Trail Creek Upstream of Blackfoot River	700		84000				530		580		0.73		170		130		60	
ST076	Trail Creek Upstream of Blackfoot River	730		96000				940		700		0.59		120		110		48	
ST130	Angus Creek, below Upper Angus Creek Reservoir	350		26000		25		720		1100		1.1		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST130	Angus Creek, below Upper Angus Creek Reservoir	330		450000		30		350		930		0.88		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST130	Angus Creek, below Upper Angus Creek Reservoir	580		200000		20		450		910		1.1		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST153	Diamond Creek Upstream of Kendall Creek	900		36000		37		1300		590		0.55		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST153	Diamond Creek Upstream of Kendall Creek	610		160000		24		740		1000		0.3		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST153	Diamond Creek Upstream of Kendall Creek	500		210000		33		1100		1500		0.75		BDL	U (10)	BDL	U (100)	74	
ST227	East Mill Creek At Fish Sampling Reach	430		240000		21		1100		380		4.3		110		120		42	
ST227	East Mill Creek At Fish Sampling Reach	580		200000		18		1100		490		12		150		110		42	
ST227	East Mill Creek At Fish Sampling Reach	430		530000		22		890		1400		19		120		120		80	

TABLE H-20

MONTGOMERY WATSON 2001 PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Lead		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium		Uranium	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST235	Meadow Creek, above Blackfoot Reservoir	780		61000				790		510		0.16		89		100		59	
ST235	Meadow Creek, above Blackfoot Reservoir	720		120000				780		480		0.27		91		110		57	
ST235	Meadow Creek, above Blackfoot Reservoir	940		68000				1100		480		0.097		110		120		68	
ST237	Timber Creek, above Diamond Creek	500		100000		24		710		440		0.23		100		110		52	
ST237	Timber Creek, above Diamond Creek	710		180000		34		700		470		0.18		110		110		52	
ST237	Timber Creek, above Diamond Creek	600		120000		41		710		550		0.32		160		120		53	
WD053-2	Champ Mine Extension Dump	560		90000		29		2800		1700		1.7		BDL	U (10)	140		BDL	U (40)
WD053-2	Champ Mine Extension Dump	510		79000		38		3900		2700		1.3		BDL	U (10)	110		42	
WD053-2	Champ Mine Extension Dump	370		110000		33		3600		3700		2.5		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD062-1	Conda Mine Middle Limb North Waste Dump	470		42000		20		5000		3500		1.5		BDL	U (10)	200		BDL	U (40)
WD062-1	Conda Mine Middle Limb North Waste Dump	440		54000		43		7300		4000		2.4		BDL	U (10)	150		BDL	U (40)
WD062-1	Conda Mine Middle Limb North Waste Dump	490		27000		16		6500		5100		19		BDL	U (10)	180		BDL	U (40)
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	480		62000		BDL	U (75)	5200		2800		39		BDL	U (10)	BDL	U (100)	58	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	470		75000		BDL	U (75)	3200		2000		9.4		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	310		59000		BDL	U (75)	3900		2100		26		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD086-2	Henry Mine Center Pit #1 Overburden Dump	260		47000		BDL	U (75)	3200		1800		4.4		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD086-2	Henry Mine Center Pit #1 Overburden Dump	1700		50000		BDL	U (75)	2700		4500		7.5		BDL	U (10)	360		150	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	530		30000		BDL	U (75)	2700		4000		4.7		BDL	U (10)	420		93	

TABLE H-20

MONTGOMERY WATSON 2001 PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS			
		Vanadium		Zinc	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
BB004	Phosphoria Outcrop near Wood Canyon Road	BDL	U (0.16)	21	
BB004	Phosphoria Outcrop near Wood Canyon Road	0.26		19	
BB004	Phosphoria Outcrop near Wood Canyon Road	0.18		14	
BB005	Phosphoria Outcrop west of Slug Valley	0.53		20	
BB005	Phosphoria Outcrop west of Slug Valley	0.3		16	
BB005	Phosphoria Outcrop west of Slug Valley	0.46		19	
BB006	Phosphoria Outcrop near Stewart Creek	BDL	U (0.16)	25	
BB006	Phosphoria Outcrop near Stewart Creek	0.19		45	
BB006	Phosphoria Outcrop near Stewart Creek	BDL	U (0.16)	23	
BB007	Phosphoria Outcrop near Timber Creek	0.25		32	
BB007	Phosphoria Outcrop near Timber Creek	BDL	U (0.16)	46	
BB007	Phosphoria Outcrop near Timber Creek	BDL	U (0.16)	82	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	1		31	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	1		28	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	0.98		22	
ST049	Little Blackfoot River Upstream of Reese Creek	0.19		24	
ST049	Little Blackfoot River Upstream of Reese Creek	5.5		66	
ST049	Little Blackfoot River Upstream of Reese Creek	0.41		29	
ST076	Trail Creek Upstream of Blackfoot River	0.37		27	
ST076	Trail Creek Upstream of Blackfoot River	0.68		27	
ST076	Trail Creek Upstream of Blackfoot River	0.38		33	
ST130	Angus Creek, below Upper Angus Creek Reservoir	1		31	
ST130	Angus Creek, below Upper Angus Creek Reservoir	1		26	
ST130	Angus Creek, below Upper Angus Creek Reservoir	0.7		33	
ST153	Diamond Creek Upstream of Kendall Creek	0.92		28	
ST153	Diamond Creek Upstream of Kendall Creek	0.55		19	
ST153	Diamond Creek Upstream of Kendall Creek	1.4		40	
ST227	East Mill Creek At Fish Sampling Reach	BDL	U (0.16)	20	
ST227	East Mill Creek At Fish Sampling Reach	0.21		23	
ST227	East Mill Creek At Fish Sampling Reach	1.6		29	

TABLE H-20

MONTGOMERY WATSON 2001 PLANT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS			
		Vanadium		Zinc	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST235	Meadow Creek, above Blackfoot Reservoir	0.82		23	
ST235	Meadow Creek, above Blackfoot Reservoir	0.71		20	
ST235	Meadow Creek, above Blackfoot Reservoir	0.76		24	
ST237	Timber Creek, above Diamond Creek	0.41		29	
ST237	Timber Creek, above Diamond Creek	0.57		21	
ST237	Timber Creek, above Diamond Creek	0.66		37	
WD053-2	Champ Mine Extension Dump	0.3		32	
WD053-2	Champ Mine Extension Dump	1.1		31	
WD053-2	Champ Mine Extension Dump	0.88		32	
WD062-1	Conda Mine Middle Limb North Waste Dump	0.73		91	
WD062-1	Conda Mine Middle Limb North Waste Dump	0.34		120	
WD062-1	Conda Mine Middle Limb North Waste Dump	0.46		72	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	0.8		82	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	0.78		70	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	0.74		37	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	0.76		36	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	2.2		56	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	2.1		41	

Notes:

BDL Below detection limit
mg/kg Milligram per kilogram
µg/kg Microgram per kilogram

Flag columns present data qualifiers reported by analytical laboratory.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
U Analyte was analyzed for but not detected at the indicated MDL

TABLE H-21

MONTGOMERY WATSON 2001 SMALL MAMMAL TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
BB004	Phosphoria Outcrop near Wood Canyon Road	45		180		110		4900		BDL	U (5)	1800		39		650		1700	
BB004	Phosphoria Outcrop near Wood Canyon Road	26		100		25		2600		62		1900		950		510		1700	
BB004	Phosphoria Outcrop near Wood Canyon Road	63		56		BDL	U (10)	2000		7.9		1900		BDL	U (2)	370		530	
BB005	Phosphoria Outcrop west of Slug Valley	16		130		BDL	U (10)	960		8.3		2100		8.7		480		820	
BB005	Phosphoria Outcrop west of Slug Valley	25		460		BDL	U (10)	890		9.6		2200		15		490		910	
BB005	Phosphoria Outcrop west of Slug Valley	14		51		BDL	U (10)	1400		7.5		1400		17		500		890	
BB006	Phosphoria Outcrop near Stewart Creek	830		75		19		3800		63		1500		15		600		3400	
BB006	Phosphoria Outcrop near Stewart Creek	1100		82		32		2600		64		1200		29		440		3400	
BB006	Phosphoria Outcrop near Stewart Creek	44		67		28		1900		60		1500		160		310		1400	
BB007	Phosphoria Outcrop near Timber Creek	35		87		36		2500		60		1500		320		500		2300	
BB007	Phosphoria Outcrop near Timber Creek	540		63		25		5600		58		900		220		420		2000	
BB007	Phosphoria Outcrop near Timber Creek	12		65		BDL	U (10)	1800		58		990		51		300		1300	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	8.6		120		52		870		BDL	U (5)	1100		56		400		990	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	34		200		37		670		BDL	U (5)	1800		32		1000		1200	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	210		150		47		2000		BDL	U (5)	1800		29		730		1700	
ST049	Little Blackfoot River Upstream of Reese Creek	49		99		BDL	U (10)	6700		64		6700		23		1100		2400	
ST049	Little Blackfoot River Upstream of Reese Creek	350		69		16		6500		8.4		3500		100		450		1200	
ST049	Little Blackfoot River Upstream of Reese Creek	44		BDL	U (50)	BDL	U (10)	1600		8		2500		11		600		1100	
ST076	Trail Creek Upstream of Blackfoot River	16		52		BDL	U (10)	1300		7.9		2500		4.6		750		660	
ST076	Trail Creek Upstream of Blackfoot River	38		BDL	U (50)	BDL	U (10)	980		7.6		2300		7.7		790		870	
ST130	Angus Creek, below Upper Angus Creek Reservoir	24		130		38		2700		BDL	U (5)	1100		13		490		1200	
ST130	Angus Creek, below Upper Angus Creek Reservoir	27		160		26		980		BDL	U (5)	840		9.3		600		1200	
ST130	Angus Creek, below Upper Angus Creek Reservoir	18		140		35		1300		BDL	U (5)	1100		11		680		1300	
ST153	Diamond Creek Upstream of Kendall Creek	94		BDL	U (50)	25		900		7.7		1600		17		410		800	
ST153	Diamond Creek Upstream of Kendall Creek	10		BDL	U (50)	BDL	U (10)	580		6.9		1900		5.2		460		500	
ST153	Diamond Creek Upstream of Kendall Creek	37		BDL	U (50)	BDL	U (10)	810		7.8		2100		9.9		460		790	
ST227	East Mill Creek At Fish Sampling Reach	27		68		16		1300		58		2100		16		520		1200	
ST227	East Mill Creek At Fish Sampling Reach	56		49		BDL	U (10)	1400		7.9		2300		10		1500		750	
ST227	East Mill Creek At Fish Sampling Reach	17		BDL	U (50)	BDL	U (10)	790		8		2100		5.5		450		600	
ST235	Meadow Creek, above Blackfoot Reservoir	110		86		BDL	U (10)	2000		64		1800		13		300		1700	

TABLE H-21

MONTGOMERY WATSON 2001 SMALL MAMMAL TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST235	Meadow Creek, above Blackfoot Reservoir	15		67		BDL	U (10)	2400		61		730		15		380		1600	
ST235	Meadow Creek, above Blackfoot Reservoir	13		64		BDL	U (10)	2400		61		790		5.7		270		1000	
ST237	Timber Creek, above Diamond Creek	83		68		BDL	U (10)	1700		65		3400		17		530		1100	
ST237	Timber Creek, above Diamond Creek	34		65		12		3200		60		1300		39		390		1500	
ST237	Timber Creek, above Diamond Creek	110		71		120		5100		63		1600		25		550		1500	
WD053-2	Champ Mine Extension Dump	28		130		54		1000		BDL	U (5)	1200		28		550		1300	
WD053-2	Champ Mine Extension Dump	5.4		130		50		1100		BDL	U (5)	860		12		790		810	
WD053-2	Champ Mine Extension Dump	9.1		BDL	U (50)	BDL	U (10)	1200		7		1900		11		330		620	
WD062-1	Conda Mine Middle Limb North Waste Dump	18		130		120		520		BDL	U (5)	3000		120		650		1400	
WD062-1	Conda Mine Middle Limb North Waste Dump	12		120		81		410		63		1700		52		620		1300	
WD062-1	Conda Mine Middle Limb North Waste Dump	14		96		240		530		62		1700		32		500		1200	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	19		88		100		490		64		750		48		490		930	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	14		89		190		310		62		1100		140		1000		5100	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	13		84		120		360		60		1200		58		400		1100	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	36		82		24		1600		65		910		22		530		1000	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	20		67		52		1700		58		1700		20		540		1200	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	40		78		16		500		64		1200		44		580		1400	

TABLE H-21

MONTGOMERY WATSON 2001 SMALL MAMMAL TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																			
		Lead		Manganese		Molybdenum		Nickel		Selenium		Silver		Thallium		Uranium		Vanadium		Zinc	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
BB004	Phosphoria Outcrop near Wood Canyon Road	130		1700		180		280		0.19		BDL	U (5)	BDL	U (50)	37		BDL	U (0.1)	33	
BB004	Phosphoria Outcrop near Wood Canyon Road	120		2300		110		260		0.4		27		BDL	U (50)	BDL	U (10)	0.11		46	
BB004	Phosphoria Outcrop near Wood Canyon Road	74		770		BDL	U (50)	40		0.4		BDL	U (5)	BDL	U (50)	26		BDL	U (0.1)	58	
BB005	Phosphoria Outcrop west of Slug Valley	48		1000		130		30		0.18		BDL	U (5)	BDL	U (50)	28		BDL	U (0.1)	18	
BB005	Phosphoria Outcrop west of Slug Valley	38		1600		210		70		0.2		BDL	U (5)	BDL	U (50)	47		BDL	U (0.1)	12	
BB005	Phosphoria Outcrop west of Slug Valley	85		1300		190		80		0.36		BDL	U (5)	BDL	U (50)	23		BDL	U (0.1)	21	
BB006	Phosphoria Outcrop near Stewart Creek	56		11000		60		320		0.18		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.2		19	
BB006	Phosphoria Outcrop near Stewart Creek	99		15000		BDL	U (50)	290		0.2		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.29		20	
BB006	Phosphoria Outcrop near Stewart Creek	87		3000		140		190		0.5		7		BDL	U (50)	BDL	U (10)	0.13		14	
BB007	Phosphoria Outcrop near Timber Creek	95		3400		66		190		0.37		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.1		43	
BB007	Phosphoria Outcrop near Timber Creek	76		7300		56		250		0.28		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.13		20	
BB007	Phosphoria Outcrop near Timber Creek	10		1100		95		110		0.2		BDL	U (5)	BDL	U (50)	BDL	U (10)	BDL	U (0.1)	22	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	27		1100		120		240		0.69		BDL	U (5)	BDL	U (50)	33		BDL	U (0.1)	13	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	78		1400		160		410		0.22		BDL	U (5)	BDL	U (50)	36		BDL	U (0.1)	19	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	67		3200		130		350		0.19		BDL	U (5)	BDL	U (50)	38		BDL	U (0.1)	16	
ST049	Little Blackfoot River Upstream of Reese Creek	360		2500		71		240		0.18		BDL	U (5)	BDL	U (50)	12		0.17		36	
ST049	Little Blackfoot River Upstream of Reese Creek	59		4400		78		190		0.37		BDL	U (5)	BDL	U (50)	29		0.17		18	
ST049	Little Blackfoot River Upstream of Reese Creek	26		1900		130		55		0.18		BDL	U (5)	BDL	U (50)	24		BDL	U (0.1)	9.2	
ST076	Trail Creek Upstream of Blackfoot River	120		840		220		190		0.43		BDL	U (5)	BDL	U (50)	24		BDL	U (0.1)	14	
ST076	Trail Creek Upstream of Blackfoot River	40		1200		91		88		0.27		BDL	U (5)	BDL	U (50)	24		BDL	U (0.1)	11	
ST130	Angus Creek, below Upper Angus Creek Reservoir	80		1200		200		210		0.23		BDL	U (5)	BDL	U (50)	36		BDL	U (0.1)	12	
ST130	Angus Creek, below Upper Angus Creek Reservoir	100		1100		170		210		0.2		BDL	U (5)	BDL	U (50)	36		BDL	U (0.1)	21	
ST130	Angus Creek, below Upper Angus Creek Reservoir	67		1600		220		200		0.37		BDL	U (5)	BDL	U (50)	35		BDL	U (0.1)	19	
ST153	Diamond Creek Upstream of Kendall Creek	33		1800		68		150		2.1		BDL	U (5)	BDL	U (50)	23		BDL	U (0.1)	13	
ST153	Diamond Creek Upstream of Kendall Creek	13		660		61		BDL	U (5)	0.46		BDL	U (5)	BDL	U (50)	22		BDL	U (0.1)	7.9	
ST153	Diamond Creek Upstream of Kendall Creek	17		1700		170		12		0.97		BDL	U (5)	BDL	U (50)	24		BDL	U (0.1)	9.7	
ST227	East Mill Creek At Fish Sampling Reach	14		1600		120		150		0.89		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.11		9.5	
ST227	East Mill Creek At Fish Sampling Reach	16		1300		140		520		0.36		BDL	U (5)	BDL	U (50)	24		BDL	U (0.1)	10	
ST227	East Mill Creek At Fish Sampling Reach	19		910		150		BDL	U (5)	0.42		BDL	U (5)	BDL	U (50)	23		BDL	U (0.1)	9.4	
ST235	Meadow Creek, above Blackfoot Reservoir	32		1900		53		180		0.15		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.17		18	

TABLE H-21

MONTGOMERY WATSON 2001 SMALL MAMMAL TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																			
		Lead		Manganese		Molybdenum		Nickel		Selenium		Silver		Thallium		Uranium		Vanadium		Zinc	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST235	Meadow Creek, above Blackfoot Reservoir	45		1100		BDL	U (50)	170		0.15		BDL	U (5)	BDL	U (50)	BDL	U (10)	BDL	U (0.1)	18	
ST235	Meadow Creek, above Blackfoot Reservoir	76		1000		93		120		0.27		BDL	U (5)	BDL	U (50)	BDL	U (10)	BDL	U (0.1)	11	
ST237	Timber Creek, above Diamond Creek	55		2400		100		180		0.28		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.22		10	
ST237	Timber Creek, above Diamond Creek	64		3600		BDL	U (50)	170		0.27		BDL	U (5)	BDL	U (50)	BDL	U (10)	BDL	U (0.1)	18	
ST237	Timber Creek, above Diamond Creek	120		7600		BDL	U (50)	220		0.29		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.14		16	
WD053-2	Champ Mine Extension Dump	43		2100		450		350		0.77		BDL	U (5)	BDL	U (50)	37		BDL	U (0.1)	11	
WD053-2	Champ Mine Extension Dump	54		550		170		150		0.86		BDL	U (5)	BDL	U (50)	36		BDL	U (0.1)	9.7	
WD053-2	Champ Mine Extension Dump	13		650		100		18		0.79		BDL	U (5)	BDL	U (50)	22		BDL	U (0.1)	10	
WD062-1	Conda Mine Middle Limb North Waste Dump	54		810		250		310		4.3		BDL	U (5)	BDL	U (50)	34		BDL	U (0.1)	22	
WD062-1	Conda Mine Middle Limb North Waste Dump	29		750		170		250		2.2		BDL	U (5)	BDL	U (50)	14		0.16		14	
WD062-1	Conda Mine Middle Limb North Waste Dump	BDL	U (5)	720		120		250		7		BDL	U (5)	BDL	U (50)	BDL	U (10)	BDL	U (0.1)	13	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	BDL	U (5)	680		130		190		2.4		BDL	U (5)	BDL	U (50)	11		0.1		10	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	1400		1100		190		490		5.2		16		BDL	U (50)	12		0.26		13	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	30		950		120		570		3.6		BDL	U (5)	BDL	U (50)	BDL	U (10)	BDL	U (0.1)	18	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	28		1200		83		210		0.99		BDL	U (5)	BDL	U (50)	BDL	U (10)	0.12		17	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	5.9		780		100		180		1.1		BDL	U (5)	BDL	U (50)	BDL	U (10)	BDL	U (0.1)	12	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	BDL	U (5)	1200		240		310		0.94		5		BDL	U (50)	12		0.16		13	

Notes:

BDL Below detection limit
mg/kg Milligram per kilogram
µg/kg Microgram per kilogram

Flag columns present data qualifiers reported by analytical laboratory.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
U Analyte was analyzed for but not detected at the indicated MDL

TABLE H-22

MONTGOMERY WATSON 2001 INSECT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	450		130		220		23000		230		20000		1700		4200		16000	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	740		150		280		30000		240		22000		1500		3100		13000	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	910		120		270		27000		260		17000		1500		3600		13000	
ST049	Little Blackfoot River Upstream of Reese Creek	800		110		220		16000		280		22000		890		10000		44000	
ST076	Trail Creek Upstream of Blackfoot River	940		BDL	U (100)	370		15000		250		11000		370		3100		33000	
ST076	Trail Creek Upstream of Blackfoot River	190		BDL	U (100)	220		8900		220		12000		360		2300		40000	
ST076	Trail Creek Upstream of Blackfoot River																		
ST130	Angus Creek, below Upper Angus Creek Reservoir	360		130		310		12000		230		16000		2500		3600		28000	
ST130	Angus Creek, below Upper Angus Creek Reservoir	170		200		110		5300		230		16000		1100		5400		29000	
ST130	Angus Creek, below Upper Angus Creek Reservoir	310		BDL	U (100)	330		5100		230		17000		1700		11000		24000	
ST153	Diamond Creek Upstream of Kendall Creek																		
ST153	Diamond Creek Upstream of Kendall Creek																		
ST153	Diamond Creek Upstream of Kendall Creek																		
ST227	East Mill Creek At Fish Sampling Reach	97		150		540		8700		210		19000		1400		2400		33000	
ST227	East Mill Creek At Fish Sampling Reach	140		130		560		4500		220		24000		1900		2700		23000	
ST227	East Mill Creek At Fish Sampling Reach	200		110		620		3300		220		15000		3600		3300		37000	
ST235	Meadow Creek, above Blackfoot Reservoir	280		130		110		5500		230		15000		93		2500		34000	
ST235	Meadow Creek, above Blackfoot Reservoir																		
ST235	Meadow Creek, above Blackfoot Reservoir	910		100		150		11000		250		17000		230		3600		28000	
ST237	Timber Creek, above Diamond Creek																		
ST237	Timber Creek, above Diamond Creek																		
ST237	Timber Creek, above Diamond Creek																		
WD053-2	Champ Mine Extension Dump																		
WD053-2	Champ Mine Extension Dump	1400		BDL	U (100)	530		9800		310		22000		1500		9100		13000	
WD062-1	Conda Mine Middle Limb North Waste Dump	55		160		540		1800		200		8900		4500		2900		43000	
WD062-1	Conda Mine Middle Limb North Waste Dump	62		BDL	U (100)	630		1400		210		6700		4600		3200		43000	
WD062-1	Conda Mine Middle Limb North Waste Dump	54		BDL	U (100)	870		1700		220		9400		7000		4700		44000	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	160		300		550		3800		230		30000		5600		8200		11000	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	330		340		610		4400		260		32000		5600		11000		10000	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	82		190		830		3400		220		14000		7300		4900		14000	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	130		190		300		1600		230		22000		1900		8500		20000	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	170		190		410		2800		230		31000		1500		14000		14000	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	140		160		350		2000		240		19000		4200		9700		22000	

TABLE H-22

MONTGOMERY WATSON 2001 INSECT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Lead		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium		Uranium	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	100		36000				680		970		1.3		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek											2.4							
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	200		180000		22		360		1400		2		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST049	Little Blackfoot River Upstream of Reese Creek	80		68000		16		680		3000		1.6		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST076	Trail Creek Upstream of Blackfoot River	200		160000				690		5100		6		BDL	U (10)	BDL	U (100)	46	
ST076	Trail Creek Upstream of Blackfoot River											4.1							
ST076	Trail Creek Upstream of Blackfoot River											1.9							
ST130	Angus Creek, below Upper Angus Creek Reservoir											3.3							
ST130	Angus Creek, below Upper Angus Creek Reservoir	92		68000				1000		1000		13		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST130	Angus Creek, below Upper Angus Creek Reservoir	100		59000				1300		1100		14		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST153	Diamond Creek Upstream of Kendall Creek	91		41000				1800		1300		11		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST153	Diamond Creek Upstream of Kendall Creek	210		21000				530		1100		0.6		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST153	Diamond Creek Upstream of Kendall Creek											2.1							
ST227	East Mill Creek At Fish Sampling Reach	510		28000				230		1600		0.58		BDL	U (10)	BDL	U (100)	74	
ST227	East Mill Creek At Fish Sampling Reach											1.8							
ST227	East Mill Creek At Fish Sampling Reach											1.8							
ST235	Meadow Creek, above Blackfoot Reservoir											0.94							
ST235	Meadow Creek, above Blackfoot Reservoir											4.4							
ST235	Meadow Creek, above Blackfoot Reservoir	820		47000				560		5200		3.8		BDL	U (10)	BDL	U (100)	170	
ST237	Timber Creek, above Diamond Creek	59		36000		12		4000		8700		13		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST237	Timber Creek, above Diamond Creek	57		32000		15		3600		9000		18		BDL	U (10)	BDL	U (100)	BDL	U (40)
ST237	Timber Creek, above Diamond Creek	74		47000		14		6000		12000		29		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD053-2	Champ Mine Extension Dump	310		52000		16		1800		3000		30		BDL	U (10)	BDL	U (100)	620	
WD053-2	Champ Mine Extension Dump	1900		48000		19		1100		3800		29		BDL	U (10)	BDL	U (100)	960	
WD062-1	Conda Mine Middle Limb North Waste Dump	130		63000		20		2900		2100		30		BDL	U (10)	BDL	U (100)	280	
WD062-1	Conda Mine Middle Limb North Waste Dump	180		23000		17		1200		2600		7.9		BDL	U (10)	BDL	U (100)	440	
WD062-1	Conda Mine Middle Limb North Waste Dump	190		18000		20		770		4300		12		BDL	U (10)	100		530	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	230		30000		11		2200		3500		10		BDL	U (10)	140		400	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	100		36000				680		970		1.3		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD081-2	Ballard Mine Pit #1 Overburden Dump #2											2.4							
WD086-2	Henry Mine Center Pit #1 Overburden Dump	200		180000		22		360		1400		2		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD086-2	Henry Mine Center Pit #1 Overburden Dump	80		68000		16		680		3000		1.6		BDL	U (10)	BDL	U (100)	BDL	U (40)
WD086-2	Henry Mine Center Pit #1 Overburden Dump	200		160000				690		5100		6		BDL	U (10)	BDL	U (100)	46	

TABLE H-22

MONTGOMERY WATSON 2001 INSECT TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS			
		Vanadium		Zinc	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	1.1		190	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	1.4		180	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	1.8		200	
ST049	Little Blackfoot River Upstream of Reese Creek	1.5		140	
ST076	Trail Creek Upstream of Blackfoot River	2.1		170	
ST076	Trail Creek Upstream of Blackfoot River	0.46		180	
ST076	Trail Creek Upstream of Blackfoot River				
ST130	Angus Creek, below Upper Angus Creek Reservoir	1.1		150	
ST130	Angus Creek, below Upper Angus Creek Reservoir	0.56		160	
ST130	Angus Creek, below Upper Angus Creek Reservoir	1		140	
ST153	Diamond Creek Upstream of Kendall Creek				
ST153	Diamond Creek Upstream of Kendall Creek				
ST153	Diamond Creek Upstream of Kendall Creek				
ST227	East Mill Creek At Fish Sampling Reach	0.4		190	
ST227	East Mill Creek At Fish Sampling Reach	0.3		180	
ST227	East Mill Creek At Fish Sampling Reach	0.37		220	
ST235	Meadow Creek, above Blackfoot Reservoir	0.63		120	
ST235	Meadow Creek, above Blackfoot Reservoir				
ST235	Meadow Creek, above Blackfoot Reservoir	2		120	
ST237	Timber Creek, above Diamond Creek				
ST237	Timber Creek, above Diamond Creek				
ST237	Timber Creek, above Diamond Creek				
WD053-2	Champ Mine Extension Dump				
WD053-2	Champ Mine Extension Dump	4.3		180	
WD062-1	Conda Mine Middle Limb North Waste Dump	0.54		270	
WD062-1	Conda Mine Middle Limb North Waste Dump	0.22		270	
WD062-1	Conda Mine Middle Limb North Waste Dump	0.3		290	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	3.8		200	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	7		230	
WD081-2	Ballard Mine Pit #1 Overburden Dump #2	2.4		240	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	3		180	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	4		200	
WD086-2	Henry Mine Center Pit #1 Overburden Dump	3.1		200	

TABLE H-22

MONTGOMERY WATSON 2001 INSECT TISSUE ANALYTICAL RESULTS

Notes:

BDL	Below detection limit
mg/kg	Milligram per kilogram
µg/kg	Microgram per kilogram

Flag columns present data qualifiers reported by analytical laboratory.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:

U	Analyte was analyzed for but not detected at the indicated MDL

TABLE H-23

MONTGOMERY WATSON 2001 WORM TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Chromium		Copper	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	4800		110		980		66000		430		7700		8000		7000		1300	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	3200		120		1800		42000		350		8900		8700		6000		2600	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	6500		BDL	U (100)	980		85000		470		6800		12000		7100		1500	
ST049	Little Blackfoot River Upstream of Reese Creek	14000		100		670		160000		690		27000		5400		7100		1300	
ST130	Angus Creek, below Upper Angus Creek Reservoir	15000		120		1800		100000		780		8500		27000		14000		3100	
ST130	Angus Creek, below Upper Angus Creek Reservoir																		
ST130	Angus Creek, below Upper Angus Creek Reservoir	16000		170		1600		87000		930		10000		10000		12000		2600	
ST153	Diamond Creek Upstream of Kendall Creek	7300		120		400		95000		540		9400		6500		10000		1000	
ST227	East Mill Creek At Fish Sampling Reach	8800		170		1600		76000		570		8000		34000		13000		2100	
ST227	East Mill Creek At Fish Sampling Reach	6500		220		1700		58000		540		9800		70000		23000		2300	
ST227	East Mill Creek At Fish Sampling Reach	9400		210		1700		83000		630		10000		61000		26000		2900	
ST235	Meadow Creek, above Blackfoot Reservoir	5900		BDL	U (100)	440		57000		560		31000		2500		10000		910	
ST237	Timber Creek, above Diamond Creek	13000		BDL	U (100)	960		100000		610		8600		12000		5800		1800	
ST237	Timber Creek, above Diamond Creek	12000		350		810		100000		620		7700		8400		5800		1800	
ST237	Timber Creek, above Diamond Creek	14000		140		830		110000		700		7500		8400		6200		1900	

TABLE H-23

MONTGOMERY WATSON 2001 WORM TISSUE ANALYTICAL RESULTS

(Page 2 of 3)

STATION ID	STATION NAME	ANALYTICAL RESULTS																	
		Lead		Manganese		Mercury		Molybdenum		Nickel		Selenium		Silver		Thallium		Uranium	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	2800		140000		210		BDL	U (100)	2100		30		BDL	U (10)	BDL	U (100)	640	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	2000		77000		160		BDL	U (100)	2100		41		BDL	U (10)	BDL	U (100)	420	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	3600		160000		340		BDL	U (100)	2200		42		BDL	U (10)	BDL	U (100)	760	
ST049	Little Blackfoot River Upstream of Reese Creek	11000		530000				BDL	U (100)	2400		11		BDL	U (10)	160		1700	
ST130	Angus Creek, below Upper Angus Creek Reservoir	8500		640000				BDL	U (100)	5800		44		BDL	U (10)	170		1200	
ST130	Angus Creek, below Upper Angus Creek Reservoir											41							
ST130	Angus Creek, below Upper Angus Creek Reservoir	8700		840000				BDL	U (100)	5000		80		BDL	U (10)	210		1700	
ST153	Diamond Creek Upstream of Kendall Creek	5500		550000				BDL	U (100)	1900		4.6		BDL	U (10)	140		1900	
ST227	East Mill Creek At Fish Sampling Reach	6700		260000				BDL	U (100)	5000		120		110		220		1600	
ST227	East Mill Creek At Fish Sampling Reach	4900		190000				BDL	U (100)	5400		180		42		330		2400	
ST227	East Mill Creek At Fish Sampling Reach	6700		450000				BDL	U (100)	6000		260		43		560		3300	
ST235	Meadow Creek, above Blackfoot Reservoir	4900		66000				BDL	U (100)	2700		3		BDL	U (10)	BDL	U (100)	690	
ST237	Timber Creek, above Diamond Creek	9900		320000				BDL	U (100)	3400		28		BDL	U (10)	210		950	
ST237	Timber Creek, above Diamond Creek	8600		310000				BDL	U (100)	3400		18		BDL	U (10)	200		680	
ST237	Timber Creek, above Diamond Creek	9600		350000				BDL	U (100)	3700		21		BDL	U (10)	230		690	

TABLE H-23

MONTGOMERY WATSON 2001 WORM TISSUE ANALYTICAL RESULTS

STATION ID	STATION NAME	ANALYTICAL RESULTS			
		Vanadium		Zinc	
		(mg/kg)	Flag (mg/kg)	(mg/kg)	Flag (mg/kg)
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	9.4		290	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	6.5		300	
ST026	Blackfoot River Upstream of Wooley Range Ridge Creek	12		240	
ST049	Little Blackfoot River Upstream of Reese Creek	23		220	
ST130	Angus Creek, below Upper Angus Creek Reservoir	28		280	
ST130	Angus Creek, below Upper Angus Creek Reservoir				
ST130	Angus Creek, below Upper Angus Creek Reservoir	33		200	
ST153	Diamond Creek Upstream of Kendall Creek	21		170	
ST227	East Mill Creek At Fish Sampling Reach	31		330	
ST227	East Mill Creek At Fish Sampling Reach	47		400	
ST227	East Mill Creek At Fish Sampling Reach	62		360	
ST235	Meadow Creek, above Blackfoot Reservoir	13		100	
ST237	Timber Creek, above Diamond Creek	26		370	
ST237	Timber Creek, above Diamond Creek	25		270	
ST237	Timber Creek, above Diamond Creek	30		240	

Notes:

BDL Below detection limit
mg/kg Milligram per kilogram
µg/kg Microgram per kilogram

Flag columns present data qualifiers reported by analytical laboratory.
When result presented as BDL, number in parentheses in corresponding flag column represents method detection limit (MDL) reported by laboratory

Data qualifier definitions:
U Analyte was analyzed for but not detected at the indicated MDL

APPENDIX I

RESPONSES TO COMMENTS ON THE DRAFT AREA WIDE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

November 8, 2002

Richard Clegg
Idaho Department of Environmental Quality
15 West Center Street
Soda Springs, ID 83276

Dear Mr. Clegg:

Thank you for contacting us to allow for our review of fish sampling data for the Southeast Idaho Phosphate Resource Area and the potential need for a fish consumption advisory. The Bureau of Environmental Health and Safety (BEHS) reviewed available data from 1998 through 2000 for fish from the streams in the Upper Blackfoot watershed. We estimated, utilizing approved protocols, that Yellowstone Cutthroat and Brook Trout from the East Mill Creek warrant a temporary fish consumption advisory.

BEHS reviewed sampling analysis data and presented its findings to the Idaho Fish Consumption Advisory Program (IFCAP) Advisory Committee for review and approval. The Advisory Committee is comprised of members of the Governor's office, the Idaho Department of Environmental Quality, the US Geologic Survey, the Idaho Department of Fish and Game, the Idaho Department of Agriculture, the Idaho Bureau of Laboratories, and BEHS. Members of this committee provide advice and recommendations on the IFCAP protocols, advisories and health education materials and methods. When presented with the data from the Southeast Idaho Phosphate Resource Area and the exposure calculations used by BEHS, there was consensus that a temporary advisory should be issued. Therefore, ***BEHS recommends that children under the age of 7 should limit the amount of Yellowstone Cutthroat and Brook Trout they consume from East Mill Creek to no more than 4 meals (4 oz.) per month***. There are no restrictions on fish consumption for the general population and pregnant women, women planning pregnancy and nursing mothers for any species of fish or other sampling locations. There are also no restrictions for children for any other type of fish or sampling locations.

In order to make a fish consumption advisory easier to understand and easier to follow for the general public, the IFCAP has six categories: no fish consumption, limited fish consumption to one meal per month, limited fish consumption to two meals per month, limited fish consumption to one meal a week (4 meals per month), limited fish

consumption to two meals a week (8 meals per month), and no consumption restriction. East Mill Creek is categorized as "limited fish consumption to one meal a week (4 meals – 4 oz. each - per month)."

BEHS will create public health notices that will be placed at camping locations along East Mill Creek and at area anglers and sporting goods stores. The BEHS web site, http://www2.state.id.us/dhw/behs/fish_advisory_program, will be updated to reflect the new advisory. BEHS will review new data as it becomes available. If new data provides for a change to this advisory, BEHS will make changes accordingly.

If you have any questions about our findings, please call me at 208-334-5950 or e-mail me at shawe@idhw.state.id.us. We thank you for the opportunity to evaluate the public health significance of consumption of fish from the Upper Blackfoot watershed.

Sincerely,

Elke Shaw-Tulloch, M.H.S.,
Bureau Chief

c: Lijun Jin, BEHS
Aaron Scheff, BEHS

Shoshone Bannock Tribes
Selenium Program Manager
Christina Cutler 208-238-5372
PO Box 306
Fort Hall, Idaho 83203

July 10, 2002

Idaho Department of Environmental Quality
224 South Arthur
Pocatello, Idaho 83204

Mr. Clegg,

The Shoshone Bannock Tribes Selenium Program Manager has provided the following comments on the Area Wide Human Health and Ecological Risk Assessment. If you have any questions please feel free to contact me at the number above.

***IDEQ Response Foreword**: The Idaho Department of Environmental Quality (IDEQ) appreciates the comments from the Shoshone Bannock Tribes and your continued support and involvement in the Area Wide Investigation process. We would also like to thank the Tribal Land Use Commissioners and environmental staff for taking the time to meet with Agency representatives on August 1st and September 10th, 2002 to discuss the Tribal concerns as well as the subsequent efforts in reaching a resolution and providing a general concurrence on our risk assessment approach and conclusions regarding direct physical health risks. The Agency acknowledges that there are some traditional uses and exposure pathways that are unquantifiable in an institutionalized risk assessment process, and that the Tribes have a number of cultural-based concerns, such as spiritual health and holistic perspectives, that lie outside the framework of standard risk assessment practices. We have agreed that these concerns should be given serious consideration during the subsequent site-specific remedial decision making processes and have incorporated mutually acceptable text in the risk assessment document to express these tribal concerns for future consideration.*

In reference to the home grown produce model, the Tribes do agree that the standard lettuce and carrot residential garden may not occur in waste rock pile soils, however, traditional gardens do and will continue to occur in waste rock pile soils, therefore, greater analysis of the amount of plant uptake and risk to the person consuming and harvesting such plants needs to take place.

***Response**: The Agency agrees that traditional gardens may occur on waste rock piles through natural invasive processes and that Tribal members have the potential to harvest such plants. As discussed, the current risk assessment addresses traditional gardens (gathering and use) through the limited evaluation of six surrogate plant species of common traditional use that were identified in collaboration with Tribal representatives. Samples of these surrogate plants were collected from both background and impacted riparian zones in the Resource Area for use in risk estimates. The Agency acknowledges that there are some specific traditional garden items and uses that may not be represented by the surrogate species*

approach and, therefore, offered to conduct further analysis of potential traditional garden exposures, particularly on waste rock piles, using vegetation concentrations previously collected from those areas during regional investigations. However, after further discussions with Tribal representatives, it was concluded that the slight increase in plant concentrations on waste rock piles versus the impacted plants used in the quantitative risk assessment scenarios would have little effect on the final risk estimates and would still result in estimated risks below established thresholds. Similarly, while there are some traditional uses that are considered unquantifiable, such as medicinal and ceremonial applications, it was agreed that the ingestion pathways would likely present the most significant and direct route of exposure to Tribal use receptors. The other potential routes of exposure are discussed in the revised Tribal qualitative risk evaluation section of the Final Risk Assessment document.

The fish ingestion scenario may be accurate in the sense that one particular stream may not support enough fish for a person or family to live solely on the fish harvested and consumed from that one stream. However, the Tribes understand that if that stream is the traditional fishing area for a particular family, then it is very possible that all of the fish that family consumes in a year would be harvested from that stream. Granted the family would not lively solely on fish. Therefore the possibility that one family may only consume fish harvested from a contaminated stream needs to be addressed.

Response: *The Agency agrees and, as discussed, has represented the highest observed fish tissue concentrations in Tier 1 of the risk assessment. This data was collected from East Mill Creek and did result in fish ingestion doses that exceed established risk threshold values based on subsistence use. This area has already been identified by the Agency as an area of focus for future corrective actions and will also be subject to a fish consumption advisory currently being processed by the Idaho Division of Health. Other impacted streams in the Resource Area are represented in Tier 2 using weighted average concentrations. However, the calculated exposure point concentrations used to represent impacted areas are highly influenced by the elevated East Mill Creek data and, therefore, result in average values that are above the observed concentrations for most of the other impacted areas. As a result, the calculated ingestion hazards reported in the risk assessment document represent conservative estimates, even on the basis of individual stream segments, and indicate regional exposure levels below threshold values.*

The plant tissue model used in the AWHHRA only addresses six plants (watercress, water buttercup, wild onion, bitter root, golden sage, and red willow) and only one exposure route (ingestion and brewed as tea and then ingested). When plants are gathered there is exposure to fugitive dust, traditional plants are ingested (either raw or cooked), inhaled, and absorbed dermal. The Tribes feel that this model is not broad enough to encompass all the risks that may be associated with harvesting and using traditional plants. Traditional plants have many uses, all of them may be ingested, inhaled, and/or absorbed, they may also be used in some combination and are used throughout the year. Therefore, the accumulative levels of gathering and using the various traditional plants must be addressed.

Response: *As discussed, the Agency acknowledges that all potential traditional plants and uses are not represented in the risk assessment. However, our Tier 1 calculations and literature research have indicated that the risks associated with inhalation, absorption and other potential routes of exposure for selenium are much lower than the direct ingestion pathway. The Agency offered to perform additional Tier 2 calculations for the pathways referenced above, however, after further discussion with Tribal representatives, it was concluded that the Tier 1 results demonstrate that the outcome of further analysis of the additional routes of exposure would still result insignificant risk levels in comparison to the*

ingestion pathways. However, it was agreed to include further discussion of these potential pathways in the revised Tribal qualitative risk evaluation text.

The possibility of someone hunting and fishing inhaling fugitive dust is not broad enough to evaluate the risks associated with inhalation. What about the range riders that ride through these areas on a weekly basis? Or the sheep rancher that turns his sheep out, rides every day and then takes his sheep home, shears them, and then works the wool? Both of the scenarios just described do and will continue to occur, therefore they must be addressed to ensure the publics health and safety.

Response: *The Agency acknowledged the lack of analysis on these particular scenarios and offered to perform additional calculations for the range rider or sheepherder receptors. However, after further discussion with the Tribal representatives, it was concluded that the existing Tier 1 results for inhalation pathways resulted in such a small risk estimate (hazard quotient [HQ]=0.0001), that even a substantial increase in the frequency, duration and concentration of dust particulate would not result in a significant exposure (HQ>1) for selenium. Additional explanatory text has been inserted in the Tribal qualitative risk evaluation section of the report.*

The Tribes are very concerned that one of the realities associated with mine sites is that if the land is allotted land there is a possibility that the allottee would move onto land that has been mined. If this happens the public needs to know what the risks are associated with living on reclaimed land from mining activities. The accumulative affects of living in such an area needs to be addressed.

Response: *As discussed, the issue of privately allotted reclaimed land appears to be unique to the Gay Mine. It is the Agency's view that unacceptable risks would be associated with residential development of any reclaimed waste rock areas. This risk issue has already arisen in the Florida phosphate fields where residential development was allowed after reclamation activities. IDEQ would recommend applying institutional controls during the Gay Mine site-specific activities in the form of deed restrictions or Tribal ordinances to prevent a residential development scenario from occurring in reclaimed areas. The State and Federal Agencies will be pursuing similar controls to prevent any potential future development of historic waste rock piles at other mines in the Resource Area.*

The risk to cattle and big game foraging on a mine site, particularly an area that has been reclaimed and seeded with alfalfa, a know accumulator of Se, needs to be addressed. The number of big game and cattle on reclaimed mine sites is significant, especially when those animals have a great possibility of be consumed. Because of the numbers of cattle and big game grazing on reclaimed land and because of their likely hood to be consumed the risk to the consumer needs to be evaluated. Also the risk of depleting big game populations and livestock losses to ranchers needs to be taken into consideration.

Response: *The Agency agrees and several area wide studies have been conducted to assess the accumulated tissue concentrations and potential effects of existing reclaimed vegetation on elk, cattle and, recently, on sheep. Elk surveys have indicated the presence of elevated selenium in livers from animals harvested in the vicinity of mine sites but not to the point of toxicological effects according to veterinarian reference values. Similarly, muscle tissue concentrations have been below the levels recommended for consumption by the U.S. Food and Drug Administrations (FDA); however, a limited number liver concentrations have been observed to be high enough to cause minor gastrointestinal effects (nausea, etc.) if consumed in large quantities over short periods of time. Hunter consumption advisories*

were previously issued by the Idaho Department of Fish & Game in consultation with the Division of Health on this issue.

At IDEQ's request, the Idaho State Veterinarian's Office has recommended livestock grazing levels for forage be set at 5 parts per million (ppm) selenium in vegetation and that any waste rock pile grazing be kept to a minimum. Previous steer studies indicated that FDA levels in beef muscle tissue were exceeded by a small percentage of the experimental herd, but only after 9 weeks of exclusive waste rock forage grazing, which is not the common practice for livestock grazing in the Resource Area. A sheep study is currently in progress to determine effects of waste rock grazing on this target receptor.

The ecological risk assessment concludes that population level effects for big game are unlikely; however, subpopulation risks may occur in highly impacted areas. The risk assessment also addresses human health risks associated with consumption of impacted livestock and game, but does not address direct health risks for foraging livestock. This is due to the fact that, unlike wildlife, once acceptable foraging levels are established and the mine sites are fully characterized; it is assumed that risks to livestock can be controlled through appropriate grazing management practices.

Thank you for your time in considering these comments and I look forward to your response.

Response: *Once again, we want to thank the Tribes for their input and assistance in developing mutually acceptable text for the revised Tribal use narratives in the final risk assessment document. The Agency has taken a conservative approach in providing estimates of direct physical health risks for the Tribal use scenarios within the context of our regional risk assessment approach. The State acknowledges the Tribal member's treaty rights to fish, hunt and gather on the off-reservation public lands within the Resource Area, and recognizes that there are Tribal concerns that are not addressed within the framework of standardized risk assessment practices. The IDEQ is committed to the continued involvement of the Tribes in future decision making processes, as stipulated in the Tribal/Interagency Memorandum of Understanding (MOU), and will continue to provide due consideration of Tribal concerns in our Lead Agency role.*

Sincerely,

Christina Cutler
Selenium Program Manager
Shoshone Bannock Tribes

July 11, 2002

Rick Clegg
Department of Environmental Quality
15 W. Center
Soda Springs, ID 83276

Fax: 208-547-3989

Re: **Synopses of Comments and Concerns Pertinent to the Selenium Project: Southeast Idaho Phosphate Resource Area, Draft Area Wide Human Health and Ecological Risk Assessment and Related Documents**

Dear Sir:

Porgans & Associates (P&A) are submitting the following brief comments to the *Draft Area Wide Human Health and Ecological Risk Assessment* in the public's interest. **Although P&A does represent clients in the affected area, the following statements are not being made on their behalf.** P&A has been conducting research pertinent to Selenium Mobilization-Contamination and Poisoning attributable to phosphate mining in the Northwestern United States for several years, and in the West for nearly 20 years, interacting with the respective federal and state agencies. P&A's research and regulatory efforts have focused primarily on lands that are directly impacted by government water projects and/or land related leases where selenium is a factor.

Since 1997, P&A has been in communication with the U.S. Bureau of Land Management (BLM), U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey and a number of Idaho State and local entities regarding phosphate mining and selenium disposition, mobilization and poisoning. P&A has completed two reports relative to phosphate mining in the Northwestern United States.[1] P&A has submitted comments to the appropriate entities relative to area wide human health and ecological risk assessment and site specific assessments, and stated its reservations regarding the State of Idaho as the designated lead agency. Since the onset of our research, it has been apparent that there have and continue to be very serious concerns and unresolved issues pertinent to the reliability of the State's and local entities' ability and/or sincerity to effectively identify the "area wide level of human health and ecological risk" attributable to impacts associated directly to past and present phosphate mining activities.

***IDEQ Response Foreword**: The Idaho Department of Environmental Quality (IDEQ) appreciates P&A's efforts in providing comments on the Draft Area Wide Human Health and Ecological Risk Assessment as we have consistently encouraged input from stakeholders and interested parties since assuming the role of Lead Agency in July 2000. We would also be interested in receiving the referenced documents published by your organization. While we understand that P&A was involved in this effort during its early voluntary Working Group period under Idaho Mining Association (IMA) control, in reality, your organization has had no involvement since IDEQ assumed the lead role two years ago and there have been no P&A representatives present at any of the nearly dozen publicly-open stakeholder meetings during that period. As a result, many of the concerns and criticisms made in your comment letter are not up to date. While we respect your opinion, it is important that we respond to your specific comments and clarify the record. Regarding coordination between our federal counterparts, upon assuming the role as Lead Agency, the IDEQ formed an Interagency Technical Group that includes technical representatives from each of the above-referenced agencies as well as U.S. Environmental Protection Agency (EPA), U.S. Bureau of Indian Affairs (BIA), Sho-Ban Tribes, Idaho*

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[1] **Porgans & Associates – Status Report** — Impact Assessment Evaluation and Review of Potential Mitigation Measures to Ameliorate Environmental Effects of Selenium Mobilization, Contamination and Poisoning of Livestock on Private and Public Grazing Lands located within the Southeast Idaho Phosphate Mining Resource Area, April 2002.
Porgans & Associates, Phosphate Mining in the Northwest United States, Selenium Mobilization-Contamination-Poisoning, an Unknown Risk or a Government Sanctioned Time Bomb? June 2000.

Department of Lands (IDL), Idaho Department of Fish and Game (IDF&G) and Idaho Department of Health (IDH). This group has met on nearly a monthly basis throughout IDEQ's tenure to reach consensus decisions, review documents and conduct planning for all Agency proposed actions. It is evident that your comments are based on incomplete and inaccurate information regarding the State's efforts and collaboration in this endeavor.

Synopses of P&A's Review of the Selenium-Related Reports and the Government-Imposed Limitation Inherent in the Respective Reports/Documents:

There is no question that a great deal of time and resources have been expended by the Idaho Mining Association (IMA) and the State of Idaho on the selenium "research" effort. However, P&A views the sheer expenditure of time and resources as a relative variable, the value of which is dependent upon the confidence that can be placed on quantifying and qualifying the level of commitment and objectivity inherent within the scope and breadth of the research effort. Unfortunately, the collective effort of the IMA, the Idaho Department of Environmental Quality (IDEQ), Montgomery Watson (MW) and the University of Idaho (U of I), indicate that to date, the research effort has been skewed, flawed and misleading. To its credit Tetra Tech EM Inc., has attempted to salvage the "research" effort; however, it would be an understatement to say that it has its hands full. It is also worth noting that MW is **no longer the lead misinterpreter of data;** that position appears to have been passed on to the U of I.

It is axiomatic that a comprehensive analysis requires a comprehensive commitment to identifying, quantifying and qualifying all of the relative issues pertinent to the *Area Wide Human Health and Ecological Risk Assessment* in an unbiased and objective manner. P&A respectfully submits that after having reviewed IDEQ's report and related documents, and considering our years of involvement monitoring the "progress" of this project, it is blatantly apparent the proponents have failed categorically to identify, quantify and/or qualify selenium impacts and risks in the *Area Wide Human Health and Ecological Risk.* Therefore, it would be a real challenge for P&A to attempt to address all of the deficiencies and/or intrinsic shortcomings in the DRAFT *Area Wide Human Health and Ecological Risk Assessment* and related documents.. Albeit, P&A will focus its comments on the fundamental flaws inherent within the research effort, which includes, but is not limited to the summary and (pre) conclusions asserted by IDEQ et al.

***Response**: It is interesting that P&A credits Tetra Tech with "salvaging" the research efforts when in fact they are IDEQ's prime contractor and have been conducting their efforts under our direction, including development of this risk assessment. The Agency has made every effort in being objective in evaluating the quality and usability of past efforts and determining area wide data needs for an independent regional risk assessment effort. If P&A had truly spent the past years monitoring the progress of the project, it would have been evident from our public discussions and the comments received on earlier documents that the Agency's positions reflect objective and neutral decision-making processes, and do not support any particular stakeholder's view, as implied. The Interagency Technical Group has also been involved in these efforts with the State and can hardly be characterized as partners in a collective effort to provide skewed, flawed and misleading research.*

IDEQ's and University Consultants' Findings and Conclusions are Premature, Skewed and Misleading:

The following are excerpts from the four-page synopsis of the minutes of the Selenium Area Wide Advisory Committee's April 2002 meeting, in which consultants for the project, Dr. Ratti, Dr. Moller, Dr. Garton and Dr. Hardy, University of Idaho professors, were purported to have made the following statements**:**

Introduction/Agenda

The meeting was opened by Rick Clegg, IDEQ, and approximately 1:05 p.m. and began by introduction of attendees (See attached list). Rick reviewed the agenda and updated the group on the current status of the Area Wide activities. He stated that the meeting today was to cover the bulk of the Area Wide Investigation deliverables consisting of the draft risk assessment results and IDEQ draft risk management plan; therefore, future SeAWAC meetings would probably be held on a semi-annual basis.

IMA Studies Update

Dr. Greg Moller of the University of Idaho facilitated the research update for the U of I professors involved in the ongoing IMA-funded studies. Dr. Moller introduced Dr. John Ratti of U of I to present an update on the Area Wide avian research and stated that it is probably the largest survey of it's kind. Dr. Ratti said the project has evolved from an egg study to nesting and reproductive success study. In 1999 and 2000, approximately 250 and 300 eggs were collected, respectively, representing about 20 species. In 2001, Dr. Ratti attempted to use four species for reproductive success studies consisting of the American Robin, Red-Winged Blackbird, Coot and Yellow-Headed Blackbird. Approximately 450 eggs were collected but because of the low water year, only the robin and red-winged blackbird could be represented in the study. The study measured hatching and fledgling success using a significant number of nesting sites that represented background and mining disturbed areas. Dr. Ratti discussed the controversy surrounding mean egg selenium levels that are reported to cause toxicological effects. Previous studies have indicated that the threshold lies somewhere between 6 and 16 ppm dry weight. ***Dr. Ratti's study concluded that in this case the threshold appears to be nearer the 16 ppm threshold and that population level impacts do not appear to be evident in the bird population in the vicinity of mining areas****. (emphasis added) His research report is currently in peer review and should be published soon.*

Dr. Oz Garton reported on the statistical analysis that he conducted in support of Dr. Ratti's study. He also concluded that population level impacts were not evident and that the birds in the mining area actually seem to have better success rates than those in the background areas, possibly from moderate dietary selenium increases in an area that is typically considered deficient. *(emphasis added) One of the most interesting findings was that the overall bird population indicated declining trends based on nesting statistics for both the background and treatment areas. After further evaluation, it was determined that the local bird population is sustained through migration from other areas. Dr. Garton concluded that remediation efforts that return all the mining areas to background levels will have little effect on the local bird population. Dr. Garton's findings are included in the avian study document pending publication.*

Dr. Ron Hardy of U of I presented the current findings of his cutthroat trout studies conducted at the U of I Fish Culture Research Facility in Hagerman. His studies began in 1999 by obtaining controlled group fish eggs from the Henry's Lake area and study group fish eggs for cutthroat trout from the Blackfoot River. He had numerous problems during the feeding trials in selecting an effective dietary mix. His study objective was to determine the effects of a large range of different selenium dietary levels and monitor the rate of deformities. He recently completed his three year study objectives although some additional laboratory analysis is still pending. He stated that going into the study he expected the upper range dietary levels to have deleterious effects on the test population. However, he not only observed the lack of any elevated toxic or mutagenic effects in the feeding trial study, ***higher biological success rates were indicated with increasing selenium concentrations in the study.*** (Emphasis added.) *He qualified his results with the realization that a toxic threshold would ultimately be reached as concentrations increased. Dr. Hardy concluded that based on his data and his knowledge of the Resource Area watersheds, he did not expect a population level impact in the Southeast Idaho cutthroat trout population. He expects to publish his data in early fall of 2002. All of the professors indicated that their studies were population-level assessments that didn't preclude the possibility of some individual or subpopulation effects occurring in specific localized areas of impact.*

Dr. Moller wrapped up the research update section of the agenda with a summary of some of the biochemistry and remediation research being conducted for selenium. U of I has received a three year $900,000 grant to continue selenium research.[2]

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[2] Southeast Idaho Phosphate Mining Resource Area, ***IDEQ Selenium Area Wide Advisory Committee's April 30, 2002 meeting minutes***, Pocatello Regional Airport, Pocatello, ID, pp. 1 and 2.

Comment No. 1: It is with all due respects to the U of I professors, that P&A takes strong exception to their unanimous findings: ***Dr. Ratti's study concluded that in this case the threshold appears to be nearer the 16 ppm threshold and that population level impacts do not appear to be evident in the bird population in the vicinity of mining areas***. (Emphasis added.) *His research report is currently in peer review and should be published soon.*

Dr. Oz Garton reported on the statistical analysis that he conducted in support of Dr. Ratti's study. He also concluded that population level impacts were not evident and that the birds in the mining area actually seem to have better success rates than those in the background areas, possibly from moderate dietary selenium increases in an area that is typically considered deficient. (Emphasis added.)

However, he [Dr. Hardy] *not only observed the lack of any elevated toxic or mutagenic effects in the feeding trial study,* ***higher biological success rates were indicated with increasing selenium concentrations in the study.***[3] (Emphasis added.)

P&A, as well as federal agencies have been at a distinctive disadvantage to contest the validity of the professors' assertions/findings due to the fact that their raw data had not been made available. Nevertheless, unless there is something extremely unique about the selenium or the fish and wildlife in Idaho, their findings challenge a pelthora of scientific data and peer reviewed studies that are contrary to their findings. In addition, P&A's ongoing interactions with those federal agencies that have and continue to conduct selenium related research in the phosphate project area, have also compiled data that is contrary to the professors' findings. The aforementioned comments contained in SeAWAC's April 2002 meeting served as the impetus for P&A to solicit comments from the U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, U.S. Forest Service and the U.S. Geological Survey to obtain their input and response to those findings and conclusions espoused by Dr. Ratti, Dr. Garton and Dr. Hardy.[4] (Attachment 2.)

Response*: P&A cites excerpts from open stakeholder meeting minutes in which the University of Idaho (U of I) professors provided interim presentations for their unpublished research. It is premature and unfair to criticize these unpublished findings when admittedly the data has not been reviewed by P&A, and accordingly, the IDEQ has avoided any premature endorsement of these findings. The unpublished studies were neither used nor referenced in the IDEQ Draft Risk Assessment, and therefore have had no influence on that independent effort. However, P&A claims that these findings challenge a plethora of scientific data and peer reviewed studies without citing a single example. It is important to note that the studies were directed at assessing population-level impacts and not localized effects in specific impacted areas. It is intuitive that a regional effort was likely to show the absence of population level toxic effects when less than 5 percent of the area streams exceed regulatory criteria and significantly-sized bird sanctuaries occur on each end of the Resource Area. The cited Agencies will probably agree. However, the IDEQ does not want to make light of the importance of addressing the local impacted zones regardless of the absence of population level effects, and the U of I professors have not contested the potential for subpopulation effects. The Agency's Risk Management Plan clearly indicates our goal of focusing remedial efforts on the localized areas of impact and eliminated ongoing releases.*

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[3] ***Ibid***., Selenium Area Wide Advisory Committee's April 2002 meeting minutes, p. 2.

[4] Porgans & Associates fax/letter USFS. Soda, Springs, ID, BLM. Boise, ID., USFWS, Portland, OR, USGS, Menlo Park, CA., **Project: Phosphate Mining in the Northwestern Phosphate Field** — Selenium Mobilization, Contamination and Poisoning — Potential Threat to Private and Public Trust Resources, **Subject: State Government, Idaho Mining Association and Consultants' Research and Findings are Rife with a Litany of Conjecture and Ambiguities that Appears to be Antithetical to Ongoing Research and Preliminary Findings of Federal Agencies, which Requires Immediate Clarification**, July 11, 2002.

IDEQ's DRAFT Area Wide Human Health and Ecological Risk Assessment:

Based on the comparison of surface water and selenium levels to background and benchmarks and fish tissue concentrations to reference values, the potential risk to aquatic receptors can not be ruled out. [5]

Comment No. 2: Suffice it to say the ambiguity associated with this statement raises the issue as to whether or not this provides the astute reader with the flexibility to "rule in" what "can not be ruled out."

***Response**: As P&A is well aware, many controversies surround selenium science, particularly in the application to aquatic environments. Every credible scientist in the selenium arena cites the need to conduct site-specific investigations in evaluating toxicological effects of selenium due to the diversity of impacts observed in different species, habitats and conditions. Due to this uncertainty, definitive statements on potential risks are often impossible. The bulk of the data on selenium effects and toxicity threshold levels are derived from warm water species in selenite-dominant conditions. Resource Area streams support cold water biota in alkaline waters resulting in selenate-dominant conditions. We refer you to a discussion of selenite vs. selenate waters contained in "Selenium Poisoning of Fish and Wildlife in Nature: Lessons from Twelve Real-World Examples" published by Joseph P. Skorupa of U.S. Fish and Wildlife Service (USFWS). It is apparent that selenate thresholds are higher than those experienced for selenite-dominant environments. Once again, the Agency is aware of, and supports actions to address the limited number of streams impacted at levels exceeding any reasonable threshold levels presenting a high likelihood of creating subpopulation effects. However, the probability of population level aquatic effects in the region are very low considering the small number of streams in which persistent regulatory numeric criteria exceedances have been observed.*

Critical Input and Data from Federal Agencies Preempted:

Comment No. 3: In P&A's previous communications with federal agency personnel. they have assured P&A that they were in the process of releasing and/or publishing data/information that provide a very different scenario than that espoused by the U of I professors. Furthermore, they stated that they have expressed an interest in the raw data generated by U of I, IMA, IDEQ and its respective consultants; however, they have not been provided with all of the data to date. In the absence of meaningful input and/or data from the respective federal agencies, any decision by IDEQ pertinent to the human health and/or ecological risk assessment impacts of the project would be premature, biased and arbitrary.

***Response**: The IDEQ is aware of the information to be released by the federal agency personnel, however, our communications with the Federal Agencies indicate that this data does not contradict any of the Area Wide population-level studies that have been conducted, but simply provides evidence of subpopulation effects occurring in highly impacted areas. All of the area wide data generated to date and available to the IDEQ has been released in area wide documents. Appendix H of the Draft Risk Assessment contains all 2001 data and was posted on the IDEQ website during the public comment period. There are also publicly available websites maintained by Montgomery Watson and Tetra Tech for their publications and data. Public accessible hard copies of all investigative reports are maintained in the IDEQ information repository in Southeast Idaho (Soda Springs). The IDEQ OSC/RPM has not received any requests for data, from P&A or others, to which he has not responded.*

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[5] Tetra Tech EM Inc., prepared for Idaho Department of Environmental Quality, ***Draft, Area Wide Human Health and Ecological Risk Assessment***, April 2002, p. 145.

Volumes of Waste Ore, Toxic Constituents, Level of Risk Yet to Be Fully Disclosed or Evaluated:

P&A has made contact with the responsible government agencies to ascertain whether or not they have specific detailed information/data on the volume of waste rock that has been stockpiled within the Conda mine area and/or any of the other inactive and/or active mine sites. In addition, P&A requested data pertinent to the characterization of toxic chemical constituents contained within the waste rock, and finally, the level of risk that the toxic materials may pose to the environment, which includes all of the client's respective concerns.

Simply stated, the government does not have substantive answers to any of the aforementioned questions. Furthermore, the government conceded to the fact that it has been extremely difficult for it even to obtain information regarding the shear volume of waste at or around the mine sites, because the mining companies contend that is proprietary information. P&A learned that the USGS did collect a "small number of samples" of the waste rock/materials at a number of the dump sites; however, that information is limited in value.

USGS Reports States Limited Samples do not Constitute Characterization of Mine Wastes:

The following quotations are excerpts from a recently published USGS report entitled: **Open-File Report 01-411, 2001**, *Chemical Composition of Samples from Waste Rock Dumps and Other Mining-Related Features at Selected Phosphate Mines in Southeastern Idaho, Western Wyoming, and Northern Utah:*

This report provides chemical analyses for 31 samples collected from various phosphate mine sites in southeastern Idaho (25), northern Utah (2), and western Wyoming (4). The sampling efforts was undertaken as a reconnaissance and does not constitute a characterization of mine wastes. Twenty-five samples were collected from waste rock dumps, 2 from stockpiles, and 1 each from slag, tailings, mill shale, and an outcrop. All samples were analyzed for a suite of major, minor, and trace elements. Although the analytical data set for 31 samples is too small for detailed statistical analysis, a summary of general observations is made.

Element concentrations vary considerably because of the differing rock types collected over a wide geographic area. For the 25 waste rock dump samples, concentrations of arsenic, antimony, thallium, chromium, copper, nickel, and vanadium are moderately elevated, ranging from 1.5 to 5.6 times those of average world-wide shale, the average concentration of four elements are significantly elevated compared to their average abundance in average world-wide shale – selenium (x 77), cadmium (x 172), molybdenum (x 19), and zinc (x 12). A sample of slag, a product of high-temperature processing, collected from an inactive elemental phosphorous plant at the Georgetown Canyon mine contains the highest concentration for 17 elements - silver, cobalt, chromium, copper, europium, iron, gallium, manganese, molybdenum, niobium, nickel, phosphorus, thorium, titanium, vanadium, ytterbium, and zirconium – and the lowest concentration for 17 others – aluminum, carbon, calcium, cadmium, mercury, potassium, lanthanum, lithium, magnesium, sodium, sulfur, scandium, selenium, strontium, thallium, yttrium, and zinc. Highly contrasting geochemical signatures occur for two samples collected from the same waste-rock dump at the Waterloo mine near Montpelier, ID illustrating the heterogenous nature waste dump rocks.[6]

USGS Open-File Report 01-142 Ranks Conda Mine as Number 2 in Total Area of Disturbed Surface:

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[6] USGS, **Open-File Report 01-411,** *Chemical Composition of Samples from Waste Rock Dumps and Other Mining-Related Features at Selected Phosphate Mines in Southeastern Idaho, Western Wyoming, and Northern Utah,* 2001, p. 4.

This report provides a description of data and processes used to produce a spatial database that delineates-related features in areas of historic and active phosphate mining in the core of the southeastern Idaho phosphate resource area. The ***data have varying degrees of accuracy*** *and attribution detail. Classification of area by types of mining-related activity at active mines is generally detailed; however, the spatial coverage* ***does not differentiate mining-related surface disturbance features at many of the closed or inactive mines****.*

Nineteen phosphate mine sites are included in the study. A total of 5,728 hc (14,154 ac [acres] *), or more than 57 km^2 (22 mi^2), of phosphate mining-related surface disturbance are documented in the spatial coverage of the core of the southeast Idaho phosphate resource area. The study includes 4 active mines – Dry Valley, Enoch Valley, Ramussen Ridge, and Smoky Canyon – and 15 historic phosphate mines – Ballard, Champ, Conda, Diamond Gulch, Gay, Georgetown – and Canyon Henry, Home Canyon, Lanes Creek, Maybe Canyon, Mountain Fuel, Trail Canyon, Rattlesnake Canyon, Waterloo, and Wooley Valley. Spatial data on the inactive historic mines is relatively up-to-date; however, spatially described areas for active mines are based on digital maps prepared in early 1999.* ***The inactive Gay mine has the largest total area of disturbance 1,917 hc (4,736 ac) or about 19 km^2 (7.4 mi^2). It encompasses over three times the disturbance area of the next largest mine, the Conda mine with 607 hc (1,504 ac****) and it is nearly four times the area of Smoky Canyon mine, the largest of the active mines with 497 hc (1,228 ac).*[7]

Comment No. 4: P&A views this lack of critical data as extremely disconcerting, because it is precisely this type of data that is essential to quantifying and qualifying the levels of risk of selenium mobilization and contamination throughout the watersheds, which would vary depending on the prevailing hydrological conditions. It is P&A's position that it is imperative for the government and the mining industry to provide this crucial data. It is precisely this type of data that will enable the "responsible parties" to establish the real level of risk attributable to phosphate mining and selenium contamination/mobilization/poisoning.

Response*: While the IDEQ agrees that this information is important, it certainly is not essential in quantifying or qualifying the levels of risk throughout the watersheds. This assessment was better accomplished through direct measurement of actual selenium concentrations of individual streams under varying seasonal and annual hydrological conditions as conducted over the last five years. Exposure pathways for risk estimation, and fate and transport mechanisms through runoff are predominantly a function of the area, not volume, of disturbance. As indicated, relatively accurate mapping of disturbed areas currently exists. Volumes of waste material are more critical to the corrective action process and stipulated as information to be provided by mine operators in their subsequent site-specific investigations for each mine. The issue of heterogeneity in the waste rock was one of particular concern to the Agency. Over 50 samples were collected for the risk assessment purposes representing up to three separate waste rock piles at each individual mine site to establish some level of confidence in the range of concentrations that could be expected. However, the location and construction of the source waste rock dumps have a much greater effect on the potential to release constituents to the environment than the volume or composition of the rock.*

Excerpts from Technical Memorandum, IDEQ, Selenium Project Officer, May 15, 2002:

C. RAG 3.0: Maintain and Protect the Multiple Beneficial Use of the Phosphate Resource Area.

The Agency supports phosphate mining in Southeast Idaho but believes the other beneficial uses in the area should also be preserved. The region is primarily comprised of public lands and is extensively used

[7] J. Douglas Causey and Phillip R. Moyle, Western U.S. Phosphate Project, *USGS Open-File Report 01-142Digital database of mining-related features at selected historic and active phosphate mines, Bannock, Bear Lake, Bingham, and Caribou Counties, Idaho*, 2001, p. 4.

for recreation, grazing and other purposes. Many of the concerns addressed in the first two Area Wide Remedial Action Goals will concurrently support this goal by reducing wildlife effects for fishers and hunters, reversing existing surface water degradation for recreational campers/hikers, and developing effective BMP's to minimize future ecological impacts in the region. However, livestock grazing is one of the primary beneficial uses of the resource area and should be addressed in the Remedial Action Objectives.

> ***1. RAO 3.1: Minimize livestock grazing losses associated with exposure to selenium-impacted areas in Southeast Idaho through effective grazing management.***
>
> *The IDEQ is not the implementing agency for grazing management issues. However, it would be irresponsible to avoid discussion of this issue in the Remedial Action Goals. Furthermore, livestock losses attributable to selenium exposures have continued to occur on a nearly annual basis since the inception of the area wide investigation efforts.*
>
> *The Agency considers continued livestock grazing losses of the magnitude observed in the past to be unacceptable . It appears that the efforts to delineate elevated vegetation boundaries or to define specific regional criteria for different domestic species has been limited and inconclusive. To effectively prevent similar incidents in the future, site-specific actions should provide detailed delineation and mapping of vegetation concentrations in on-site and off-site impacted areas for dissemination to regional grazers and management agencies.*[8]

Comment No. 5: It is encouraging to know that *"The Agency considers continued livestock grazing losses of the magnitude observed in the past to be unacceptable .* However, it is equally disconcerting that the efforts to delineate boundaries and to define criteria has been limited and inconclusive (i.e., ***It appears that the efforts to delineate elevated vegetation boundaries or to define specific regional criteria for different domestic species has been limited and inconclusive.)*** On numerous occasions P&A has raised these concerns to the respective federal agencies, and implores IDEQ to fully assess and address these issues in its final report.

> ***1. RAO 2.1 Reduce or control existing exposure to regional wildlife from historic mining activities to the lowest practicable levels.***
>
> *The Agency suggests that practicable responses should be taken to reduce or control unnecessary wildlife subpopulation exposures in selected areas using NCP alternative selenium criteria. Critical areas should be determined based on subpopulation densities, migration routes, areas of impact and exposure pathways to get the greatest benefit from committed resources. The former practice of increasing forage productivity on reclaimed sites has inadvertently resulted in providing an enhanced pathway for wildlife exposure. All reclaimed waste rock piles are exhibiting vegetation concentrations well in excess of the typical 5mg/kg grazing recommendations. Many of the seeps, springs, and related riparian zones, drainage basins, pit lakes and other site features also provide uncontrolled wildlife exposure to concentrated levels of selenium. Proposed BMPs do not eliminate similar exposure pathways at future sites. Therefore, the Agency suggests addressing a selected portion of the historic operation area to remedial activities to help offset the cumulative exposures that will result from increased reclamation of future mining operations.*

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[8] Richard L. Clegg, P.E., IDEQ Selenium Project Officer to Administrative Record for the Selenium Area Wide Investigation, Subject: *IDEQ Risk Management Statement: Area Wide Remediation Goals and Objectives for Selenium Impacts from Historic Mining Operations in Southeast Idaho*, May 15, 2002, p. 7 of 9.

A critical evaluation should be performed at each mine site to identify practicable methods to reduce or control existing wildlife exposure paths.[9]

Comment No. 6: The terms and definition of "controlling existing exposures to lowest practicable levels" need to be better defined. P&A also has some reservations regarding the following statement, which the Agency also needs to clarify: "….*the Agency suggest addressing a selected portion of the historic operation area to remedial activities to help offset the cumulative exposures that will result from increased reclamation of future mining operations*."

***Response**: The Agency agrees with this comment and is currently in the process of developing risk-based action levels for the media of concern. A subsequent public comment period will be provided on the IDEQ Risk Management Plan upon completion of the draft document. In general, the Agency does not support the notion that corrective actions are only warranted for population-level ecological impacts, and believes that subpopulation impacts and releases occurring as a result of ineffective Best Management Practices, regardless of intent, should be addressed.*

Comment No. 7: In the absence of having quantified and/or qualified the volumes of existing waste ore and their inherent levels of contaminations and related risks, **it is imperative that the Agency provides the criteria for its selection of sites, the extent of the sites to be used for remedial activities; otherwise, the Agency's action could be viewed as being made in a vacuum.**

***Response**: The Interagency Technical Group developed a list of prioritized sites subject to investigation under removal action criteria in November of 2001. The list included the 14 major mine sites historically operated by the members of the IMA Selenium Committee. The NCP provides the model for site-specific investigations and engineering evaluation/cost analysis as well as decision criteria for remedial action alternatives. The IDEQ will propose action levels for various media that trigger EE/CA consideration.*

D. RAG 4.0: Protect Regional Groundwater Resources

IDAPA 58.01.11 Groundwater Quality Rule provides the groundwater standards for the State of Idaho. These regulations encourage mining activity in Idaho by allowing temporary on-site groundwater impacts during period of active mining but requires compliance with groundwater numeric criteria upon completion of the mining operations. The Agency is aware of observed groundwater exceedances in several localized springs as well as monitoring wells bordering some impacted riparian areas. Review of available local water supply records and sampling of a minimal number of private and domestic wells in the area have not indicated any significant regional impacts to date. ***However, groundwater in the vicinity of most of the subject mine sites has yet to be characterized.*** (Emphasis added.)

RAO 4.1: Identify, characterize and respond to potential groundwater contamination sources in the phosphate mining resource area. *The IDEQ has recommended that the hydrological conditions at each site be properly characterized to assess potential impacts to groundwater resources. The evaluation should include the local aquifer systems including the on- and off-site springs recharged by site precipitation.*[10]

Comment No. 8: P&A finds it very disconcerting that the Agency and its affiliates, have yet to conduct the evaluation referenced above. Whether or not this was an intentional and/or

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[9] *Ibid.*, p. 6 of 9.

[10] *Ibid.*, p. 8 of 9.

unintentional oversight, is reflective of P&A's fundamental concerns regarding the scope and depth of the initial investigations upon which the **no-risk scenario was predicated.**

IDEQ New Release, May 23, 2002:

IDEQ [Agency's conclusions] *conducted regional risk evaluations as part of an area-wide investigation into the nature and extent of potential selenium contamination. The study considered the impacts of releases of selenium and other trace metals from historic mining activities on recreational hunters and fishers, modify subsistence life styles, Native American exposure scenarios, and various ecological target receptors.*

The Draft Risk Assessment document ***indicates negligible human health risks from selenium****, which is naturally occurring, and other trace metals. In addition, it* ***concludes that population-level ecological risks are unlikely based on current area-wide observances, although the potential for localized effects is possible for some species.***[11] [Emphasis added.]

IDEQ's *Draft, Area Wide Human Health and Ecological Risk Assessment*, Summary and Conclusions:

The IDEQ has prepared the Area Wide Remediation Goals and Objectives contained herein in accordance with the requirements of the Area Wide Investigation Interagency MOU and the AOC with the involved mining companies. These goals and objectives provide regional guidance for subsequent site-specific actions but do not obligate Lead Agencies in managing their sites outside their discretion. The State site managers will use the stated goals and objectives incorporate regional issues into State-led site-specific activities. The regulatory standards, evolving science and Agency-accepted findings from relevant studies/research.

The Agency supports the phosphate mining industry in Southeast Idaho and recognizes their continued commitment to improve practices and responsible resource management. IDEQ also understands that the environmental conditions observed in the Phosphate Mining Resource Area are not a result of negligence or intent on the part of the companies or land management agencies, but simply a lack of sufficient science for predicting the future effects of past mining practices. [Emphasis added.] The observed environmental and ecological conditions are such that focused investigation and carefully targeted site-specific responses at historic sites will not only prevent further degradation of natural resources, but may result in a reversal of current surface water impacts and wildlife effects. Furthermore, continued development and improvements in the phosphate industry best management practices will ensure the future protection of Southeast Idaho's ecological and water resources, and the longevity of the industry.[12]

Comments No. 9, Pertinent to the Agency's Summary and (Pre) Conclusions:

If one simply reads through the nuances and rhetoric inherent in the report and its summary and conclusions, it is safe to conclude that the past and future business practices of phosphate mining and the related impacts will continue relatively unmitigated, and with no responsibility

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[11] Idaho Department of Environmental Quality, News Release, ***DEQ seeks comments on draft documents pertaining to impacts of selenium releases in southeast Idaho***, May 23, 2002, p. 1.

[12] *Ibid*., p. 9 of 9.

for impacts placed on the mining companies. The conclusion that the observed environmental condition (minus the Agency's ability, to date, to quantify and/or qualify the level of risk and impacts) is "not the result of negligence or intent, but simply a lack of sufficient science for predicting the future effects of past mining practices'" confirms the phosphate mining industry's political influence, limited remediation responsibility and assured longevity, all of which P&A predicted before the consortium got the so-called risk assessment off the ground. Notwithstanding, the most egregious component is not the "carte blanche — anything goes because of the insufficient science" defense, but the fact that **the Agency and its cohorts are attempting to justify limiting the scope and mitigation of the Area Wide remediation goals and objectives by using the science avoidance protocols.** Lastly, P&A categorically challenges IDEQ's assertion of no fault or bad intent; such a determination, in the absence of all the relative data, is prejudicial, arbitrary and capricious.

***Response**: The Agency disagrees with this characterization and believes an unbiased reader would take this text as intended. In all sincerity, we do not believe the selenium impacts are a result of negligence or intent on anyone's part. To imply such infers that all the mining companies, permitting Agencies, contractors and original EIS reviewers were fully aware of the mechanisms for selenium release and its potential ecological impacts. This conspiratorial view would also apply to more than a dozen selenium-impacted sites around the country that were developed in the same era and would assume the intensive research in selenium science over the last two decades was unnecessary. Contrary to P&A's assertions, current and future mining practices have changed drastically with significant associated increases in operating costs since this issue was discovered. A number of new and innovative best management practices are being applied at current sites and are proposed for future sites that will be subject to future monitoring programs for verification. The IDEQ has not put any limitations on the scope of remedial actions other than focusing on the areas in which impacts are occurring and fails to understand P&A's desire or rationale for any other alternative.*

Comment No. 10: After years of studies and millions of dollars of expenditures critical information regarding selenium mobilization, contamination and poisoning remains relatively unknown. In general the effects from levels of selenium similar to those found in Idaho have caused environmental devastation in other areas of the western United States; i.e., on government irrigated lands. However, the Idaho contingent in their collective "infinite wisdom" has yet to benefit from the voluminous scientific documentation relating to the effects of selenium, which can be construed as wasting time and stonewalling.

***Response**: All of the technical representatives involved in this project are familiar with the historic cases of selenium contamination and the varied effects due to differing site conditions. The "one size fits all" attitude espoused by P&A shows a true lack of concern with scientific determinations as opposed to emotional appeal. The unfamiliarity with the differences in local conditions and those observed in irrigated lands, as well as the lack of consideration of speciation and documented difference in site-specific toxicological effects, demonstrate a lack of any comprehensive review of existing information both on this project and the "voluminous scientific documentation."*

Closing Comments, Suggestions/Recommendations:

Since the onset of this project, P&A has repeatedly stated its concerns regarding inherent conflict of interest of IDEQ being designated as the "lead agency" on this project and the political influence exerted by the IMA.

Your collective pre-decision to essentially obfuscate the *Area Wide Human Health and Ecological Risk Assessment* is extremely disconcerting; nevertheless, it reaffirms P&A's initial concerns regarding IDEQ's inability to be objective and unbiased.

Based on IDEQ et al's fundamental preconceived risk assessment/misinterpretation and/or miscalculations, it appears that you have made a critically flawed **judgment to limit the scope and mitigation of the Area Wide remediation goals and objectives**. The IDEQ's confidence level in its risk assessment is extremely disconcerting, as is its tactic to "side-step" meaningful participatory input from entities outside the "in-State loop." These decisions will have long-term negative effects, i.e., that both the private and public sectors within the phosphate mining area will remain at an unknown level of risk.

A. Defer the IDEQ et al decision to **limit the scope and mitigation of the Area Wide remediation goals and objectives**, and cease obfuscating the gravity and breadth of the selenium mobilization, contamination and poisoning impacts to humans and the environment.

B. Review and assess data and comments compiled and/or submitted by the USFWS, USFS, USBLM and the USGS pertinent to this project.

C. Correct the internal conflicts of interest that have and continue to impair the State of Idaho's ability to conduct the public's business in a manner consistent with the common good of all of its residents.

In the absence of all the data not being disseminated and/or reviewed and lacking data and meaningful input from all of the involved federal agencies and/or interested parties, the process to date has been less than transparent and in conflict with the State of Idaho's public trust responsibilities. Please enter this correspondence and the attachments into the record. Original will be sent via U.S. mail and a copy of the file will be ***e***-mailed. Thank you.

Response*: Once again, the Agency appreciates P&A's comments and your reentry into the public involvement arena for this project. We regret that P&A has lapsed in its involvement since the IDEQ assumed the role of Lead Agency two years ago. Without the benefit of participating in the decision process, we feel that you have incorrectly prejudged the results of the State-led investigation. The State's efforts have been closely coordinated in a collaborative process with the same Federal Agencies P&A consistently cites as technical experts, and the Companies have been afforded the same considerations as any of the other stakeholders in the process. We believe P&A's involvement in this project can be beneficial to the State and other stakeholders, and would encourage more active participation in the future.*

Respectfully,

Patrick Porgans

Idaho Mining Association
Selenium Committee Comments
Submitted

June 25, 2002

on

Idaho Department of Environmental Protection's
Draft Area Wide Human Health and Ecological Risk Assessment
Selenium Project Southeast Idaho Phosphate Mining Resource Area

April 2002

EXECUTIVE SUMMARY

***IDEQ Response Foreward**: The Idaho Department of Environmental Quality (IDEQ) appreciates the Idaho Mining Association's (IMA) efforts in providing comments on the draft risk assessment and will consider your input in finalizing the document. We are disappointed in the reviewer's tone and the repetitive nature of several of the comments. For instance, there are numerous comments that the risk assessment does not make use of studies conducted by the University of Idaho (U of I). These studies have not been released by the university or the researchers because they have not been peer reviewed or published, and the data have not been released to the IDEQ for incorporation into the draft risk assessment.*

There are numerous comments citing the absence of IMA's Draft 2001 Area Wide Investigation Data Summary in the reference section. This document was not submitted to the Agency until after the start of the public comment period. There are over 25 comments that refer back to previous comments. It is not clear to the IDEQ why some of these issues are addressed so redundantly, especially since the IMA states that they are in agreement with the general conclusions.

While it is clear that there are differences in professional judgment and the philosophical approach to this effort, it should be reiterated that the purpose of the Agency's effort was to undertake an independent screening and risk assessment approach. The effort was undertaken because of a lack of confidence on the part of the other stakeholders regarding previous risk assessment methods, and the resulting conclusions drawn by the IMA. While we respect IMA's position in defending their selected approach, the Agency's approach has provided a document that has the general concurrence of the other regulatory entities and the majority of the stakeholders.

Finally, the IMA has criticized the Agency's use of standard industry practices throughout the Area Wide Investigation process, such as the use of directed concentration-gradient sampling approaches, deterministic risk assessment methods and the procedures for handling data, particularly below method detection limits. The Agency has worked to apply universal methods accepted by the wide majority of practitioners in the environmental industry that will help the companies expedite site-specific investigations, saving time and money, and that are based on good science. In reviewing previous, ongoing and proposed investigative activities by the IMA member companies, it has been noted that in most cases the same standard practices are being applied and proposed for implementation of their site-specific activities. It is inappropriate to present the critical views contained in IMA's comments on the standard methods utilized by IDEQ as the consensus position of the mining industry when clearly this is not the case.

The IMA has many concerns on the above-referenced draft, but, in summary, the following seven constitute the major concerns:

1. Most of the comments IMA provided on the agency's draft risk assessment work plan (R. Geddes and B. Winegar, IMA Se Committee [Letter to R. Clegg, IDEQ] November 30, 2001) were, unfortunately, rejected. In fact, IMA didn't see a final risk assessment work plan until the day that the draft risk assessment report was issued. The consensus approach that IMA has fostered for more than five years has been abandoned, and the quality of the agency's draft risk assessment, as pointed out in our subsequent comments, is a result of such action. A conscious decision to ignore the knowledgeable input of industry violates a cornerstone of project planning, that the input of all stakeholders be considered. The IMA sees no advantage in the agency continuing to estimate risks under a veil of secrecy.

   Response: The DEQ disagrees with this characterization. A significant number of work plan revisions were made based directly on the IMA's comments and consideration was given to all

stakeholder input during the process as documented in the final plan. The final work plan was distributed at the first scheduled stakeholder meeting following the receipt of comments, consistent with the process used for the last two years. The final documents provide selected revisions and responses to comments citing the Agencies' position but are not, nor have they ever been, subject to additional repetitive comment periods as implied. Therefore, the draft risk assessment results were unaffected by the date of distribution of the final work plan. Nevertheless, the IMA was clearly aware of our proposed risk assessment approach from the draft document, as well as the fact that we were continuing the risk estimation process under the established schedule, thus, the accusation of the Agency conducting this work under a veil of secrecy is unfounded.

As the lead regulatory agency for the Area Wide Investigation, we have attempted to be balanced and fair in our decisions throughout the project. Our decision-making authority however is not dependent on reaching consensus, which is virtually impossible with such a diverse group of stakeholders, but in making determinations that are protective of public health and the environment, and in the best interests of all stakeholders and the citizens of Idaho. The record demonstrates that the Agency has consistently sought input from all stakeholders to find solutions to difficult problems. However, with the multiplicity of stakeholders involved in this process, complete unity may never be attainable. The project has moved forward in as cooperative a manner as possible and on schedule. Furthermore, IDEQ disagrees with the IMA position that it had fostered a consensus approach with stakeholders throughout their management of the previous voluntary efforts. In fact, previous attempts to represent the IMA's findings in such a manner resulted in some stakeholders withdrawing from the former working group and the issuance of a disclaimer letter signed by virtually all working group participants except the IMA and its contractors.

2. There is no clear and concise summary of the assessment's findings and conclusions. At the end of the risk assessment effort, one should be able to understand if a risk is likely to exist, the receptors (if any) at potential risk, the locations of such risks, the contaminants that could be causing such risks, and the relevant exposure pathways associated with such risks. The agency went to great effort to develop conceptual site models at the outset of the assessment to identify specific receptors, locations, contaminants, and pathways to be addressed in the assessment. Now that they have been addressed, even though perhaps only preliminarily, the conceptual site models need to be refined to inform the stakeholders of the receptors, locations, contaminants, and pathways that continue to be of potential concern. The IMA agrees with the apparent conclusion that there is no risk to humans. The IMA also agrees with the apparent conclusion that the risks to terrestrial birds and mammals are similar to background risks. While the agency appears to not rule out potential risks to aquatic life, considerable effort has been undertaken to find such risks, but none have been observed.

Response: To clarify the record, the Agency concluded that there is minimal risk to human health and population level risks were unlikely for terrestrial birds and mammals. However, subpopulation risks were evident in localized areas including aquatic species; observed concentrations in highly impacted areas clearly indicate a likelihood for localized effects. The Agency considers the risk assessment to be an objective technical document and specifically instructed our contractor not to make risk management decisions reserved for policy makers. The intent was to summarize the cumulative findings and regulatory interpretations in the Agency's risk management plan, as appropriate. The Agency is currently in the process of including an Executive Summary in the final document to more concisely describe the assessment's findings. Based on standard risk assessment methodology it is inappropriate to eliminate potential risk pathways that may contribute to overall exposure estimates at individual sites, or to specify localized risk locations when site-specific delineations are still pending. It should be noted that the Agency has

decided to redraft the accompanying risk management plan to include a more concise description of future decision making criteria and proposed remedial action levels for impacted media. Since this document will include substantial revisions, it will be subject to a subsequent public/stakeholder review and formal comment period.

3. The document is incomplete and contains many technical and editorial errors. Much critical information is omitted, including the data used to generate exposure doses and risks. Statistics are improperly used or inadequately documented. For example, unweighted standard errors are used with weighted averages, but simulations show that this may grossly overestimate the upper confidence bounds of the weighted averages, thereby contributing to gross overestimations of exposure. Furthermore, maximum observations are compared, meaninglessly, to a multiple of a non-area-specific background average rather than to a multiple of the background standard deviation added to the background average, thereby resulting in elements with naturally occurring concentrations to be misclassified as contaminants. There are so many technical errors throughout the document that it appears it was not subjected to a quality control review; rather, that the report was rushed into publication.

   Response: Admittedly, the report development process was abbreviated due to the extended laboratory turnarounds for critical data and unavoidable delays experienced in the work plan finalization process. Additional quality review and editing time for the draft document would have been beneficial, however, the Agency was assured that adequate time had been provided for the actual technical work and calculations, and we were confident in the technical basis of the document and accuracy of the risk estimates. In consideration of the extended lost time in rescheduling a canceled stakeholder meeting, the Agency decided the timely distribution of the draft assessment outweighed the impacts of some additional editorial errors. While we apologize for the late publication of the data summary appendix, the comment period was formally extended for seven additional days to allow review of this component of the document.

   The Area Wide Human Health and Ecological Risk Assessment (AWHHERA) will be thoroughly reviewed and all technical and editorial errors corrected. Critical information, including the data used to generate exposure doses and risks, will be consolidated in the final document. The basis for all statistics will be documented and, as appropriate, uncertainties associated with the statistical procedures used will be discussed in the uncertainty sections.

4. The risk assessment ignores five years of data collected by the Selenium Working Group in favor of a much more limited data set. Recent data of high relevance and high quality are ignored in favor of smaller, intentionally biased, and more uncertain data sets. For example, highly relevant, site-specific, and state-of-the-art studies by Drs. Hardy, Powell, Ratti, and Garton from the University of Idaho are entirely ignored. The refined baseline (Tier 3) ecological assessment includes the 1998 surface water data, but ignores data for other media collected in 1998 and all data collected in subsequent years. This, despite the agency's conclusion that surface water is risk-free, not only fails to constitute a refinement, but also violates the principle of data comparability. The limited data that were used in the report are not presented, nor is a reference provided for them.

   Response: The Agency disagrees with IMA's assertions and, in particular, the inaccurate paraphrasing of the conclusion that "surface water is risk-free". The data set selected for Tier 1 and 2 of the risk assessment is much larger and more complete than the data set from past IMA investigations, in that it included a full range of mining-related analytes, versus the constituents screened by the IMA based only on the first year (1997) surface water results collected during mid-summer, as reported in IMA's 1998 sampling plan.

Exception is also taken to the reference that the data used was intentionally biased. The Agency acknowledges that the one set of data used was the result of directed sampling based on concentration gradients. The use of directed sampling is well within the range of statistical veracity, EPA guidance and accepted practices. As for comparability, two different data sets were used: the Agency-collected data to show a representative scenario, and IMA data to show temporal variation. Both sets of data were collected according to approved standards and both analyses were of high quality and provided the needed information.

Finally, the IMA is aware the referenced U of I studies have not been published nor the data released. For the Agency to include discussions of the relevance or site-specific application of these unpublished results based solely on interim presentations would also violate scientific principles.

5. The tiered approach to risk assessment, as used, is flawed. Contrary to USEPA guidance, there is a failure to use the approach to screen out contaminants, pathways, receptors, and locations that pose no significant risk. For example, no evidence of an arsenic release is provided, but arsenic is carried through all three tiers of the human health assessment. The baseline (Tier 2) ecological assessment for riparian and terrestrial receptors concludes that surface water contributions to risk are insignificant; but the Tier 3 assessment is identical to Tier 2 except for temporally incomparable differences in surface water concentrations. Impacts to aquatic receptors (i.e., benthic invertebrates and fish) are not evaluated until Tier 3, but with benchmarks that are more appropriate for a screening-level (Tier 1) assessment.

   Response: IDEQ disagrees with this comment. The screening process is not flawed -- it represents a conservative approach. Tier 1 is a screening step and is the point in the risk assessment process where specific exposure scenarios and chemicals of potential concern (COPC) are screened from further review. The chemicals screened out based on Tier 1 results are clearly identified in Section 6.7.2.1. The selection of chemicals as COPCs is documented following a conservative four-step process. The basis for retention or rejection of each COPC is clearly documented in Appendix B. IDEQ acknowledges that no specific evidence is provided regarding the magnitude of arsenic released from waste rock into the environment. The presence of elevated concentrations of chemicals (including arsenic), identified by comparison of waste rock concentrations to regional soil concentrations, is used as a surrogate for those substances "whose release rates are accelerated by handling during the mining process."

6. Untenable assumptions are used in the human health evaluation. For example:

   - headwater streams are incorrectly assumed to be productive enough to sustain a harvestable fishery, but in such streams no fish of harvestable size have yet to be observed;

   - gardens are assumed to exist within riparian zones of the Resource Area, but gardens in such locations have never been observed; and,

   - a hypothetical subsistence lifestyle scenario is assumed to be occurring, but no one such person, let alone his or her entire family, is known to inhabit the Resource Area, and IDHW has stated that this scenario is unrealistic.

   Response: The reviewers should be aware that U.S. Environmental Protection Agency (EPA) guidance requires the risk assessment process to consider scenarios that have the potential to occur. There are no current restrictions that prevent the harvest of fish from headwater streams, the presence of gardens in riparian areas by local residents, or subsistence lifestyle use of the

Resource Area. The subsistence lifestyle scenario was determined to be a reasonable upper bound estimate to assess potential risk for lesser users without a major scientific effort in quantifying actual regional use parameters.

The fish ingestion exposure pathway is evaluated on a watershed basis in the area wide human health risk assessment (AWHHRA). All text referring to an evaluation of the productivity of specific streams will be removed from the AWHHRA. Based on the large number of fishable streams in each watershed, IDEQ assumed that each of the three watersheds evaluated in the AWHHRA is productive enough to support the assumed fish ingestion rates (including the subsistence lifestyle receptor).

No resources have been expended searching for gardens in riparian areas of the Resource Area; therefore, no information is available regarding the number of such gardens in the Resource Area. IDEQ acknowledges that IDEQ and Tetra Tech EM Inc. (TtEMI) have not noted any such gardens during field work to date. The AWHHRA will be revised to note that no gardens have been identified and that no resources have been expended for the purpose of such identification.

Finally, no studies have been conducted regarding the potential presence of subsistence lifestyle receptors in the Resource Area; therefore, no statements can be made regarding the potential presence or specific number of such receptors in the Resource Area. However, IDEQ acknowledges that the Resource Area is very sparsely populated by ranchers, none of whom rely solely on area resources for subsistence. Impacted zones comprise a small percentage of the overall Resource Area and occur primarily on public lands that prohibit residential use. While the IDEQ is aware that selected members of the local population may rely on area resources for a significant supplement to their diets, IDEQ agrees with the Idaho Department of Health's (IDH) health consultation conclusion that a subsistence lifestyle is unrealistic. However, with the lack of empirical data on the exact level of local resource use, IDEQ explicitly chose a conservative scenario to eliminate risk concerns for lesser users. The AWHHRA will be revised to note that the subsistence lifestyle receptor is theoretical.

7. Untenable assumptions are used in the ecological health evaluation. For example:

- biased sampling of black shales on dump surfaces is assumed to be representative of entire waste rock dumps, but this worst-case stratum represents a fraction of the surface of most dumps;

- watershed-specific risk estimates are generated using non-watershed-specific data, and the contributions to risk from headwater riparian zones—among which are those most elevated in selenium—are grossly over weighted;

- despite stating that an appropriate population-level ecological assessment was performed, no such approach is presented anywhere in the document; and, conclusions regarding potential surface water hazards to cutthroat trout were made based on non-credible selenium benchmarks that are not species-specific and that are, at best, nothing more than screening criteria, while ignoring recent, highly relevant, and species-specific studies conducted in Idaho by Dr. Hardy and in British Columbia by Kennedy et al. (2000).

Response: Regarding the first bullet, most of the older waste piles, and those responsible for the majority of observed impacts and therefore requiring the focus of risk estimation, do have black shales at the surface. Historically, shales presented the most cost-effective growth medium for reclamation activities; segregation of cherts and shales during mining and/or the application of

topsoil covers on waste piles are a relatively recent occurrence, and can be specifically identified in the site-specific actions.

For some media, limited data was available and not all watersheds were represented. IDEQ elected to take a conservative approach and evaluate potential risk in these watersheds using data from other watersheds as a surrogate rather than ignore potential contributions to dose from specific media because of the limited data sets. The use of these surrogates is an uncertainty in the risk assessment but the affect on the assessment is unknown. The result could be a conservative or non-conservative estimation of risk depending on the actual media concentrations in each watershed. Data from headwater riparian zones were appropriately included on an area-weighted basis. While the assessments are conservatively biased, IDEQ disagrees with the assertion that the watershed specific estimates of risk are "grossly over weighted" to areas of elevated selenium.

No studies were conducted for this risk assessment that evaluated the actual populations of various species in the field. Varying population dynamics, habitat conditions, and other factors in an area as large as the Resource Area complicate the interpretation and limit the usefulness of such field studies in an ecological risk assessment (ERA). Therefore, the risk assessment was based on available literature data on various species, toxicology studies, and Resource Area media concentrations. Following accepted industry practice, the information derived from this process was used to infer the potential for population level effects. IDEQ takes exception with the categorization of National Ambient Water Quality Criteria (NAWQC) as "non-credible selenium benchmarks." While these criteria are not specific to a single species of fish, species other than trout will be protected in the Resource Area. As discussed in the response to General Comment 4, the Idaho Mining Association (IMA) is aware that the referenced University of Idaho (U of I) study by Dr. Hardy has not been published, nor the data released. The specific Kennedy et al. (2000) study could not be identified and was not reviewed. IDEQ requests that IMA provide a complete reference to the study and if pertinent, the results of the study will be considered in the risk management decisions. However, since these studies are specific to cutthroat trout, the benchmarks used in the assessment are not expected to change.

SPECIFIC COMMENTS

<u>Table of Contents and global changes</u>

1. LIST OF TABLES, p. vi. The list of tables is incomplete. Tables 6-1 through 6-30 and Tables 7-7 through 7-26 are missing. Please include these in the List of Tables.

   Response: The list of tables will be updated in the revised AWHHERA.

2. ABBREVIATIONS AND ACRONYMS, p. viii and p. x. The two U.S. Fish and Wildlife Service acronyms (i.e., FWS and USFWS) are redundant. One or the other should be used consistently for clarity.

   Response: The preferred acronym will be U.S. Fish and Wildlife Service (USFWS) and the appropriate changes will be made to the revised AWHHERA.

3. Throughout the document, numerous table titles and table numbers, or references to the tables, are incorrect. The table titles and/or the table numbers should be corrected as well as the references to these tables.

   Response: The appropriate changes will be made to the revised AWHHERA.

4. Acronyms and references to IDNR throughout the document should be removed.

   Response: The appropriate changes will be made to the revised AWHHERA.

5. It would be helpful if a figure describing the tiered approach for the AWERA was created, for ease of understanding the tiered approach. This is particularly true since different tiered approaches were evidently used during preparation of the human health risk assessment (HHRA) and the ecological risk assessment (ERA).

   Response: Figure 2 in the AWHHERA describes the tiered approach for the human health risk assessment (HHRA). A new Figure will be included in the revised AWHHERA that describes the selection of COPCs, the selection of exposure point concentrations (EPC), and the area wide ecological risk assessment (AWERA) process.

Section 1.0 – Introduction

6. Section 1.1, p. 2. The "weight-of-evidence approach" for the basis of the overall risk to ecological receptors is not well defined or described in this section. A clear description of the "weight-of-evidence approach," or reference to the section where this is described, should be inserted.

   Response: A more detailed discussion concerning the weight-of-evidence approach is provided in Section 7.1 and will be reviewed and revised for clarity.

7. Section 1.1, p. 2. The EPA (1998) reference is incomplete. The complete reference should be corrected to read "(EPA, 1998a)."

   Response: The appropriate change will be made to the revised AWHHERA.

8. Section 1.1, p. 2. Please include guidance documents that were used during preparation of the AWHHRA, and the rationale for their selection.

   Response: Section 1.1 will be revised to include the list of primary guidance documents used to prepare the AWHHERA. This list was previously provided in Section 7.1.1 of the work plan (TtEMI 2002a).

9. Section 1.2, p. 2. Please replace the Section 4.0 title with 'General Conceptual Site Model', to reflect the actual title of Section 4.0.

   Response: The requested change will be made to the revised AWHHERA.

Section 2.0 – Location, Environmental Setting, and Background

10. Section 2.1, p. 4. Table 1-1 should be re-titled Table 2-1 since the first reference to it is in Section 2.0.

    Response: See response to General Comment 3.

11. Section 2.1, p. 5. Include 2001 in the series of reports prepared by MW for IMA.

    Response: The requested change will be made to the revised AWHHERA.

12. Section 2.1, p. 5. To help clarify the mines located in the resource area, quantify the 'numerous "orphaned" mine sites' and include in Table 1-1 the orphaned mine sites that are included on Figure 1.

    Response: The orphan mine sites will be identified in figures and tables in the revised AWHHERA, where appropriate.

13. Section 2.4, p. 9. 1998 Regional Investigation. Please note that samples were analyzed for inorganic chemicals including Se, Cd, Mn, Ni, V, Zn, Ca, Fe, Mg, K, Na, alkalinity, bicarbonate, carbonate, chloride, sulfate, and hardness. The inorganic chemicals Cu, Cr, and Co were analyzed and archived in the project files. Field parameters included dissolved oxygen, oxygen reducing potential, pH, specific conductivity, water temperature, and turbidity. Flow measurements were also taken when possible. All of the results are provided in Appendix D of the 1998 Regional Investigation Report.

    Response: Comment noted.

14. Section 2.4, p. 9. IMA 1999-2000 Regional Investigation. This report presented data for surface water, sediment, and aquatic biological samples collected in September 1999, October 1999, and May 2000. Monthly surface water samples were also collected from May 1999 to May 2000.

    Response: The summary of the IMA 1999-2000 Regional Investigation in Section 2.4 will be revised to identify the surface water, sediment, and aquatic biological samples collected in May 2000 and the monthly surface water samples collected from May 1999 through May 2000.

15. Section 2.4, p. 10. Have the "IDEQ 2001 Surface Water and Sediment Investigation" and the "IDEQ 2001 Summer Risk Assessment Sampling Reports" been reviewed or published, and will they be supplied to the IMA for review?

    Response: The Final 2001 TMDL Baseline Monitoring Report is available for review. All other 2001 data will be included as Appendix H of the revised AWHHERA.

16. Table 1-1. Gay Mine should be removed from the "Inactive" mines column for "Astaris Production LLC" and replaced with "None." A row should be added for the companies "Simplot and FMC," and "Gay Mine" should be added under the "Inactive" mine column for "Simplot and FMC". Reference the most recent table that is located in MW's "Summer 2001 Area-Wide Investigation Data Summary (March 2002)."

    Response: Table 1-1 will be revised as suggested.

17. Table 2-1. Table Heading. Reference the "MW" Fish Tissue cell heading. What year was the fish data analyzed?

    Response: Table 2-1 will be revised to correctly reference the "MW" fish tissue cell heading.

18. Table 2-1. MW Fish Tissue. Why are only 3 MW fish samples listed in Table 2-1, when 9 fish were collected?

    Response: Any difference between the number of fish collected and the number of reported fish tissue samples will be correctly footnoted in Table 2-1.

19. Table 2-1. USFWS[3] Column. Remove the column and the reference to it because no data was used.

    Response: The appropriate change will be made to the revised AWHHERA.

20. Table 2-1. Notes. Change footnote bullet to an asterisk. Describe the "mine pit features" that were used (i.e., springs, seeps, pit ponds, stock ponds, etc). Laboratory data provided by MW was reported as dissolved for trace metals and as total for selenium, anions, alkalinity and TSS.

    Response: Table 2-1 will become Table 2-2 and the table will be revised to (1) change the footnote, (2) describe the "mine pit features" that were used, and (3) note that laboratory data provided by Montgomery Watson (MW) was reported as dissolved for trace metals and as total for selenium, anions, alkalinity, and total suspended solids (TSS).

21. Table 2-1. Notes. Reference the MW "Final Spring 2001 Sampling and Analysis Plan (April 2001)" and the MW "Final Summer 2001 Sampling and Analysis Plan (August 2001)" directly and include in section 8.0 REFERENCES. What is the reference TtEMI 2001e? Is this supposed to be TtEMI's Technical Memorandum?

    Response: See response to General Comment 3. The list of references will be revised to include all references cited in the text. The reference TtEMI 2001e was listed in the "References" Section 8 and refers to the "Sampling Work Plan for Montgomery Watson Spring/Summer Sampling."

<u>Section 3.0 – Data Quality Assessment</u>

22. Section 3.0, p. 11. TtEMI did not evaluate the quality of the data collected by IMA. However, MW provided medium specific data validation summaries along with the validated IMA data in the Final-Spring 2001 Area-Wide Investigation Data Transmittal (March 2002) and the Summer 2001 Area-Wide Investigation Data Summary (March 2002). MW conducted the data validation following USEPA protocols found in "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses" (USEPA, 1994). Please include the above references in Section 8.0 REFERENCES.

    Response: TtEMI did conduct a data quality review and provided identifiers in accordance with EPA guidelines where U of I laboratory quality assurance (QA) documentation was available. It should be noted that the Agency requested MW and the IMA to provide EPA-level validation, which is required for NCP-consistent projects, for their previous investigative efforts. Presently the cited MW data summaries were not referenced in the draft document because only the Spring 2001 transmittal had been provided to the Agency at the time of publication. As a result, the Agency requested that TtEMI compile all raw 2001 data into a draft data appendix. Even though the draft data appendix was delayed it was subsequently published (see response to General Comment 3). MW's data summary reports will be included in the reference section of the final document.

23. Section 3.0, p. 11. Explain why the data was not validated by TtEMI according to EPA functional guidelines. Was unvalidated TtEMI data utilized in the AWERA and AWHHRA?

    Response: See response to Specific Comment 22.

24. Section 3.6 and 3.7, p. 13. In previous investigations, IMA did not censor the data by assigning arbitrary numbers to below detection limit values and therefore the detection limits did not

influence the quality of the data set. The data was not censored by IMA, consistent with recommendations in Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Reinhold. New York, New York.

Response: The IDEQ must use EPA guidance and standard industry practices for its data validation and presentation. For consistency, the Agency requests all stakeholders to follow the same guidelines, the majority of which have done so. It should be noted that with a single exception, the IMA companies involved in this project use the same approach as IDEQ in handling data that are below detection limit values.

Section 5.0 – Screening of Chemicals of Concern

25. Section 5.0, General Comments. The Draft Area Wide Risk Assessment framework outlined in Chapter 5 is conducted under a 4-tiered process for screening chemicals of potential concern in regards to ecological and human health concerns. Many arguments presented in support of this approach, as pointed out in subsequent specific comments below, are neither rational nor defensible. This process does not allow for the elimination of COPCs or COPECs, since the process, under the fourth tier, allows for the inclusion of previously eliminated constituents. The inclusion of previously eliminated constituents during Tier 4 invalidates previous tiers of the screening process. The rationale for this approach isn't clearly described in Chapter 5.0, or in Appendix B. In addition, the 4-tiered process is inefficient, as described in the following comment.

    Response: The screening process used to identify COPCs does in fact eliminate chemicals as COPCs, in contrast to the statement made in the comment. The use of a fourth tier, in which additional consideration is given to retaining or rejecting chemicals as COPCs, does not invalidate the selection process. Instead, the fourth tier, as described in Appendix B, allows consideration of additional information that either cannot be readily quantified or is largely policy in nature. The goal of the entire COPC selection process is to focus the risk assessments on those chemicals most likely to have been released from waste rock piles into the environment and associated with potentially significant human and ecological exposures. In this context, the four-tiered process is conservative and effective.

26. Section 5.0, p. 18, Tier 1. This paragraph is confusing as written because it states that maximum levels of concentrations in waste rock will be compared to mean background levels in the western US. The comparison of the maximum concentration in waste rock to the mean concentration of western US background soils is inappropriate because this comparison is being made between two distinctly different statistical parameters and should be changed so that the comparison is between two similar statistics. Eliminating certain constituents based on waste rock concentrations alone, by comparison to non-site-specific soil concentrations, at this initial stage in the screening can lead to incorrect conclusions, and increase the uncertainty in potential risk estimates for the different types of media that were not evaluated during the Tier 1 screening process (riparian soils, surface water, and sediment). The paragraph further outlines that other media are to be compared in Tier 1, which does not occur, but occurs in Tier 2. The second to the last sentence contains conclusions that should be left to the 'conclusions' section.

    Response: Based on a review of previous investigative results, it is apparent that rigid statistical testing is not required to distinguish the presence of elevated concentrations of contaminants in impacted areas; therefore, non-statistical standard industry approaches similar to those accepted by EPA Region 4 and U.S. Forest Service (FS) Region 3 were used by the IDEQ for background screening comparisons. Average background concentrations were calculated or identified in the literature for each chemical/medium from undisturbed, upgradient mining zone data sets that are

representative of pre-mining conditions, or in the case of waste rock comparisons, a regional background data set. Concentrations in excess of twice the background average will be considered impacted and evaluated in the risk assessment process.

As further precedent for this approach, a common industry practice for establishing industrial site background comparison levels under the Resource Conservation and Recovery Act (RCRA) is to collect 3 to 5 directed samples from areas believed to represent pre-industrial conditions for the calculation of a 95 percent upper confidence limit (UCL_{95}). UCL_{95} typically result in values that are approximately 1.5 to 3 times the mean value, depending on data variability. This method requires neither random sampling nor a large data set for statistical analysis. In using the proposed non-statistical approach, the IDEQ explicitly accepts slight increases in the level of statistical uncertainty in the background screening results, but IDEQ is confident that the uncertainty is within the normal tolerances associated with the risk assessment process.

The presence of elevated concentrations of chemicals, identified by comparison of waste rock concentrations to regional soil concentrations, is used as a surrogate for those substances "whose release rates are accelerated by handling during the mining process." Because waste rock is assumed to be the source of chemicals potentially released into the environment of the Resource Area, use of a determination of elevated concentrations of chemicals in waste rock was determined to be an acceptable screening step.

The description of Tier 1 will be clarified in the revised report. The text will be clarified to explain that no chemical was eliminated solely on the basis of waste rock data. If the chemical was determined to be low compared to western U.S. background soil levels, the chemical was given a high probability that it would not pose a significant risk. The concentrations in all other media were evaluated, and if that data did not indicate a significantly elevated concentration, the chemical was then dropped from consideration.

27. Section 5.0, p. 18, Tier 2. Clarification is needed to explain why all media weren't screened against background in the Tier 1 evaluation, and why the use of site-specific background concentrations for each relevant media is appropriate in Tier 2 but not in Tier 1. Further, it isn't appropriate to compare the maximum concentration against the mean background, as these are not statistically similar parameters. Doing so promotes the use of a "looking for the best fit" scenario, which the author can use to skew the comparison. Clarification is required regarding the inclusion of sediment as a human health exposure pathway during Tier 2, since it was eliminated completely during Tier 3 as an incomplete exposure pathway. Why was human exposure to sediment not discarded from the outset?

    Response: With regard to comparing maximum concentrations to mean background concentrations, see the response to Specific Comment 26. The goal of Tier 1 in the COPC identification process is to identify those chemicals that are present at elevated concentrations. Medium-specific background concentrations are included in Tier 2. The concentrations of chemicals in sediment were evaluated as part of the identification of aquatic plant tissue COPCs. Those chemicals that were found to be present at elevated concentrations in both sediment and in aquatic plant tissues were selected as aquatic plant tissue COPCs.

28. Section 5.0, p. 19, Tier 3. See comments on Appendix B. The use of USEPA Region 4 soils benchmark criteria may not be appropriate, as the conditions in general soil and climate in the southeastern US are dramatically different from the arid, high altitude climate found in SE Idaho.

Response: No soil screening levels are available specifically for the western U.S. The EPA Region 4 values are conservative and have been through a review process. No changes are required for the revised AWHHERA.

29. Section 5.0, p. 19, 4h bullet. The use of the UET acronym should be included with the other secondary categories, or eliminated from usage. There are approximately 4 secondary categories of benchmark values that were used from the NOAA SQRT tables that are not included in this sentence.

    Response: The values used from the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRT) Table include the threshold effects level (TEL) (two versions included), probable effects level (PEL), and upper effects threshold (UET). No other values were considered. No changes are required for the revised AWHHERA.

30. Section 5.0, p. 19, Tier 4. This paragraph requires clarification. The paragraph can be interpreted to mean that, even after the three previous tiers, all media will be screened again during Tier 4 and this tier may supercede the efforts of the previous tiers. This is an inappropriate use of the screening process since any chemical that is screened out with a value less than the applicable benchmark should be further eliminated from consideration as a COPC or COPEC. This tier does not consider the efforts of the previous 3 tiers, and re-evaluates any constituent that was previously eliminated during the screening process. The discussion of the tiered evaluation does not adequately explain the decision making process.

    Response: The use of a fourth tier, in which additional consideration is given to retaining or rejecting chemicals as COPCs, does not invalidate the selection process. Instead, the fourth tier, as described in Appendix B, allows consideration of additional information that either cannot be readily quantified or is largely policy in nature. The goal of the entire COPC selection process is to focus the risk assessments on those chemicals most likely to have been released from waste rock piles into the environment and associated with potentially significant human and ecological exposures. In this context, the four-tiered process is conservative and effective. The paragraph will be reviewed and, as necessary, revised to clarify the decision-making process.

<u>Section 6.0 – Area Wide Human Health Risk Assessment</u>

31. Section 6.0, p. 20, 1st paragraph. What are the unstated secondary goals of the AWHHRA?

    Response: The first paragraph of Section 6.0 will be rewritten as follows: "TtEMI prepared this AWHHRA for the Southeast Idaho Phosphate Mining Resource Area (Resource Area). The overall scope of the AWHHRA is to evaluate potential exposures to COPCs in multiple media and characterize the associated risks and hazards across the entire Resource Area for several receptor groups. The specific objectives of the AWHHRA are to (1) identify exposure scenarios (receptor and exposure pathway combinations), locations (for example, particular watersheds or stream segments), and COPCs that are associated with or contribute significantly to cancer risks and hazards greater than acceptable levels; and (2) focus ongoing and subsequent field investigations on the exposure scenarios, locations, and COPCs associated with or contributing significantly to unacceptable risks and hazards."

32. Section 6.1.1, p. 22, "Purpose." Tier 1 is defined as an initial screening step; however, it is not used as such in the assessment. In fact, Tier 1 results are repeatedly used as a rationale for predicting high site-specific risks. Tier 1 screening results are not meant to be used for risk prediction or characterization.

Response: Tier 1 is in fact used as an initial screening step in the AWHHRA. As noted in Section 6.1.1 and Figure 2, one of the outcomes of the Tier 1 analysis was the identification and elimination from subsequent evaluation of (1) exposure pathways resulting in cancer risks and noncancer hazards lower than 1E-06 and 1, respectively, and (2) COPCs associated with cancer risks and noncancer hazards lower than 1E-07 and 0.1, respectively. Section 6.7.2.1 clearly identifies the exposure pathways and COPCs that were eliminated from further evaluation based on Tier 1.

33. Section 6.1.1, p. 22, "Detail." Incremental lifetime cancer risks up to 10^{-4} (one in ten thousand) can be, and per USEPA guidance usually are, deemed to be acceptable per the NCP.

Response: Comment noted.

34. Section 6.1.1, p. 22, "Exposure Point Concentrations (EPCs)." There are no gardens, residential or otherwise, located on any of the truly riparian soils within the study area. IMA field teams have never observed such gardens.

Response: Section 6.1.1 will be revised to note that no gardens, residential or otherwise, have been observed on any riparian areas in the Resource Area and that the ingestion of homegrown produce from such a garden is a theoretical exposure scenario.

35. Section 6.1.2, p. 23, "Purpose." Tier 1 results are noted as being screened in terms of exposure pathways. Screening of contaminants and receptors of potential concern should have also been conducted.

Response: As noted in Figure 2, an additional outcome of Tier 1 was the identification and elimination from subsequent analysis of COPCs associated with risks less than 1E-07 and hazards less than 0.1. The "Purpose" portion of Section 6.1.2 will be revised to state "Tier 2 was an area-wide evaluation of exposure pathways and COPCs carried over from the Tier 1 assessment . . ."

36. Section 6.1.2, p. 23, "Detail." Why are the final two bullets denoted as (5) and (6)? The elk and beef ingestion pathways omitted from Tier 3? Is this because they weren't significant contributors to risk, or because the authors didn't know how to include them in the next tier? Does (6) mean that Tier 2b is equivalent to Tier 3? If not, what are the differences?

Response: The two items identified as "(5)" and "(6)" will be revised as bulleted items. The basis for not considering the ingestion of wild game and ingestion of beef cattle (first bulleted item) is presented as part of the first bulleted item. In summary, the elk and beef tissue data sets used to evaluate these exposure pathways under Tier 2 could not be readily broken down for further analysis; this is particularly true for the beef tissue data set. Also, as noted in Section 6.1.3, the purpose of Tier 3 was to "assess the impact of temporal changes in COPC concentrations." Elk and beef are expected to receive the majority of their exposure to COPCs through ingestion of plant material. Significant temporal changes in plant tissue concentrations are not expected, compared with potentially significant variations in COPC concentrations in surface water (and possibly fish tissue).

Section 6.1.2 will be revised to (1) discuss the expected lack of temporal variation of COPC concentrations in plant tissues, as well as the lack of additional elk and beef tissue data sets for comparison, as additional reasons why ingestion of wild game and beef cattle tissue were not evaluated under Tier 3; and (2) clarify the distinctions between Tier 2 and Tier 3.

37. Section 6.1.2, p. 24, "EPCs." What does "weighted by stream-specific productivity" mean? Please provide estimates of stream-specific productivity.

Response: The first sentence in Section 6.1.2 under the subsection "EPCs" is incorrect; this statement was retained from an earlier version of the AWHHRA. EPCs were calculated for all media as described in Appendix C. Section 6.1.2 will be revised accordingly.

38. Section 6.1.2, p. 24, "Exposure Parameters." It appears that the authors expect the readers to believe that CTE estimates are means or medians. Note that CTE inputs to a model do not (in fact, rarely do) result in a CTE output from the model. As most environmental data are well characterized by log normality, their means will often be relatively high quantiles; as such, a model using CTE inputs may well provide a result in excess of the RME realm (which is defined by USEPA as somewhere from the 90th to 99.9th percentile of the output). There is no way to know whether a CTE or RME result is really a valid CTE or RME estimate unless it is compared to a fully stochastic output of the model.

Response: As stated in the subsection "Exposure Parameters," each central tendency exposure (CTE) parameter represents a "central tendency value (for example, mean or 50th percentile)." Section 6.1.2 does not address the outcome of a model using CTE inputs. As stated in the comment, the outcome of such a CTE model may generate results that are greater than the mean or 50th percentile and, in fact, may generate upper percentile results. However, the AWHHRA calculated CTE results in a manner consistent with EPA guidance. The potential for the CTE methodology used to generate upper percentile results is discussed in Section 6.10.4.

39. Section 6.1.3, p. 24, "Detail." We agree that ingestion of fish from a stream like East Mill Creek is unlikely to occur, but, more importantly, no significant chronic exposure to such streams can occur due to their limited size and inability to sustain a harvestable fishery. Please provide estimates of productivity on each stream. Why does whether spawning has been observed in a stream affect the value of FI? Why does the agency say that fish and water ingestion may be evaluated on a stream-specific basis in the future if it admits "it is considered unlikely that receptors will be exposed exclusively to fish and surface water from individual streams."?

Response: As stated in the first sentence of Section 6.1.3 "Detail," "cancer risks and non-cancer hazards were calculated on a watershed basis." Given the number of potential fishing streams in each watershed, it was assumed that all watersheds considered in the AWHHRA are able to support both exposure scenarios considered in Tier 3. The text will be revised to clearly state this assumption. The text will be revised to state further that "As necessary, these two exposure pathways may also be evaluated on a stream-specific basis in the future as part of mine-specific risk assessments. As part of the stream-specific evaluations, the potential for each stream to support a particular exposure scenario should be considered. For example, some streams in the Resource Area (for example, Maybe Creek) have been shown to currently support little, if any, aquatic life; therefore, ingestion of fish from impacted stretches of these streams is unlikely to occur under current conditions. The potential for each stream to support the fish ingestion exposure scenario could be characterized through the use of stream-specific fraction-ingested (FI) values. These FI values should reflect the productivity of each stream and should be developed using a variety of criteria including, but not limited to (1) order; (2) the number, type, size, and species of fish present; and (3) whether spawning has been observed in the stream." The last sentence in this subsection will be revised to add the assumptions discussed at the beginning of this response.

While receptors are unlikely to be exposed exclusively to fish and surface water from individual streams, receptors may receive a majority of their exposure through these exposure pathways from a single stream. Therefore, it will be important to evaluate potential exposures on a stream-specific basis as part of the site-specific risk assessments. Further, the presence of spawning in a stream will increase the number and size of fish present in a particular stream, which may, in turn, increase the amount and percentage of total fish ingested for a particular stream.

40. Section 6.1.3, p. 25, "EPCs." See comment above on Section 6.1.2, p. 24, "EPCs."

    Response: See response to Specific Comment 37.

41. Section 6.1.3, p. 25, "Exposure Parameters." See comment above on Section 6.1.2, p. 24, "Exposure Parameters."

    Response: See response to Specific Comment 38.

42. Section 6.2, p. 25. There is a frequent reference to "medium-specific analytical results." To qualify the results as being "medium-specific" is unnecessary; such qualifier should be removed?

    Response: IDEQ believes that the text as stated provides an adequate description and will not be changed.

43. Section 6.2.1, p. 25. Three samples were obtained from dumps at each of 14 mines. Note that samples were collected from black shale areas, which represent a worse case scenario, and therefore this data is not representative of the entire waste rock dump. The list of analytes included more than just metals, and the list, although extensive, was not comprehensive.

    Response: Section 6.2.1 will be revised to note that the samples were collected from black shale areas and may not be representative of the entire waste rock pile at each mine. The use of these "worst case" results as part of the AWHHRA and AWERA is consistent with the overall conservative approach adopted for the risk assessment to ensure that no potentially significant exposures, risks, and hazards are overlooked.

44. Section 6.2.5, p. 27. IMA personnel do not recall seeing any gardens planted in riparian zones in the Resource Area.

    Response: The AWHHRA (including Section 6.2.5) will be revised to note that no gardens, residential or otherwise, have been observed on any riparian areas in the Resource Area and that the ingestion of homegrown produce from such a garden is a theoretical exposure scenario.

45. Section 6.2.3, p. 26. Table 6-3 seems to indicate that fish tissue samples were collected by IDEQ at only four streams, all "investigative" (which presumably means non-background). Where were the other two or six locations? (Note: The file containing Figure 7 on the CD is corrupted.) In Table 6-5, "scurpin" should presumably be sculpin, and all of the three trout collected by MW on East Mill Creek in 1998 were less than 6 inches long. Table 6-5 seems to indicate that IDEQ sampled 6 stream stations—3 impacted, and 3 background. Length of the fish at Kendall Creek and East Mill Creek is not noted. The data from the three stations sampled by MW in 1998 were reported in MW's 1998 regional investigation report, not the 1999 report. Also, MW sampled many more stream and reservoir stations in 1999 and 2000, and these data have been reported in two interim reports but are excluded from Table 6-5 for some reason. Change RMA to IMA. South Fork Sage Creek (ST228) is incorrectly labeled as impacted. At the time that it was sampled, South Fork Sage

Creek was a background station (although it is now considered potentially impacted due to mine expansion at Smoky Canyon.

Response: Tables 6-3 and 6-5 will be reviewed for accuracy and consistency and revised accordingly.

46. Section 6.2.4, p. 26, 1st paragraph. What are the full scientific names for bitterroot, golden sage, and red willow? If these plants are eaten by the Shoshones and Bannocks, we assume that they harvest a single species of each and not all members of the respective genera.

Response: Meetings were held with tribal representatives on March 16, 2001 and April 25, 2001 to discuss the proposed Native American risk assessment process, exposure pathways, and surrogate species. Meeting attendees included Jeanette Wolfley, Shoshone Bannock tribal counsel; Dan Christopherson, Tribal Wildlife Staff; Sam Hernandez, U.S. Bureau of Indian Affairs (BIA); Jeff Jones, FS; Rick Clegg, IDEQ; and Joe Davis and Mike Puett, TtEMI. Ms. Wolfley informed the IDEQ of upcoming meetings with the Tribal Risk Assessment Committee and EPA, and a follow-up meeting was scheduled. At the subsequent meeting, Ms. Wolfley provided a list of surrogate species, reportedly developed with the assistance of Tribal Risk Assessment Committee members. The meeting participants discussed the generic uses for the plant species and were informed that some members of the Tribe occasionally use the Resource Area for hunting, fishing, and gathering. However, tribal representatives did not provide specific species of plants that were gathered. Therefore, while Native American receptors may harvest only individual species, for the purposes of the AWHHRA, potential exposure was evaluated for the entire genera. Specifically, tissue samples were collected from two aquatic species – watercress (Nasturium officinale) and water buttercup (Cara photomycetin) and from four terrestrial species – wild onion (Allium canadense), bitterroot (Camus spp.), golden sage (Artemesia spp.), and red willow (Salix spp.).

47. Section 6.2.4, p. 26, 2nd paragraph. Why was bitterroot only collected at unimpacted sites? Why was water buttercup sampled if it was deemed to be unlikely to be ingested?

Response: Bitterroot was searched for at both impacted and unimpacted site; however, it was not identified (and therefore not collected) at impacted sites. Water buttercup plants were collected primarily for consideration in the AWERA, but also as a potential surrogate for plants ingested by human receptors. The initial sampling event conducted during Spring 2001 focused on collecting plant species that may be used or consumed by members of the Shoshone-Bannock tribe. The Summer 2001 sampling event included collection of aquatic and riparian species that might be consumed by human or ecological receptors.

48. Section 6.2.5, p. 27. There are no gardens known to exist in the riparian zone of IMA's entire study area. What is the likelihood of such gardens being encountered? How were the riparian areas that were sampled selected?

Response: The AWHHRA (including Section 6.2.5) will be revised to note that no gardens, residential or otherwise, have been observed on any riparian areas in the Resource Area and that the ingestion of homegrown produce from such a garden is a theoretical exposure scenario. Riparian areas were identified for sampling as described in TtEMI (2001d).

49. Section 6.2.7, p. 27. We suggest deleting, for clarity, "as for elk" from the final sentence. Mention should be made that the steers were confined on seleniferous pasture for the purpose of the study, and that such confinement is not normal.

Response: With regard to the suggested revision to the final sentence, IDEQ respectfully disagrees; the sentence will remain as written. Section 6.2.7 will be revised to state that the steers were confined on a seleniferous pasture for the purpose of the study and that such confinement is not a normal practice. While cattle are not typically penned on waste rock piles, the reclaimed areas present the most palatable forage in the Resource Area and would appear to attract free ranging animals. The IDEQ would need further information to conclude that this study represents a "worst case" scenario.

50. Section 6.2.8, p. 28. The IMA samples collected in 1998 were analyzed for more than just metals, but not for 18 metals. Again, data from September 1999 and May 2000 are ignored in this report. Note that Se is not a metal.

Response: Section 6.2.8 will be revised to accurately identify surface water analytes for MW samples collected in 1998. The AWHHRA and AWERA focused primarily on the most recently collected medium-specific samples collected. However, for the purpose of evaluating the impact of temporal changes in the concentrations of COPCs in surface water and fish tissue, surface water and fish tissue EPCs were calculated based on the analytical results for samples collected in 1998 (a high flow year). IDEQ acknowledges that samples collected by MW in September 1999 and May 2000 were not used in the AWHHRA and AWERA. The uncertainty associated with not using these data will be discussed in the uncertainty sections (Sections 6.10 and 7.10 in the AWHHRA and AWERA, respectively).

51. Section 6.3, p. 28, item (1). Comparing a maximum value to twice the background mean found in western soils has little or no meaning. Also, please provide a citation to the report used to define the mean in western soils.

Response: See response to Specific Comment 26. The reference used to define the mean in western soils is Shacklette and Boerngen (1984). Section 6.3 will be revised to add this reference.

52. Section 6.3, p. 28, item (2). All chemicals should be evaluated against background. If a chemical doesn't exceed background, it cannot be a contaminant, let alone one of potential concern.

Response: All chemicals detected in waste rock at maximum concentrations greater than twice the mean background level of soils found in the western U.S. (Tier 1) were screened against medium-specific background concentrations in Tier 2.

53. Section 6.3, p. 29, item (4). What chemicals were retained or rejected on the basis of this criterion, and what were the specific reasons for doing so for each?

Response: Section 6.3 will be revised to identify the chemicals that were retained or rejected on the basis of item (4) and to note that the specific reason for each retention and rejection is discussed in Appendix B.

54. Section 6.3.2, p. 29. How can waste rock, a natural substance, contain elevated concentrations of anything? What is of concern are those substances in waste rock whose release rates are accelerated by handling during the mining process. A mineralized geologic stratum, whose existence is the reason for the mining to occur, is not and cannot be a contaminated medium.

Response: It is acknowledged that a primary concern "are those substances in waste rock whose release rates are accelerated by handling during the mining process." However, while the rock itself is a natural substance, the specific form, composition, and placement of the waste rock is

influenced by specific mining processes and human decisions. It is in this context that waste rock is considered (1) the source of the chemicals potentially released into the environment of the Resource Area and considered as COPCs and chemicals of potential ecological concern (COPEC) in the AWHHRA and AWERA, respectively, and (2) to have elevated concentrations of COPCs. Note: the presence of elevated concentrations of chemicals, identified by comparison of waste rock concentrations to regional soil concentrations, is used as a surrogate for those substances "whose release rates are accelerated by handling during the mining process."

55. Section 6.3.4, p. 30. Comparison of maximum observed concentrations to twice the background average has no logical meaning and ignores available background variance information.

    Response: See response to Specific Comment 26.

56. Section 6.3.5, p. 30. Comparison of maximum observed concentrations to twice the background average has no logical meaning and ignores available background variance information. Chemicals retained include more than just metals. Why was Cu added for this medium? The paragraph implies that soil concentrations of COPECs are compared to concentrations in vegetation, but there is no basis for this comparison.

    Response: See response to Specific Comment 26. Section 6.3.5 will be revised to refer to metals and other inorganic chemicals. Section 6.3.5 mistakenly refers to soil; the text will be revised to refer to sediment, the medium from which aquatic plants grow. Copper was added because it was present in sediment and in aquatic plant tissues at concentrations greater than twice the medium-specific mean background concentrations. In determining if a chemical was retained as a COPC, impacted sediment concentrations were compared with background sediment concentrations and impacted plant tissue concentrations were compared with background plant tissue concentrations.

57. Section 6.3.9, p. 31. As noted in the preceding comment, comparison of maximum observed concentrations to twice the background average has no logical meaning and ignores available background variance information.

    Response: See response to Specific Comment 26.

58. Section 6.4.1, p. 31. How many people living a subsistence lifestyle have IDEQ personnel or TtEMI personnel observed in the IMA study area during their involvement in the SE Idaho Se issue? What are the particular public and stakeholder concerns being addressed? Have those living the subsistence lifestyle expressed any concerns?

    Response: No studies have been conducted regarding the potential presence of subsistence lifestyle receptors in the Resource Area. Therefore, no statements can be made regarding the potential presence or specific number of such receptors in the Resource Area. However, IDEQ acknowledges that the Resource Area is very sparsely populated by ranchers, none of whom rely solely on area resources for subsistence. Impacted zones comprise a small percentage of the overall Resource Area and occur primarily on public lands that prohibit residential use. While the IDEQ is aware that selected members of the local population may rely on area resources for a significant supplement to their diets, IDEQ agrees with IDH's health consultation conclusion that a subsistence lifestyle is unrealistic. However, with the lack of empirical data on the exact level of local resource use, IDH explicitly chose an overly conservative scenario to eliminate risk concerns for lesser users.

59. Section 6.4.2, p. 32, 1st paragraph. How were qualitative assessments performed on the pathways noted here?

Response: As noted in Section 6.4.2, "an explanation of the basis for concluding these exposure pathways contribute only a negligible part of the total dose to the receptor is provided in Section 7.3.2.2 of the work plan." This information will be added to Section 6.4.2 and referred to in Section 6.11 as the qualitative assessment of those exposure pathways not considered quantitatively in the AWHHRA.

60. Section 6.4.3, p. 33, 2nd paragraph. For clarity, mg/kg-day should be denoted as either mg/kg/day or mg/(kg•day) so as to not suggest the nonsensical mg/kg - day.

Response: The text will be revised to consistently denote milligrams per kilogram per day as mg/kg/day.

61. Section 6.4.3, p. 33, Equation (6-1). With regard to C, tissue concentrations should always be noted as to whether they are on a wet-weight (ww) or dry-weight (dw) basis.

Response: The explanation for chemical concentration (C) associated with Equation 6-1 will be revised to specify the basis (wet-weight or dry-weight) of all tissue concentrations considered in the AWHHRA. Tables 6-1 and 6-2 will be revised similarly.

62. Section 6.4.3, p. 34, 1st paragraph. Figure 4 appears to be an ecological site conceptual model, not exposure equations.

Response: The correct Figure 4 that presented the equations used to estimate receptor-specific exposures was inadvertently omitted from the AWHHRA. The correct Figure 4 will be added to the AWHHRA and all other figures renumbered, as required.

63. Section 6.4.5, p. 36, "Background Exposure." The word "background" is used in more than one way herein. To simplify matters, for assessments involving carcinogens, one can state that exposure pathways are evaluated using incremental contaminant concentrations; i.e., in place of C in the general exposure equation, $C\text{-}C_{background}$ is used. This is the simplest and most open way of conducting the evaluation, a $C_{background}$ is already included in the national background cancer rate of approximately $3x10^{-1}$ and should obviously not be double counted. For systemic toxicants, the background component of each contaminated medium is not subtracted out and in addition exposures through normal diet and supplementation must be accounted for because they may contribute toward a potential exceedance of a toxicity threshold. Such a description gets rid of using background to characterize both a component of contaminant concentration and a component of the diet.

Response: As noted in IDEQ's response to an IMA comment on the work plan (TtEMI 2002a) regarding calculation of excess lifetime cancer risks (ELCR) based on an EPC calculated as incremental concentrations (or "$C\text{-}C_{background}$"), the IDEQ disagrees with the IMA's interpretation of the National Contingency Plan's (NCP) provision. The NCP refers only to "controlling" incremental risk; in other words, the potentially responsible party (PRP) is not responsible for risks below background levels. The background risk must be included in the initial assessment calculations to determine the overall cumulative risk to the target organism. Therefore, for assessments involving carcinogens, exposures have been calculated using an EPC without subtracting $C_{background}$. Section 6.4.5 becomes Section 6.4.7 and the text will be revised to better clarify the use of the term "background" to represent more than one concept.

64. Section 6.4.5, p. 38, second paragraph. Change "potential exposure to cadmium" to "potential exposure to chromium."

Response: The text will be corrected.

65. Section 6.4.5, p. 40, "Supplemental Exposure, Selenium." This would be better described as supplement exposure. For your information, MWH refined the estimation of Se intake via multivitamins and Se supplements. The probability of a randomly selected person taking multivitamins is represented by *b* (15.1, 25, 0, 1.00), which denotes a beta distribution with an alpha shape factor of 15.1, a beta shape factor of 25, a lower bound of 0, and an upper bound of 1.00. This distribution has a mean of 38% and a 95th percentile of 50%. The probability that a multivitamin contains Se is represented by BN(0.60, 10)/10, a binomial distribution with a probability of success of 60% based on a sample size of 10 (divided by 10 to convert back into probability units). The daily intake of Se from those multivitamins that do contain Se is represented by *b* (0.32, 0.80, 0, 0.20) mg/d, which has a mean of 0.057 mg/d and a 95th percentile of 0.184 mg/d. When the likelihood of someone taking multivitamins at all is accounted for, this drops to a mean of 0.022 mg/d with a 95th percentile of 0.149 mg/d. When the likelihood of the multivitamin containing Se at all is accounted for, this drops to a mean of 0.0131 mg/d with a 95th percentile of 0.113 mg/d. In addition to supplementation via multivitamins, we're evaluating the contribution of special Se supplements, too (e.g., yeast tablets containing 0.050 or 0.20 mg of Se in the form of selenomethionine). We've estimated the likelihood of someone taking these as *b* (0.95, 19.2, 0, 1.00), which has a mean of 4.7% and a 95th percentile of 14.0%. The daily intake of Se from special Se supplements is estimated as *b* (0.96, 24, 0.050, 2.0), which has a mean of 0.125 mg/d and a 95th percentile of 0.27 mg/d. When the likelihood of someone taking special Se supplements is accounted for, this drops to a mean of 0.0059 mg/d and a 95th percentile of 0.00184 mg/d (this isn't a typo—the mean lies beyond the 95th percentile). When the two forms of supplementation are added together, the intake has a distribution with a mean of 0.0188 mg/d and a 95th percentile of 0.139 mg/d. Compare this to the IDEQ value of 0.098 mg/d (factoring out the median body weight of 70 kg). These refinements came about because we found information indicating that multivitamin usage statistics do not include usage of mineral supplements, and we found information regarding Se mineral supplement usage.

Response: Section 6.4.5 (and elsewhere, as applicable) will be revised to (1) refer to "supplement exposure," and (2) incorporate MW's revised estimation of selenium intake via multivitamins and selenium supplements.

66. Section 6.6.1, p. 44, 2nd paragraph. No adverse health effects are "generally" expected with an HQ = 1.0? Under what specific conditions would one expect adverse health effects with an HQ = 1.0?

Response: Section 6.6.1 will be revised to state "Adverse health effects are not expected at a hazard quotient (HQ) of 1 or lower."

67. Section 6.6.1, p. 44, Equation (6-3). This equation should not be used unless COPC-1 and COPC-2, for example, affect the same toxicological endpoint or are otherwise known to exhibit additive effects.

Response: The use of Equation 6-3 is consistent with EPA guidance (EPA 1989). As noted in the second to last paragraph of Section 6.6.1, all total hazard indices (HI) that exceeded 1 were

evaluated further. In some cases, a refined assessment included development of separate total HIs based on specific target organs and systems.

68. Section 6.6.1, p. 45, final paragraph. Again, HQs from different contaminants should not be summed unless the contaminants affect the same toxicological endpoint. If HIs in excess of 1.0 are driven by two COPCs and these two COPCs do not affect the same toxicological endpoint, the HI could be an artifact of improper addition.

    Response: Comment noted. See response to Specific Comment 67.

69. Section 6.6.2, p. 46, Equation (6-5). The LADD should be an incremental LADD, with the background component of the concentration term subtracted out. (In the paragraph following the description of the equation variables, there is an 'i' omitted from the word, 'linearized.'

    Response: As noted in the response to Specific Comment 63, the IDEQ disagrees with the IMA's interpretation of the NCP's provision. The NCP refers only to "controlling" incremental risk; in other words, the PRP is not responsible for risks below background levels. The background risk must be included in the initial assessment calculations to determine the overall cumulative risk to the target organism. Therefore, for assessments involving carcinogens, exposures (or lifetime average daily doses [LADD]) have been calculated using an EPC without subtracting $C_{background}$.

70. Section 6.6.2, p. 48, final paragraph. If an incremental lifetime cancer risk of 10^{-6} is defined as the point of departure, why is $1x10^{-7}$ being used as the point of departure?

    Response: The value 10^{-6} *was used as a point of departure for characterizing total carcinogenic risks. As such, it was used to eliminate entire exposure scenarios. However, a lower value,* 10^{-7}*, was used as the basis for eliminating individual COPCs to account for the fact that summing risks from several COPCs, each with a risk greater than 1E-07 and less than 1E-06, may result in a total risk greater than 1E-06.*

71. Section 6.7.7.1, p. 49, 3rd sentence. This sentence states "This hazard resulted from data for fish samples collected from East Mill Creek…" which seems contradictory to the earlier statement that "some streams in the Resource Area (for example, East Mill Creek) have been shown to support little if any aquatic life" (page 24). Fish samples collected from East Mill Creek are used to determine concentrations for all impacted tributaries (except Spring Creek) in the Blackfoot watershed. All fish collected by TtEMI in 2001 were less than six inches. The bag limit for the entire upper Blackfoot watershed is two trout (and cutthroat trout must be released). This should be compared with the fish ingestion scenario to ensure that potential ingestion is not being overestimated.

    Response: As described in Section 6.1.1, Tier 1 calculations are based on the maximum detected concentration for each medium. Use of maximum detected concentrations is a conservative step consistent with the screening nature of Tier 1. This approach helps to ensure that exposure scenarios and COPCs clearly associated with insignificant risks and hazards can be eliminated from further consideration in Tiers 2 and 3 and that exposure scenarios and COPCs potentially associated with significant risks and hazards are not eliminated without a more comprehensive evaluation in Tiers 2 and 3.

72. Section 6.7.1.1, p. 50, "Adult Recreationalist" and "Child Recreationalist." The risks purported to be significant are attributable to eating fish from East Mill Creek. East Mill Creek doesn't support enough fish, because of it's small size, to support a fishery from which one could derive a

significant chronic exposure. IDFG spent about a half hour electro shocking perhaps a 100-yard reach of the creek in September 1998 and was only able to capture 4 or 5 trout, all of which were less than 6 inches in length—i.e., it is doubtful that anyone would bother to keep and cook such small trout, and even if they did they would have an unsatisfying meal and would have a very difficult time scaring up another meal, even such a meager one, from the creek again for some time.

Response: The IMA reported harvesting a number of fish from East Mill Creek in their September 1999 and May 2000 Draft Investigation Reports. Four of those were characterized for salmonid "skin-on" fillet analysis, which reportedly required a measured body length in excess of six inches. Based on these reported tissue concentrations, the Idaho Fish Consumption Advisory Program Committee, headed by the Idaho Division of Health, has made a determination to issue a temporary fish consumption advisory for East Mill Creek.

73. Section 6.7.1.2, pp. 50-51, "Adult Native American" and "Child Native American." See the comment immediately above, and note that East Mill Creek is nowhere close to the Shoshone-Bannock Reservation. In fact, East Mill Creek has no counterpart with regard to Se content known anywhere on or near Gay Mine.

Response: The Native American scenario was used to assess risks in the Resource Area through the traditional use of off reservation resources granted under existing treaty rights. The distance to the Reservation or counterparts at Gay Mine are irrelevant in this context.

74. Section 6.7.1.3, pp. 51-53, "Adult Subsistence Lifestyle Receptor" and "Child Subsistence Lifestyle Receptor." See the comment prior to the one immediately above. In addition, this receptor is not known to exist in the study area and IDHW has deemed it to be an unreasonable exposure scenario. Finally, the purported As cancer risk must contain background levels, as IMA is unaware of any evidence of statistically increased levels of As in the environment attributable to phosphate mining. Given that the risk estimate is not an incremental one, as required by regulation, it is an invalid bounding estimate.

Response: See response to Specific Comments 69 and 71. Also, as noted in a response to an IMA comment on the draft work plan (TtEMI 2002a), the AWHHRA defines the "subsistence lifestyle" to reflect a more realistic regional "worst case" rural resident approach that assumes a majority of the dietary needs are met through the immediate environment but excludes poaching and allows for some foodstuffs from commercial sources. The IDH is a partner with IDEQ in the human health risk assessment effort and concurs with the subsistence lifestyle screening approach. It is indisputable that a segment of the local population relies heavily on local livestock, wild game and fish for a significant portion of its diet. It should also be noted that the IDH has recently acknowledged that while the Agency for Toxic Substances and Disease Registry (ATSDR) Health Consultation stated that a subsistence scenario is unlikely, this scenario is not out of the question (IDH 2001). Therefore, IDH representatives agreed that the subsistence lifestyle receptor should be retained for consideration in the AWHHRA.

75. Section 6.7.1.3, p. 52, last paragraph. The hazard resulted from data for a single surface soil sample collected along Rasmussen Creek in the Blackfoot River watershed. There is only one person who lives near Rasmussen Creek, and, as of a year ago, she spent most of the year in California. This pathway seems unlikely.

Response: Comment noted. See response to Specific Comment 71.

76. Section 6.7.2.1, pp. 54-55. The retention of elk and beef ingestion despite both of these pathways being screened out in Tier 1 is an example of the flawed tiered approach, as described in General Comment No. 1, above. Just because hunting and ranching are common activities is no reason to retain these screened-out pathways. Inhalation is a much more common activity and that pathway was allowed to remain screened-out. Retaining Cr after it, too, was screened out poses the same problem. Especially, when the unsubstantiated assumption of 100% hexavalent species is noted.

Response: IDEQ acknowledges that retention of elk and beef tissue ingestion exposure pathways departs from a strict screening approach. However, retention of these exposure pathways is considered acceptable given the expected interest in the results for these exposure pathways. Inhalation is evaluated as an exposure route in the AWHHRA only in the context of inhaling fugitive emissions from waste rock piles. Hunting (or recreating) near waste rock piles is not expected to be especially common given the small percentage of the total Resource Area represented by waste rock piles. Therefore, screening out the inhalation exposure pathway was considered appropriate. Finally, chromium was retained because risks and hazards associated with this COPC were greater than 1E-07 and 0.1, respectively. It is acknowledged that the assumption that chromium is present entirely as hexavalent chromium (chromium VI) is conservative. However, without data on speciation, the use of this assumption was determined to be acceptable. The uncertainties associated with this assumption are discussed in Section 6.10.

77. Section 6.7.2.1, p. 55, first paragraph. It seems very unlikely that all detected chromium exists in the hexavalent form.

Response: Comment noted. See response to Specific Comment 76.

78. Section 6.7.2.2, pp. 55-56. The practitioners do a disservice by failing to use Tier 1 for what they define it as—a screening step. All stakeholders would derive maximum benefit from focusing on those contaminants, pathways, and receptors that have a potential to pose a threat. All pathways are of potential concern, but retaining those that have been shown to pose no substantive concern is distracting and inefficient. Why was any pathway other than ingestion of aquatic life carried forward? Even slightly more realistic assumptions would eliminate concerns for human health, and would focus the area wide risk assessment on actual concerns.

Response: As stated in the response to Specific Comment 32, Tier 1 is in fact used as an initial screening step in the AWHHRA. As noted in Section 6.1.1 and Figure 2, one of the outcomes of the Tier 1 analysis was the identification and elimination from subsequent evaluation of (1) exposure pathways resulting in cancer risks and noncancer hazards lower than 1E-06 and 1, respectively, and (2) COPCs associated with cancer risks and noncancer hazards lower than 1E-07 and 0.1, respectively. Section 6.7.2.1 clearly identifies the exposure pathways and COPCs that were eliminated from further evaluation based on Tier 1 results.

79. Section 6.8, p. 56. What is the difference between Tiers 2a and 2b?

Response: As noted in Figure 2, Category 2a exposure pathways are those that extend (or could extend) beyond stream-, riparian area-, or mine-specific exposure areas, and Category 2b exposure pathways are those with stream-, riparian area-, or mine-specific exposure areas.

80. Section 6.8.3.1, pp. 57-58, "Adult Recreationalist," "Child Recreationalist," "Adult Native American," and "Child Native American." How can Cd be considered a driver to the RME estimates when, in each case, the HQ for Cd does not exceed 1.0?

Response: The AWHHRA will be revised to clarify that "risk and hazard drivers" are those COPCs that singly or in combination with other COPCs contribute about 90 percent or greater of the total calculated risk or hazard. By this definition, both selenium and cadmium are considered hazard drivers.

81. Section 6.8.3.1, p. 59, final paragraph. Given that As was not detected in either water or fish, the proper conclusion seems to be that there is no evidence of a release of As that can be attributed to phosphate mining and, therefore, As is not a contaminant, let alone a COPC.

Response: Comment noted.

82. Section 6.8.3.2, pp. 59-60, "Adult Recreationalist," "Child Recreationalist," "Adult Native American," "Child Native American," and Adult Subsistence Lifestyle Receptor." How can Cd be considered a driver to the RME estimates when, in each case, the HQ for Cd does not exceed 1.0?

Response: See response to Specific Comment 80. Based on this criterion, only selenium is considered a hazard driver; Section 6.8.3.2 will be revised accordingly.

83. Section 6.8.3.2, p. 61, final paragraph. Given that As was not detected in either water or fish, the proper conclusion seems to be that there is no evidence of a release of As that can be attributed to phosphate mining and, therefore, As is not a contaminant, let alone a COPC.

Response: Comment noted.

84. Section 6.8.3.3, pp. 61-62, "Adult Recreationalist," "Child Recreationalist," "Adult Native American," and "Child Native American." How can Cd be considered a driver to the RME estimates when, in each case, the HQ for Cd does not exceed 1.0? How was a fish-consumption risk defined for the Georgetown Canyon watershed when no fish were sampled in the watershed?

Response: See response to Specific Comment 80. Based on this criterion, both selenium and cadmium are considered hazard drivers. As discussed in Appendix C, in the absence of watershed-specific fish tissue data, EPCs for the Georgetown watershed were estimated as the average of the fish tissue concentrations for watersheds with fish tissue data, weighted by the relative presence of impacted and unimpacted streams in the Georgetown watershed. This use of surrogate data was considered appropriate to better evaluate risks and hazards associated with total intake from various exposure pathways. The uncertainties associated with this approach are discussed in Section 6.10.

85. Section 6.8.3.3, p. 63, final paragraph. Given that As was not detected in either water or fish, the proper conclusion seems to be that there is no evidence of a release of As that can be attributed to phosphate mining and, therefore, As is not a contaminant, let alone a COPC.

Response: Comment noted.

86. Section 6.8.3.6, p. 65. Throughout this document, all references to "subsistence lifestyle receptor" should be prefaced with the word, hypothetical, unless the agency can identify at least one such person within the study area fitting the definition.

Response: This revision is unnecessary since the word scenario, which is used frequently to describe the assessed conditions, infers a modeled situation. There are no risk assessment models that accurately reflect any one person. It is acknowledged that the Resource Area is very sparsely

populated by ranchers, none of whom rely solely on area resources for subsistence. Nonetheless, it is indisputable that a segment of the local population relies heavily on local livestock, wild game, and fish for a significant portion of its diet. Therefore, the AWHHRA defines the "subsistence lifestyle" to reflect a more realistic regional "worst case" rural-resident approach that assumes a majority of the dietary needs are met through the immediate environment but excludes poaching and allows for some foodstuffs from commercial sources. Based on this definition of the subsistence lifestyle receptor, the use of the qualifier "hypothetical" is not required.

87. Section 6.8.3.6, p. 66, "Child Subsistence Lifestyle Receptor." It appears that the only way an RME of 1.6 can be obtained is by assuming that the toxicological effects of As and Cd are similar and additive; they are not.

Response: Consistent with EPA guidance, the HI of 1.6 was further evaluated based on COPC-specific target organs and systems. As noted in the comment, the noncancer toxicological effects that the reference dose (RfD) of arsenic and cadmium are based on are not the same. However, review of the toxicological data indicates that other effects not used to develop the RfD do affect the same organs in similar manners. Therefore, IDEQ believes it is reasonable to assume additivity for the purpose of ensuring conservatism in the risk assessment.

88. Section 6.8.3.6, p. 66, final paragraph. The comparison of risk attributable to a mean non-area-specific background concentration to that attributable to an upper bound site concentration is not valid. If it were, one could conclude that upper bound concentrations of background are greater than those of mean background—a rather meaningless observation. Both should be either means or upper bounds to be comparable and representative.

Response: IDEQ respectfully disagrees. The comparison of site-specific EPCs to background concentrations based on unimpacted soil from the Resource Area, as well as regional soil concentrations for the western U.S., provides valuable context. The AWHHRA used a conservative COPC selection process. The comparison presented in this section indicates that the site-specific risks based on arsenic are similar to those associated with background concentrations of arsenic.

89. Section 6.8.3.7, p. 68, 1st two paragraphs. Please present the total HIs that add the background and supplement contributions to the site HIs. It should be noted that, in addition to child background for As, the adult background for As poses a risk, that the Cd background is very close to posing a risk, and the Se background plus supplements contributions (which sum to 0.6) add a significant number. Adding these values to the site HIs does more than "only slightly increase" the site HIs (which by themselves are meaningless numbers).

Response: Section 6.8.3.7 will be revised to present the total HIs that add the background and supplement contributions to the site HIs. The statement that adding these values to the site HIs "only slightly increase" the receptor-specific totals will be removed.

90. Section 6.8.3.7, p. 69, 1st paragraph. Was the risk the same for each watershed because the data and assumptions were the same for each watershed? The document should clearly state the approach used for watershed-specific risk estimates, and, if the data and assumptions were the same for each watershed, then the terminology "watershed-specific" should be dropped.

Response: The risk was the same for each watershed primarily because the risks are driven by risks associated with ingestion of surface soil. It was assumed that subsistence lifestyle receptors would be exposed through exposure watershed-specific exposure pathways as well as exposures at their place of residence. The term "watershed-specific" is applied throughout the AWHHRA only

to exposure pathways associated with fish, aquatic plant, and terrestrial plant (not homegrown produce) ingestion. Section 6.8.3.7 will be revised to clarify that total risks for subsistence lifestyle receptors were driven by exposure through soil ingestion and did not change based on inclusion of watershed-specific risks.

91. Section 6.8.4.1, p. 69. How could Cd drive the Tier 2 RME estimates when it didn't drive the Tier 1 RME estimates? Also, this summary appears to ignore at least some of the results of the background and supplement contributions? An element should not be deemed to be driving a risk estimate when it doesn't produce or contribute to a HQ or HI in excess of unity, and background contributions (including those attributable to use of mineral supplements or multivitamins) need to be considered for systemic toxicants.

    Response: As noted in response to several previous comments, risk and hazard drivers are defined as those COPCs that alone or in combination with other COPCs contribute about 90 percent or more of the total hazard. Consistent with EPA guidance, total hazards for which no single COPC has an HI greater than 1 were further evaluated based on target organs and systems (EPA 1989). Section 6.8.4.1 will be revised to clarify that some totals (for example, those driven by selenium and cadmium) are based on COPCs that do not affect the same target organs or systems. Consistent with EPA guidance, total hazards that include at least one COPC with a HI greater than 1 were not requantified. However, the uncertainty associated with these totals is discussed in Section 6.10.

92. Section 6.8.4.2, p. 71, final paragraph. Almost by definition CTE estimates are more representative than RME estimates because CTE conditions are much more likely to be encountered than are RME conditions. In fact, it often turns out that a stochastic assessment shows an RME estimate has less than a 0.1% chance of occurring, making the RME estimate not anywhere near reasonable. The details in this paragraph indicate there is room for substantial refinement in the risk modeling.

    Response: Comment noted.

93. Section 6.8.4.3, p. 72. What contaminants and receptors are carried through to Tier 3?

    Response: Fish ingestion was the only exposure pathway carried through to Tier 3. COPCs carried through to Tier 3 include arsenic, cadmium, chromium, and selenium.

94. Section 6.9.1.1, p. 72, 1st paragraph. For the hypothetical child subsistence lifestyle receptor a Cd hazard that is well under 1.0 and one-tenth of the Se hazard is inappropriately described as a driving value. It appears to be an innocuous value.

    Response: See response to Specific Comment 80. Based on this criterion, only selenium is considered a hazard driver; Section 6.9.1.1 will be revised accordingly.

95. Section 6.9.2.2, p. 74, 1st paragraph. What are the bases for the 2001 and 1998 data? Why are the IMA data from 1999 and 2000 not addressed? What deleterious effect did data censoring have on the statistical summary of the 2001 Cd data?

    Response: The 2001 data set is presented in Appendix H. The 1998 data set includes the analytical data presented in MW 1999. The IMA data from 1999 and 2000 were not addressed for two primary reasons. First, the 2001 data represents the most recent analytical data, while the 1998 data represents data from a "high flow" year and is useful for evaluation of temporal concentration changes. Second, the 1999 and 2000 data collected by IMA represents a relatively small data set that did not provide results substantially different from the data used in the

AWHHRA. Censored data was handled in accordance with EPA protocols. The potential uncertainties introduced by censoring the 2001 cadmium data are discussed in Section 6.10.

96. Section 6.9.2.2, p. 74, 3rd sentence. "The 2001 data has concentrations that are…" There is no basis for this comment considering how the reach-specific analytical numbers were generated. There does not appear to be a systematic approach by which results are used to represent a particular reach. The document should be revised to clearly describe the approach used and the results for deriving the reach-specific analytical numbers.

    Response: The process used to calculate watershed-specific COPC surface water concentrations is described in Appendix C; spreadsheets showing the calculations will be added to Appendix C.

97. Section 6.9.2.2, p. 74, 4th sentence. The 1998 number is one order of magnitude greater than the 2001 number.

    Response: IDEQ respectfully disagrees; the area-weighted average concentration (AWAC) of cadmium in fish tissue is 0.23 milligram per kilogram (mg/kg) based on the 2001 data and 3.15E-02 mg/kg based on the 1998 data.

98. Section 6.10, pp. 75-84. The IMA's preliminary risk assessment, which is fully stochastic, explicitly acknowledges the uncertainty described in Section 6.10. The preliminary risk assessment incorporates this uncertainty into the model, and discloses the effects. While the IMA model is not directly comparable to the IDEQ's effort, it is sufficiently comparable to understand that the degree of overestimation of risk by IDEQ is substantial.

    Response: Comment noted.

99. Section 6.10.1.1, p. 75, 1st paragraph, 3rd sentence. Please describe how Se and Cd potentially degrade.

    Response: The first paragraph of Section 6.10.1.1 will be revised to remove reference to degradation of COPCs.

100. Section 6.10.1.1, p. 75, final paragraph. Se is not a metal and it can significantly metabolize, being incorporated into proteins. It is, after all, an essential nutrient.

    Response: Section 6.10.1.1 will be revised to note that selenium can significantly metabolize and be incorporated into proteins.

101. Section 6.11, p. 84, 1st paragraph. What were the secondary objectives of the AWHHRA? Note that the first sentence in this paragraph states two primary objectives, and the second sentence states two more primary objectives. How many primary objectives are there? In the first bullet there is mention of receptor-specific risk, but no mention of contaminant- or pathway-specific risk. The second bullet mentions receptor-specific risk again but not contaminant-specific risk. A major objective of any risk assessment should be to identify those receptors at potential risk and from what contaminants and pathways such risk is posed.

    Response: See response to Specific Comment 31. Section 6.11 will be revised accordingly.

102. Section 6.11.1, p. 84. A summary of the 3-tiered process and results is provided here. Given that Tier 1 is merely screening, there is no need to summarize it, as it just lends confusion to keep

bringing up the results as if they have some deep meaning outside of screening. Similarly, Tier 3 results should override any corresponding Tier 2 results.

Response: IDEQ respectfully disagrees. It is important to summarize the results from all three tiers of the AWHHRA. Tier 3 results are meant to provide an assessment of the potential for temporal changes in COPC concentrations in surface water and fish tissue. Therefore, Tier 3 results supplement those of Tier 2 but do not replace Tier 2 results.

103. Section 6.11.2, p. 85. A maximum observed value that is twice its relative background mean does not provide any evidence of having been "found to exceed the background." Such a comparison is not statistically meaningful.

Response: As noted in the response to Specific Comment 26, review of previous investigative results indicates that rigid statistical testing is not required to distinguish the presence of elevated concentrations of contaminants in impacted areas. Therefore, non-statistical standard industry approaches similar to those accepted by EPA Region 4 and FS Region 3 were used for background screening comparisons. Concentrations in excess of two times the background average were considered impacted and evaluated in the risk assessment process. As further precedent for this approach, a common industry practice for establishing industrial site background comparison levels under the RCRA is to collect 3 to 5 directed samples from areas believed to represent pre-industrial conditions for the calculation of a UCL_{95}. UCL_{95} typically result in values that are approximately 1.5 to 3 times the mean value, depending on data variability. This method requires neither random sampling nor a large data set for statistical analysis. In using the proposed non-statistical approach, the IDEQ explicitly accepts slight increases in the level of statistical uncertainty in the background screening results but we are confident that the uncertainty is within the normal tolerances associated with the risk assessment process.

104. Section 6.11.4, p. 86. Only the ultimate tier need be summarized. The inclusion of summaries for preceding tiers is redundant.

Response: See response to Specific Comment 102.

105. Section 6.11.5, p. 90, 2nd paragraph. An HI summing hazards from As, Cd, and Se is presented and then qualified as an inappropriate methodology. A major goal of any assessment is to provide a focus on potential risks. Carrying through inappropriate concepts is contrary to such goal. The summation and subsequent discussion should be deleted from the document.

Response: The subject hazard has been further evaluated based on target organs and systems consistent with EPA guidance (EPA 1989). Section 6.11.5 (and related sections) will be revised accordingly.

106. Tables 6-1 and 6-2. The tissue concentrations and tissue ingestion rates in Tables 6-1 and 6-2 need to be specified as to whether they are ww (wet-weight) or dw (dry-weight) basis.

Response: Tables 6-1 and 6-2 will be revised.

107. Tables 6-1 and 6-2, footnote 3. It should be noted that a functional beef depuration period following removal from montane pasture is normal (i.e., a combination of non-seleniferous lowland pasture and feedlot), and that the steers included in the study were artificially penned in on seleniferous vegetation during the duration of montane exposure.

Response: Footnote 3 to Tables 6-1 and 6-2 will be revised to note that the steers were artificially penned on a seleniferous pasture. It should be noted that the IDEQ has no definitive evidence regarding area livestock grazing practices. While cattle are not typically penned on waste rock piles, the reclaimed areas present the most palatable forage in the Resource Area and would appear to attract free ranging animals. Further information is required in order to conclude this study represents a "worst case" scenario.

108. Tables 6-1 and 6-2, footnote 4. Other locations in the report refer to "golden sage," not "silver sage." If "infusion" means tea, what does "transfer of metals from dry tea into the infusion" mean? What is an infusion made from tea? Why is it assumed that native materials from which tea is made are "not as strong as commercially prepared teas"? From what we've observed, the quantity of plant material in native herbal tea bags, for example, peppermint, is comparable to that found in, for example, tea bags containing Earl Grey. Furthermore, sagebrush tends to contain considerable amounts of natural toxins. On this basis, one might argue that less material is used to brew native teas.

Response: The AWHHRA will be revised to consistently refer to sage – the specific species used by members of the Shoshone-Bannock nation are not known. Footnote 4 will be revised to refer to "transfer of metals from dry tea into water." The assumption that native plant material is not as strong as commercially prepared teas has been dropped. Therefore, it was assumed that the same amount of native plant material as commercially prepared tea is required to prepare the infusion.

109. Tables 6-1 and 6-2, footnote 9. In their risk assessment, the IMA is using a beef ingestion rate distribution of LN(0.063, 0.112) kg/d and a body weight distribution of LN(72, 14.0) kg that are moderately and positively correlated with one another (i.e., r = 0.71). These are for adults. The 95th percentile of the ingestion rate divided by the body weight is 2.5 g/(kg•d), and the mean is 0.77 g/(kg•d). Compare these to IDEQ's RME estimates of 2.3 for non-Natives and 2.8 for Natives, and CTE estimates of 0.83 for non-Natives and 1.0 for Natives.

Response: Comment noted.

110. Tables 6-1 and 6-2, footnote 11. Why are the beef and game ingestion rates in g/(kg•d) while the fish ingestion rate is in g/d? The latter units are consistent with the general equation provided that include body weight.

Response: The medium-specific units are consistent with the source of the data. Also, the medium-specific units are consistent with the exposure pathway-specific equations presented in the correct Figure 4, which will be added to the AWHHRA.

111. Tables 6-1 and 6-2, footnote 16. The assumption of an FI of 1.0 is not supported in the document and, especially for the CTE estimates, is excessively conservative. More realistic FIs, as that developed by the SeWG for cattle ingestion, would likely be far lower for most scenarios.

Response: Footnote 16 clearly states that a FI of 1.0 was used unless otherwise noted. Tables 6-1 and 6-2 present a variety of exposure pathway-specific FI values less than 1.0.

112. Tables 6-1 and 6-2, footnote 20. What is the basis for assuming that the hypothetical subsistence lifestyle receptor will: (1) hunt closer to home, and (2) will have twice as great a chance of encountering seleniferous elk? The value of 29% applies to the entire study area. Is the hypothetical receptor living in only a portion of the study area? If so, what is the basis for that assumption and what statistics are used to say that frequencies differ in different areas?

Response: Tables 6-1 and 6-2 will be revised to present a FI value of 0.29 for the subsistence lifestyle receptor.

113. Table 6-3 and Table 6-5 are inconsistent on fish collection information. See comparison below:

Comparison of Table 6-3 and 6-5 Fish (Trout) Collection Information		
	Table 6-3	Table 6-5
Background		
Sage Creek	1*	1
Spring Creek		2 (+5 sculpin)
Kendall Creek		1
Impacted		
Lower Sage Creek		3
Spring Creek	4	2 (+5 dace and 12 sculpin)
East Mill Creek	1	2
Kendall Creek	1	

Which table is correct? (Note: * may denote the potentially impacted portion of Sage Creek instead of the background portion; it is unclear from Table 6-3.)

Response: Table 6-3 presents the number of fish tissue samples analyzed and Table 6-5 presents the actual number of fish that were collected. Some of the analytical samples were composited from more than one fish; therefore, the number of samples analyzed may not be representative of the number of samples collected. Footnotes will be added to both tables for clarification.

114. Table 6-6. Surface water results should be reported in mg/L.

Response: Corrected.

115. Table 6-9. Are results reported in dry weight or wet weight?

Response: The results are reported in dry weight. After the statistics were performed, the calculated EPC was converted to wet weight based on the average percent moisture reported for the tissue samples. Table 6-9 and similar tables will be revised to make this clear.

116. Table 6-9. Why use a Sage Creek sample as part of the impacted Blackfoot River watershed? This value is neither reach-specific nor watershed-specific.

Response: As noted in Table 6-9, samples from Sage Creek were not used to estimate Blackfoot River watershed fish tissue EPCs.

117. Table 6-9. For each of the tributaries (except East Mill Creek) in the upper Blackfoot watershed (Blackfoot River, Dry Valley Creek, Maybe Creek, State Land Creek), reach-specific analytical results are a combination of samples collected from East Mill Creek, Lower Sage Creek, and Spring Creek. In 1999 and 2000, MWH collected fish from the Blackfoot River, Angus Creek, East Mill Creek, Spring Creek, and unimpacted stations. This data would be more appropriate for reach-specific analytical data than combining data from different reaches and calling it reach-specific.

Response: Samples were assigned to specific reaches based on their locations. Samples identified as associated with a particular reach were assigned to that reach because they are located in that reach. The portion of the comment regarding MW's 1999 and 2000 fish tissue data is noted.

118. Tables 6-9, 6-10, 6-11, 6-12, 6-13, 6-14, 6-17, 6-18, 6-19, and 6-20. Incorrect symbol for micrograms.

Response: The AWHHRA will be revised to consistently use the symbol "µ" to represent micrograms.

119. Table 6-13. For the Georgetown watershed fish EPCs, the sample results come from East Mill Creek, Lower Sage Creek, and Spring Creek. None of these are in the Georgetown watershed. This should not be called "reach-specific analytical data", and is not even watershed-specific.

Response: Table 6-13 will be revised to indicate that (1) analytical data outside of the Georgetown watershed were used as surrogate data to represent the Georgetown watershed, and (2) this surrogate data was weighted using Georgetown watershed-specific impacted and unimpacted reaches. Because the surrogate data was weighted using watershed-specific information, the EPCs may still be considered watershed-specific.

120. Table 6-17, note 1. Remove the reference to Appendix H if it is truly only for 2001 results since all of the results referred to are from 1998. Why was data not used from the 1999-2000 Regional Investigation?

Response: The reference to Appendix H will be removed and replaced with a reference to MW (1999). With regard to the results from the 1999-2000 Regional Investigation, see the response to Specific Comment 95.

121. Table 6-17, note 5. There are no sample numbers listed after Spring Creek.

Response: Spring Creek-specific sample numbers have been added to Table 6-17.

122. Table 6-18. Fix note 1. Note 5, change RMA to IMA. This table is not referenced anywhere in the document.

Response: Note 1 will be revised to present the full reference. RMA will be changed to IMA in note 5. The AWHHRA will be revised to reference Table 6-18.

123. Table 6-20, note 1. Change RMA to IMA.

Response: Note 1 will be revised to change RMA to IMA.

124. Table 6-30. The lack of variability in the fish quality data should be evaluated. All three watersheds have identical Cd and Se concentrations for background, and the Salt watershed's WAC is apparently identical to the three background values. The 95 UCLs for background are not reported, but should be.

Response: In order to provide a more comprehensive data set, the background fish tissue values from all three watersheds were combined and used to represent background for all three watersheds. The Salt watershed's AWAC is very similar to but different from the unimpacted values. The similarity is because the majority of the Salt watershed is unimpacted. Therefore, the

weight of fish tissue concentrations from the impacted portion of Salt Creek receives very little weight. The UCL_{95} values for unimpacted samples will be added to Table 6-30.

Section 7.0 – Area Wide Ecological Risk Assessment

125. General comments. As discussed in "IMASC Comments on 'Draft Area Wide HHERA Work Plan,'" the targeted field and laboratory studies for birds and cutthroat is highly relevant site-specific information that would only serve to decrease the uncertainties of this risk assessment. IDEQ's response to comments suggests that the results of these studies will be included when the studies are completed and the results become available. The bird study and population study are both completed; however, their results are not incorporated into this AWERA. The fish study in on-going, but data is available that could be incorporated into this AWERA to provide very relevant site-specific information. Please consider incorporating this information into your analysis.

Response: The Agency did agree to discuss these results once published. However, requests by the Agency to incorporate unpublished data into the AWERA were denied by the researchers. Therefore, the Agency cannot include this as site-specific information. Furthermore, the Agency has some concern in applying this information to the Area Wide assessment in a meaningful manner. While we are in general agreement with the conclusions of these studies regarding the absence of population-level effects for the species subject to research. A single-species feeding trial is not sufficient to replace the existing regulatory criteria for cold water biota. In this case a waiver for exceeding the criteria would be required or a change in the federal regulations would be needed. Additional work may also be required to determine how the information from the study of robins and blackbirds can be applied to waterfowl, which are known to be more sensitive. Further evaluation will be necessary upon receipt of all the published documents.

126. General comments. Description of Tiers I, II, and III of the AWERA provided in Section 5.0, p.18 seem inconsistent with the description of Tiers I, II and III of the AWERA provided in Section 7.1, p. 93. Please correct the discrepancies.

	Section 5.0 description p. 18	**Section 7.1 description** p. 93
Tier I	The results of analysis of the waste rock were compared with data on the naturally occurring levels found in background soils in the western United States. If the maximum concentration detected in waste rock was less than 2 times the mean background level for the western U.S., the chemical was considered for elimination as a COPC or COPEC. Data for sediment, surface water, and soil were evaluated for chemicals present at background levels in the waste rock. If the concentrations were not elevated in the other media, the chemical was eliminated from consideration.	In this step, the highest observed concentration for each medium and chemical and the most conservative exposure parameters (see Table 7-4) will be used to calculate an HQ for each target species and COPEC. Any chemicals that do not present a potential risk using this worst-case scenario can then be safely removed from further consideration on a receptor-specific basis.
	Section 5.0 description p. 18	**Section 7.1 description** p. 93
Tier II	The concentrations of the chemicals that passed the Tier 1 screening were evaluated for riparian soils, surface water, and sediment against area-specific background	In the second tier, chemicals and receptors that were not eliminated in Tier 1 will be evaluated on an area-wide basis using area-weighted EPC for each medium and mean

	concentrations. If the maximum detected concentration for the medium was less than 2 times the mean area-specific background level for the chemical, it was eliminated from consideration as a COPC or COPEC for that media. All chemicals retained after this comparison were evaluated on a media specific basis in Tier 3.	exposure parameters for each receptor intended to represent average population-level exposures. IDEQ chose to use a targeted sampling approach to support development of area-weighted exposure points. HQs were developed based on NOAEL benchmarks as referenced in Table 7-6. The HQs derived from these data sets provide sufficient information to place the calculated risks in an appropriate context to represent the average risk in the Resource Area.
Tier III	The maximum detected concentrations of chemicals for each medium that remained after the Tier 2 screening were compared with media-specific benchmarks. The Tier 3 screening was conducted separately for COPCs for human health and COPECS for ecological receptors.	The third tier provided additional assessments to analyze the uncertainties of various parameter values used in the risk assessment calculations. This included running separate calculations based on the mean concentrations of COPEC from historical data and assessing uncertainties in the exposure parameters to evaluate their effects on the HQ values calculated in Tier 2. The results of the risk characterization were also analyzed in terms of other lines of evidence.
Tier IV	After all media were screened, a full evaluation was conducted of the information on each chemical based on the results of the medium-specific screening. The individual data sets were evaluated to identify any additional information that would provide an additional weight of evidence for retaining or rejecting a chemical as a human health COPC or COPEC. Based on this evaluation, a COPC or COPEC was selected or rejected for the area-wide risk assessment.	

Response: Section 5.0 discusses the procedures for identification of COPECs, while Section 7.1 describes the process whereby exposure point concentrations were determined along with the AWERA process. Figure 6 will be included to illustrate the AWERA process from selection of COPECs through selection of EPCs to the ERA steps.

127. Section 7.1, p. 93. Please explain the rationale for use of only the 2001 data set in Tiers I and II, but use of all historical data in Tier III. By only using data collected from one sampling season in 2001 the assessment under-represents the variability of the available data set. The decreased data set is not representative of natural variability. The use of only 2001 data is producing unrealistic conditions not representative of actual conditions.

Response: The rationale for using the 2001 data set is provided in the response to General Comment 4. The purpose of the historical data set in Tier 3 was to represent temporal variability for the constituents available. While background conditions remained relatively stable in all data

sets, impacted areas were of higher concentrations in 1998 during a more normal water year and Tier 3 represented the risk levels that could be expected under average precipitation conditions. The watershed average EPCs were also adjusted to represent these conditions by utilizing the impacted stream segment lengths from the 1998 activities.

128. Section 7.1.1, p. 93. Table 7-4 is reference before tables 7-1, 7-2, and 7-3. Also Table 7-6 is reference on p. 94 before mention of Table 7-5. Consider re-numbering the tables in the order referenced in the text.

Response: See response to General Comment 3.

129. Section 7.1.2, p. 93, Paragraph 1, 1st sentence. Text states that the area wide ecological risk assessment (AWERA) Tier 2 was intended to represent "…average population-level exposures." It should be clarified that the AWERA Tier 2 assessment does not represent a *true* 'population-level' assessment, as other factors critical to a population-level evaluation such as fecundity, natural stressors, and recruitment of individuals from other populations were not considered. Please note that Dr. Oz Garten of the University of Idaho has conducted population-level studies of the Resource Area. In addition, it should be noted that the Tier 2 assessment was conducted using toxicity reference values (TRVs) based on the lowest no-observed-adverse-effect-level (NOAEL). The lowest NOAEL-based TRV tends to be more protective of *individuals* rather than populations (USEPA, 1997).

Response: The ERA was conducted in the basic format as guided by EPA, and the resultant risk assessment only provides data that can be used to infer the risk to the receptors on a population level. The statement will be corrected in the revised AWERA. The study by Dr. Garten was not used because it was not available for evaluation prior to preparation of the risk assessment.

130. Section 7.2, p. 95. Under the Surface Water heading, National Ambient Water Quality Criteria is listed as the source of screening values in Table 7-1; however, Table 7-1 lists NOAA SQuiRT tables as the source. The primary reference for screening values should be cited, as errors may occur in secondary references.

Response: IDEQ agrees. The appropriate change will be made to the revised AWERA.

131. Section 7.2, p. 95. Identification and Prioritization of Chemicals of Potential Ecological Concern. Text states, "Average and single point concentrations that are more than two times the calculated background average were considered impacted and were evaluated in the risk assessment process." Please provide the source or rationale for the 'two times' background screening criterion.

Response: The approach is based on the EPA Region 4 guidance to address background comparisons. The FS has in some cases used three times background. IDEQ decided to use two times background as a conservative approach. No changes are required for the revised AWERA.

132. Section 7.2, p. 96, soils bullets. Only three sources are listed as providing soil screening criteria, however Table 7-1 also lists 5 additional sources of soil screening criteria. Consider listing all sources from Table 7-1 in this section of the text.

Response: Only two sources were used. First, the EPA Region 4 soil screening levels is based on a number of studies, which are included in Table 7-1, but are considered as one database and therefore referred to singularly in the text. The second source is based on the ecological soil

screening levels (ECO-SSL). The soil screening levels for cobalt and copper are also related to the ECO-SSLs as indicated by the reference (see footnote 12 of Table 7-1). No changes are required for the revised AWERA.

133. Section 7.5.1.2, p. 108, 1st paragraph, 4th sentence. The sentence is incomplete as it currently reads. "There is some data on the toxicity of selenium for benthic invertebrates, and the toxic effects that occur selenium-contaminated invertebrates are directly consumed are important."

Response: The appropriate change will be made to the revised AWERA to correct the incomplete sentence.

134. Section 7.5.1.2, p. 108. As discussed in "IMASC Comments on 'Draft Area Wide HHERA Work Plan'", p. 28, please support with the appropriate reference(s) the statement, "… selenium exposure in the diet and drinking water of raptors is associated with reproductive abnormalities, congenital malformations, selective bioaccumulation, and growth retardation."

Response: The statement as presented in the text references Eisler (1985) as the source of the statement. No changes are required for the revised AWERA.

135. Section 7.5.2, p. 114. Please provide rationale for selection of surrogate species in the AWERA. It is unclear why some species were chosen to represent other species. In particular, it is unclear why the rainbow trout was chosen as a surrogate species for the large-spotted Snake River cutthroat trout. The Selenium Working Group sponsored a multi-year toxicity study in native cutthroat trout harvested from the Upper Blackfoot River. The selection of rainbow trout as a means of evaluating potential impacts to native cutthroat trout rather than using site-specific data is unclear.

Response: Surrogate species are selected based on the availability of accepted and peer-reviewed toxicological reference information. The rainbow trout has been subject a number of toxicological studies and has published reference handbook information, and therefore serves as a good surrogate for trout species and other salmonids. As indicated earlier, the referenced study has not been published for use, nor peer-reviewed. Nevertheless, the Agency was not aware that the intent of this study was to produce verifiable Toxicity Reference Values (TRV) for use in the scientific community.

136. Section 7.6, p. 116. It is not currently possible to recreate the exposure dose and risk calculation for aquatic/riparian or terrestrial receptors based on the following deficiencies:

- The basis of tissue concentration in food items other than plants is not stated.
- The source of the data used to derive tissue concentrations in prey items is not presented.
- It may be inferred that exposure doses to aquatic/riparian and terrestrial receptors are estimated based the results of site-specific tissue sampling data; however, this information is not presented anywhere in the AWERA. Furthermore, if tissue concentrations are based on site-specific tissue data it is not described whether those concentrations represent maximum, mean, or upper bound concentrations measured in samples of site-specific biota.

Response: This information is presented in Appendix C. Section 7.6 will be revised to reference Appendix C.

137. Section 7.6, p. 116, SUF. Home ranges were provided in Table 7-5, however this information was not incorporated into the AWERA because the site utility factor was arbitrarily set equal to 1.0. One can presume a SUF of 1.0 was used because the area of any watershed is greater than any receptors home range. However, this was not clearly presented or explained in the AWERA.

Response: The statement is referred to in the text in the definition to the site use factor (SUF) for the generic dose equation presented in Section 7.6.1. No changes are required for the revised AWERA.

138. Section 7.6, p. 116. TTC – The trophic transfer coefficient used in the dose calculations for each receptor in Tiers I, II, and III is arbitrarily set to 1.0. The use of a TTC of 1.0 is overly conservative and not representative of actual transfer coefficients at the site. Use of data collected by IMA could be used to calculate site-specific transfer coefficients that would more accurately represent conditions at the site.

Response: Actual data was available to calculate a transfer coefficient and was included in each dose equation for each receptor. The use of the biotransfer factor (BTF) in place of the trophic transfer coefficient (TTC) will be explained in the revised AWERA.

139. Section 7.6.1, p. 116. As discussed in "IMASC Comments on 'Draft Area Wide HHERA Work Plan,'" p. 15, the comparison of the size of a typical waste rock dump to the size of a typical foraging range for most carnivores explains why impacts to carnivores are virtually impossible. IDEQ's response indicates the use of a SUF as an input parameter to be considered in the model. However, the AWERA uses a SUF arbitrarily set equal to 1.0 for all receptors evaluated. The arbitrary determination of 1.0 does not incorporate the variability of foraging range between receptors.

Response: The area for which risk was calculated for each receptor is greater than any of the receptors' home ranges. Also, see response to Specific Comment 137 above. The discussion on the SUF in the "Uncertainty" Section 7.10.2.1 will be expanded in the revised AWERA.

140. Section 7.6.1.11, p. 128. The equation to model dose to the mink uses parameters to model both sediment and soil ingestion. Based on Tables 7-4 and 7-5 the soil/sediment ingestion rate is 9.4% of the food ingestion rate. The effect of modeling exposure to both soil and sediment at a rate of 9.4% is doubling the exposure by incidental ingestion to a rate of 18.8%. If modeling both soil and sediment exposure the ingestion rate of 9.4% should be partitioned between the two media.

Response: IDEQ agrees and the corrections will be made in the revised AWERA.

141. Section 7.6.1.11, p. 128, equation for mink dose. Equation is missing a "+" sign.

Response: The appropriate change will be made to the revised AWERA.

142. Section 7.6.2, p. 131. Section 7.6.2 describes the calculation of bio transfer factors (BTFs) for sediment to aquatic plants, riparian soil to riparian plants, and terrestrial soil to terrestrial plants, however no explanation is given in Section 7.0 as to how the calculated BTFs are incorporated into the dose calculations. The last sentence in this section (p. 132) states, "A trophic transfer coefficient of 1 was used because site-specific tissue data are being used." Why does use of site-specific BTFs confer the use of a TTC of 1.0? Please explain the relationship between these parameters and the rationale of using a TTC of 1.0. Also please demonstrate how the BTFs are

incorporated into the dose calculations. It is currently not apparent how these values are being used.

Response: Actual data was available to calculate a transfer coefficient and was included in each dose equation for each receptor. The use of the BTF in place of the TTC will be shown in the revised AWERA.

143. Section 7.6.2, p. 131, Paragraph 2. Text states that soil-to-invertebrate biotransfer factors (BTFs) could not be calculated because of difficulties in collecting soil invertebrate samples. However, an explanation is not provided regarding the methods that were used to derive soil invertebrate exposure point concentrations (EPCs) for evaluation of dietary exposures to receptors such as the American robin. Were these based on site-specific soil invertebrate data, or literature-derived BTFs? Please provide appropriate methods and/or literature references for estimating terrestrial invertebrate EPCs.

Response: The actual tissue data from the terrestrial invertebrate samples was used to calculate an EPC for invertebrate ingestion (see Appendix C). No changes are required for the revised AWERA.

144. Section 7.6.3, p. 132, 2nd paragraph, 3rd sentence. "UV" should be "UF."

Response: The appropriate change will be made to the revised AWERA.

145. Section 7.6.3, p. 132, Paragraph 2, last sentence. The statement, "UFs were not applied to any of the TRVs used in this assessment" is inconsistent with Footnotes 2, 3 and 6 in Table 7-6, which indicates that UFs were applied to specific TRVs.

Response: Uncertainty factors (UF) were applied to the original derivation of the TRVs. However, no new TRVs were developed for this project and, therefore no UFs were applied that are specific to this assessment. This fact will be clarified in the revised AWERA.

146. Section 7.6.4, p. 133, Paragraph 2, 2nd sentence. Text states that allometric conversion of ecological TRVs was performed according to the methods of Sample and Arenal (1999). Please note that in Sample and Arenal (1999) the percentage of chemicals with scaling factors *not* significantly different from 0.75 was approximately 68% for birds and 64% for mammals. Thus, the statistical basis for the scaling factors of 1.2 and 0.94 proposed for birds and mammals, respectively, in Sample and Arenal (1999) is not well supported. In addition, the authors state that the scaling factors presented in this reference are most appropriately applied to *acute* toxicity data. The authors further note that because ecological risk assessments rely primarily on chronic data, allometric scaling factors for chronic data need to be developed to reduce the uncertainty associated with the application of acute scaling factors to chronic data. Please provide appropriate rationale for using the indicated allometric scaling factors.

Response: Use of the scaling factor by Sample and Arenal (1999) is well founded and accepted in conducting ERAs. No scaling factors based on chronic values are available at this time and development of such was not a mandate of this project. No changes are required for the revised AWERA.

147. Section 7.7, p. 134, Paragraph 3, 1st sentence. Text states that estimated daily doses for higher trophic level receptors were compared to 'low' TRVs. Please explain the reference to 'low' TRVs; this suggests that there is more than one set of TRVs.

Response: Only a single TRV was used for each chemical and receptor for this project. The language will be clarified in the revised AWERA.

148. Sections 7.7.1 through 7.7.8, p. 134. These sections summarize Tier 1 screening results for all chemicals with HQ > 1. However, there is no mention of chemicals with HQ < 1 or chemicals eliminated from consideration as COPECs. One of the purposes of the screening ERA is to identify chemicals, receptors, exposure pathways and locations that may be eliminated from further consideration, in order to focus subsequent phases of the ERA. For completeness, please identify all chemicals that were eliminated as COPECs based on the Tier 1 assessment, as well as any receptors or exposure pathways for which HQ estimates are less than 1.

Response: Section 5.0 does, in part, mention those chemicals eliminated as COPECs. A description of the process along with a listing of COPECs retained or eliminated will be presented in a revised Figure 5.

It is unclear why aquatic receptors were not evaluated in the Tier 1 assessment. Please explain why these receptors were not evaluated until the Tier 3 assessment.

Response: Tier 1 was designed only to screen the respective media for COPECs. No changes are required for the revised AWERA.

149. Section 7.8.1-8, p. 139-142. Sections 7.8.1-7 describe the comparison of modeled HQ concentrations from impacted areas to background HQ concentrations as "The maximum **ratio** of impacted divided by background HQ for [guild] was…" Section 7.8.8 describes the comparison as "COPECs and receptors were selected based upon a 0.5, or more, difference between the background HQ and at least one of the watershed HQs." The two don't seem to be consistent. Is the criterion:

$$\frac{HQ_{impacted}}{HQ_{background}} > 0.5 \quad \text{or} \quad HQ_{impatcted} - HQ_{background} > 0.5?$$

What is the basis for such a screening criterion?

Response: The equation should be $HQ_{impacted} > 0.5\ HQ_{background}$. Use of 0.5 is based on best professional judgment based on what IDEQ believes is a conservative value to differentiate impacts beyond background concentrations. The text will be clarified in the revised AWERA.

150. Section 7.8.8, p. 142, Paragraph 1, 1st sentence. The word 'media' should be changed to 'medium.'

Response: The appropriate change will be made to the revised AWERA.

151. Section 7.8.8, p. 142, 2nd paragraph, 2nd sentence. The sentence refers to "the following table," however since tables are not incorporated into the text it might be more appropriate to reference them by their respective table number designations.

Response: The table referred to is Table 7-22. The appropriate changes will be made to the revised AWERA.

152. Section 7.8.8, p. 142, 2nd paragraph, 3rd sentence. Text states, "HQs greater than 1.0 for the COPECs and receptors shown on Table 7-22 are likely associated with some increased level of risk due to mining related activities in the watershed. Please note that, with two exceptions, HQs

presented in Table 7-22 for aquatic/riparian and terrestrial receptors evaluated for the *background* area were also greater than 1.0. Does this imply that background areas are also associated with increased risk due to mining activities? Please revise this statement.

Response: HQs for the background area were generally greater than 1, but the HQs for the corresponding chemicals were always higher than for the background area. The difference between the two indicates a level of risk attributable to the mining area. No changes are required for the revised AWHHERA.

153. Section 7.8.8, p. 142, Paragraph 2, 4th sentence. Text states, "COPECs and receptors were selected based upon a 0.5, or more, difference between the background HQ and at least one of the watershed HQs." Please provide the source of this selection criterion.

Response: See response to Specific Comment 149.

154. Section 7.9, p. 143, 2nd paragraph. This paragraph described the Tier I and II analyses as only addressing terrestrial mammals and birds, however many of the assessment endpoints and associated receptors are listed as applicable to the aquatic/riparian ecosystem. Specifically, benthic invertebrates are listed in Table 7-2 as being assessed through other communities and guilds. Furthermore, this issue was discussed in "IMASC Comments on 'Draft Area Wide HHERA Work Plan'" where IDEQ responded that "Potential exposures and impacts to aquatic/riparian species are evaluated through food chain/ingestion modeling and will be supplemented with historic data, where needed." (p. 25).

Response: The Tier 1 and 2 assessments also apply to aquatic and riparian receptors. The text will be corrected and clarified in the revised AWERA.

155. Section 7.9, p. 143, 2nd paragraph. The other approach listed to evaluate potential risks to aquatic receptors is comparison to media-specific benchmarks for surface water and sediment and comparison of fish tissue concentrations to literature reported tissue concentrations at which effects have been documented. This approach seems very general and overly simplified. How is this approach different than the COPEC selection screening against benchmark concentrations presented in Table 7-1?

Response: Screening against the respective benchmarks is the same. However, additional screening was done in Tier 3. The text will be corrected and clarified in the revised AWERA.

156. Section 7.9, p. 143, 2nd paragraph, 3rd sentence. The statement regarding terrestrial receptors is not consistent with the remainder of the paragraph's discussion of evaluation of aquatic receptors. Should the word "terrestrial" in this sentence be "aquatic"?

Response: Reference is made to the higher aquatic/riparian and terrestrial trophic levels. The appropriate changes will be made to the revised AWERA.

157. Section 7.9.1, p. 143. Comparison to Historic Data Concentrations. The basis and conclusions of the Tier 3 assessment for aquatic/riparian and terrestrial receptors are flawed. The Tier 3 assessment for aquatic/riparian and terrestrial receptors was conducted using soil, sediment and biota concentrations collected in 2001, and surface water concentrations collected in 1998. This assessment was based on the premise that "…the dose contributed by surface water is a minor portion of the dose for most receptors." While *ingestion* of surface water may be a minor contributor to the total dose for most receptors, the overly simplified sensitivity analysis failed to

recognize that COPEC concentrations in dietary items (e.g., forage and prey) of aquatic/riparian receptors are influenced by *surface water* concentrations. In fact, tissue-sampling data collected by IMA in 1999 and 2000, and available to TtEMI, demonstrate that selenium concentrations in aquatic biota are more highly correlated with surface water concentrations than with concentrations in any other media. Hence, fluctuations in surface water concentration are a major determinate of dietary concentrations and doses in aquatic/riparian receptors. Because aquatic/riparian receptors constitute the majority of receptors evaluated in the Tier 3 assessment for selenium, and all of the receptors evaluated in the Tier 3 assessment for cadmium, the conclusion that there is "…little difference in potential risk in 1998 and 2000…" is unsupported. The Tier 3 assessment for aquatic/riparian receptors should be eliminated from the AWERA, or conducted using abiotic and biotic media from the same year(s).

Response: A sensitivity analysis of the dose equations indicates that ingestion of water does not contribute significantly to the exposure dose for aquatic and riparian receptors. The existing data is not sufficient to support the conclusion that surface water concentrations of selenium are highly correlated with tissue concentrations in aquatic biota. In fact, the literature indicates that most of the effects from selenium are more likely due to concentrations in sediments and not in surface water (EPA 1998b). No changes will be made to the revised AWERA.

158. Section 7.9.2.5, p. 147, 1st Paragraph. Text states that the maximum concentration of selenium in surface water is 1.5 orders of magnitude higher than the average concentration in background surface water. The maximum surface water concentration is *3* orders of magnitude higher than the average background concentration.

Response: The appropriate change will be made to the revised AWERA.

159. Section 7.9.2.5, p. 147, 2nd Paragraph. Selenium concentrations in surface water were compared to the current surface water-based national ambient water quality criterion (NAWQC) for freshwater of 5 μg/L. The current surface water-based criterion for selenium is based primarily upon impacts to warm water fish, including bluegill. This is inconsistent with the selection of rainbow trout as a surrogate for the large-spotted Snake River cutthroat trout (as presented in Table 7-2), and is also inconsistent with the comparison of tissue selenium concentrations to tissue-based benchmarks for rainbow trout (as presented in Table 7-25).

*Response: The NAWQC of 5.0 micrograms per liter (*μg/L*) must be used since it is a federally mandated water quality criterion. No changes are required for the revised AWERA.*

160. Section 7.9.3, p. 149, 1st paragraph. The second sentence states that fish tissue concentrations collected from impacted and background areas were compared to "…the lowest reported levels at which effects have been noted in trout." However, all tissue benchmarks are apparently based on no-observed-effect-levels (NOELs), as reported in footnotes to Table 7-25. Please reconcile this inconsistency.

Response: The text will be revised to clarify the comparisons.

161. Section 7.9.3, p. 149, last sentence. Tables referenced should be "Tables 7-23 through 7-25," not "Tables 7-23 through 2-25."

Response: See response to General Comment 3.

162. Section 7.10.1, p. 149. The 1st paragraph and Table 7-25 correctly depict that all exposure parameters that were used in the Tier 1 assessment *overestimate* risk. However, this fact is inconsistent with the last sentence of Paragraph 1 of the AWERA conclusions (p. 155), which states that the extremely high Tier 1 HQs for some receptors indicate that there is a "…high probability of significant risk to terrestrial receptors occurring in some localized areas." How can a screening level assessment that grossly overestimates risks, as evidenced by corresponding background risks, be used to make broad generalizations about *probable* impacts to terrestrial receptors?

Response: The correct reference should be to Table 7-26 and the text will be corrected in the revised AWERA. Because there were some very high HQs for chemicals in the mining impacted area, the fact that some localized risk may be occurring cannot be ignored. No changes are required for the revised AWERA.

163. Section 7.10.2.1, p. 152. Sentence 2 under the heading "Prey Species Variation in COPEC Uptake" is incomplete. "As stated above, uncertainty associated with combining tissue from multiple **[word missing]** is related to the potential for differential uptake of COPECs based on taxonomic differences between species."

Response: See response to General Comment 3.

164. Section 7.10.2.2, p. 153. Sentence 5 under the heading "Exposure Conditions of Literature Derived Toxicity Reference Values" contains a typo. "Although then…" should be "Although the…"

Response: See response to General Comment 3.

165. Section 7.11.1, p. 155, 4th paragraph. Conclusions regarding the Tier 3 assessment for aquatic/riparian and terrestrial receptors are flawed, as described in Comment #158 above. In addition, the statement, "…other media serve as a sink for the various COPECs that move with the surface water" is an oversimplification. While this is probably true for sediment concentration of COPECs such as selenium, tissue-sampling data collected by IMA indicate that aquatic biota concentrations change from year-to-year and between seasons. Furthermore, it is likely that tissue depuration occurs between times of higher exposures and lower exposures, particularly, in migratory species including waterfowl and cutthroat trout.

Response: There is no Section 7.11.1. IDEQ does agree that there are temporal changes that are species-specific that do indeed affect tissue concentrations of the various receptors. These interactions are highly complicated and cannot be defined in this study. IDEQ does agree that depuration, as stated above, does occur as indicated and may affect the concentrations in the prey. However, other factors such as use during breeding seasons may be as important or more important than depuration. Therefore, IDEQ has determined that the assumptions made are conservative and appropriate. No changes will be made to the AWERA.

166. Section 7.11.1, p. 156, 5th paragraph. The last sentence concludes, "…the potential risk to aquatic receptors can not be ruled out." Unsupported generalizations such as this provide no meaningful information to risk managers regarding the potential nature or locations of any impacts, receptors at potential risk, or chemicals that may be attributable. Does this statement apply to copper, cadmium and selenium which exceeded their respective surface water benchmarks; or cadmium, chromium, copper, nickel, selenium and zinc in sediments which exceeded sediment benchmarks? If so, this information should be clearly communicated in concise terms so that risk managers can formulate decisions regarding potential future actions that may be warranted based on the results of the risk assessment.

Response: There is no Section 7.11.1. Based on the Tier 3 analysis, all of the contaminants except nickel and vanadium were a risk to the aquatic/riparian, omnivorous birds (red-winged blackbird)(see Table G-6, Appendix G). For the aquatic/riparian, herbivorous birds (song sparrow), all contaminants except nickel and vanadium also posed a risk in all three watersheds. All contaminants posed a risk to the aquatic/riparian, herbivorous mammals (meadow vole) except for chromium and copper. Selenium was the only contaminant that appeared to impact the piscivorous bird guild (great blue heron) in all three watersheds. Selenium also was the only contaminant that posed risk to the aquatic/riparian, benthic-feeding birds (mallard) in the Blackfoot and Georgetown watersheds, but not in the Salt watershed. Nickel, selenium, and vanadium posed a risk to the aquatic/riparian, carnivorous mammals (mink) in all three watersheds. Cadmium also posed a risk to the mink in the Blackfoot and Georgetown watersheds. The same contaminants also were found to affect the aquatic/riparian, omnivorous mammals (raccoon). Only cadmium and selenium posed a risk to the terrestrial, herbivorous birds (represented by the northern bobwhite) in all three watersheds (see Table G-68, Appendix G). Nickel posed a risk to the terrestrial, herbivorous mammals (cottontail rabbit) in all three watersheds, while selenium only posed a risk in the Blackfoot watershed. For the terrestrial, omnivorous birds (American Robin), all contaminants posed a risk in all three watersheds except for nickel and vanadium. For the terrestrial, omnivorous mammals (deer mouse), all contaminants posed a risk in all three watersheds except for chromium and copper. Based on the Tier 3 analysis, there does not appear to be any impact to the terrestrial, carnivore guild (coyote) and the raptors (northern harrier). The primary substance of the study is that there are some potential risks, but the data is not sufficient to be definitive. Additional information will be added to the revised AWERA.

167. Section 7.11, p. 156. Sentence states "The Tier 1, 2, and 3 analyses only evaluated exposure to terrestrial receptors. Data concerning effects on aquatic receptors is less well developed and has a higher level of uncertainty…" However, Tables 7-2 and 7-3, and Section 7.5.1.2 outline assessment endpoints and associated receptors to evaluate aquatic and riparian ecosystems. Therefore, it would appear that the aquatic and riparian ecosystems were also evaluated in this risk assessment and the statement to the contrary on p. 156 is erroneous.

Response: The appropriate change will be made to the revised AWERA.

168. Table 7-3, p. 8, assessment endpoint. "Protection of aquatic riparian omnivorous…" should be "Protection of aquatic riparian, omnivorous…"

Response: The appropriate change will be made to the revised AWERA.

169. Table 7-4, p. 1, body weight. The units of grams per kilogram are confusing. Suggest giving body weight in either grams or kilograms, not both.

Response: The appropriate change will be made to the revised AWERA.

170. Table 7-4, p. 4, calculation of food ingestion rate. Please provide the rationale for using different body weights than those presented in Tables 7-4 or 7-5 for the calculation of food ingestion rates. Also please provide the appropriate references for these values.

Response: The body weights cited with the formula for the ingestion rate are correct; the actual body weights at the top of Table 7-4 were unchanged. The appropriate references will be included in the revised AWERA.

171. Table 7-4, p. 7, and Table 7-5, p. 7, home range for American robin. The value listed is based on mean *territory size*, however literature values do provide *home ranges* for this species. Zeiner et al. gives 124.1 acres as the mean home range for this species, which is over 314 times higher than the territory size used in the AWERA.

Response: IDEQ has checked the cited reference and does not find the above referenced information. No changes will be made to the revised AWERA.

172. Table 7-4, p. 7, and Table 7-5, p. 8, home range for Red-winged blackbird. The value listed is based on mean territory size, however literature values do provide home ranges for this species. Zeiner et al. gives 794,530 acres as the conservative home range for this species in California, which is over 1608 times higher than the territory size used in the AWERA.

Response: IDEQ has checked the cited reference and does not find the above-referenced information. No changes will be made to the revised AWERA.

173. Table 7-6, p. 1. "Chromium IV" should be "Chromium VI."

Response: The appropriate change will be made to the revised AWERA.

174. Table 7-6, source information. IDEQ's response on p. 27 of IMASC Comments on "Draft Area Wide HHERA Work Plan" suggests that the hierarchy for determining TRV information will be included in the text. It also suggests the hierarchy to be the Navy document as the primary source with Sample and others (1996) used as a supplement. This hierarchy/rationale is absent from the AWERA text. There are also instances without explanation where this hierarchy is not followed. Please include the hierarchy in the text of the document and provide explanation when the two listed sources are not used.

Response: The text will be revised to provide the hierarchy. In some cases, the values used in the Navy document have generated significant controversy and changes have been proposed by various parties. Where the hierarchy was not followed, justification will be provided. The text will be corrected and clarified in the revised AWERA.

175. Table 7-6. Please identify rationale in the AWERA for using "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California" (U.S. Department of the Navy, 1998) TRVs preferentially over any other source. This document cites that TRVs were selected from empirical studies published in the toxicological literature for use in evaluation of naval institutions in the San Francisco Bay area. It is unclear why this source relates to the mining sites in Idaho more than any other sources of TRV data.

Response: The Navy document was developed for ERAs in the western U.S. It is a cooperatively developed document involving the Navy, EPA, and state regulatory agencies and it has been extensively peer reviewed. The process followed to develop the TRVs in this document was adopted by EPA in the development of their ECO-SSLs. Therefore, with some minor exceptions, the TRVs used in this document are widely accepted and used. Other sources of TRVs, such as Sample and Others (1996), were developed with a much lower level of peer review. Therefore, the preference for the TRVs in the Navy document is justified and will not be changed. No changes will be made to the revised AWERA.

176. Table 7-6, source information for Cr +6. Chromium VI mammal TRV dose of 13.14 is listed in Sample and others (1996) as a LOAEL. Sample and others (1996) also lists a NOAEL of 3.28 based on tests conducted with rats. The NOAEL is more appropriate than the LOAEL for this table. The avian dose of 1.0 from Haseltine and others did not appear to come from either of the two sources listed under "Notes:" Please confirm the accuracy of this value and its source.

Response: IDEQ agrees and the appropriate changes will be made to the revised AWERA.

177. Table 7-6, source information for lead. Lead appears to have come from Sample and others (1996), however TRV data for this chemical does exist in the Navy document, which should be hierarchically preferenced. U.S. Department of the Navy (1998) lists lead with a low-TRV of 0.0015 based on the white rat (Krasovski, 1979) and an avian TRV of 0.014 based on the Japanese quail (Edens et al., 1976).

Response: The TRV as presented in Navy (1998) is recognized as being too low and has some inherent problems. Presently the EPA Region 9 Biological Technical Assistance Group (BTAG) is considering revising the lead TRV. The rationale for using the lead TRV from Sample and Others (1996) will be clarified in the revised AWERA.

178. Table 7-22, p. 1. Why was Zinc (Deer Mouse) included on this table? The maximum impacted HQ is equal to the background HQ and should not be representative of any potential risk at the site.

Response: The HQ for the Blackfoot watershed may indicate some potential risk to the deer mouse even though it is close to the background HQ. No changes will be made to the revised AWERA.

179. Table 7-22, p. 1. The values for Selenium (Raccoon) do not match the values for this receptor on Table 7-19. Also, Zinc (Deer Mouse) BFR HQ and BKG HQ do not match the values presented in Table 7-21 for this receptor.

Response: The values in Table 7-22 are correct and the values in Tables 7-19 and 7-21 will be corrected in the revised AWERA.

180. Figure 5:

- Consumers
  Long-tailed vole should be highlighted/blue

- Consumers
  Red-winged blackbird should be highlighted/blue and denoted as a surrogate
  Mallard should be highlighted/blue
  Table 7-2 lists the Large-spotted Snake River Cutthroat trout with the rainbow trout as a surrogate indicator species; however, Figure 5 lists the Yellowstone cutthroat trout as the indicator species with the rainbow trout as a surrogate.

- Several other indicator/endpoint species are not present on this figure. Please include all indicator species in the figure. The missing species are: song sparrow, meadow vole, Great blue heron, mink, and yellow-headed blackbird.

Response: IDEQ agrees with the comment and the appropriate changes will be made to the revised AWERA.

Appendix B – Screening of Chemicals of Concern

181. General Comments. Page B-1 second sentence, states that data sets collected prior to 2001 are inadequate. IMA has collected sufficient amounts of background and impacted data on a site-specific basis. These data were selected from locations using a systematic approach or on a stratified random basis and sampled using protocols accepted by state and federal regulatory agencies. The IDEQ, in their response to comments provided in a letter to the Greater Yellowstone Coalition (GYC), dated November 29th, 2001 states in their response on the first page, that after an extensive review, the existing data collected from the study area were acceptable for use, and that methods and quality were generally acceptable. The second page, third paragraph, states in the second sentence that the current data sets include areas that are representative of pre-mining conditions. The IDEQ has recognized that these data are valid. Therefore, these data collected by MWH are sufficient for use, and necessary in the characterization of background and impacted conditions. However, these data are not used in the initial Tier 1 screening of Appendix B, nor do they appear to be included in the entire tiered screening process, at least not annotated in the footnotes of the appropriate tables. The elimination of constituents due to waste rock concentrations alone can drastically increase uncertainty in other media. The fate and transport mechanisms in different media are not the same throughout. Constituents in soil, sediment, and water behave differently for liquid and solid matrices. By ignoring this reality, the author may be lead to erroneous conclusions in the risk assessment.

Response: The Agency acknowledges our previous statements concerning the quality of the historic data, however, the prior data sets were considered inadequate for assessment purposes due to the limited analyte list. Historic data was used in Tier 3 but the Agency chose to use more conventional raw laboratory data from the archived certificates of analysis in lieu of MW's statistically adjusted values. Since raw data was never reported in any of MW's historic documents, specific references could not be provided. The assessment screening process did not eliminate constituents solely on observed waste rock concentrations but considered observances in other media, and potential fate and transport processes.

182. Tables B-1 through B-5. The five tables presented in Appendix B, contain numerous errors, including formatting, the lack of use of significant figures, the use of incorrect human health or ecological values from the referenced source, as well as inconsistencies in the terms, ND, NO, YES, NAF.

Response: All tables will be reviewed for accuracy and consistency. Any inaccuracies or inconsistencies will be corrected in the revised appendix.

183. Section 1.0, p. B-1, 1st bullet. Aluminum was dropped from Table B-4. Aluminum was analyzed for, and reported in Table 3-4, Draft – Summer 2001 Area-Wide Investigation Data Summary.

Response: The data from the referenced report will be incorporated into Table B-4.

184. Section 2.1, p. B-2, 1st sentence. No reference is provided for the use of the background levels for western United States. Also, no justification is provided for this atypical tiered screening process.

Response: The reference used to define the mean in western soils is Shacklette and Boerngen (1984). This reference will be added to the references in the document. The COPC screening process was developed to address specific concerns for the Resource Area. This risk assessment was an area-wide assessment and not specific to any single mine site. Therefore, the screening process was designed to select chemicals that were of importance on an area-wide basis. These

concerns include multiple potential source areas, potential impacts to both aquatic and terrestrial receptors, multiple watersheds, and a large areal extent of potentially impacted areas. Based on these concerns, a multi-stage screening process using all potentially impacted media was used to ensure that potential impacts to any receptor were not overlooked at the initial screening process. All comparisons and data were evaluated to provide a conservative, but reasonable screening of potential COPCs.

185. Section 2.2, p. B-2. The use of Table B-5 is unclear because it is not discussed in Appendix B in Section 3.0.

Response: Table B-5 presents data from the on-site surface water bodies at the mines. This data was evaluated separately from off-site surface water data to ensure that no COPCs were excluded in the primary screening that were present at concentrations of concern in on-site surface water bodies. Evaluation of the on-site surface water did not indicate that any additional COPCs should be added to the list to be considered in the risk assessments. The appendix will be revised to explain the issue.

186. Section 3.1.1, p. B-4. See MWH Draft—Summer 2001 Area-Wide Investigation Data Summary, Table 3-4 for results on aluminum in waste rock, riparian soils, and upland background areas.

Response: The data for aluminum from the referenced report will be included in the revised appendix.

187. Section 3.1.2, p. B-4, last paragraph. Second and third sentence require revision, as the reported TEL for aluminum is 2.55%, which is equivalent to 25,000 mg/kg, not 255,000 mg/kg reported by IDEQ.

Response: The comment is correct. The values should be 25,500 mg/kg instead of 255,000 mg/kg. The value and discussion will be corrected in the revised appendix.

188. Section 3.1.3, p. B-5. This requires justification on the comparison of two different statistical parameters, maximum and mean. This is an inappropriate comparison, since these two parameters provide different, unequal values for a specific data set. The only two different data sets that this would be accurate, but not scientifically or mathematically accurate, would be a datum set that consisted of one number or a data set that contained the same value for all locations. Then, the comparison of two different parameters would be accurate, but still not scientifically sound.

Response: As discussed in the response to Specific Comment 184, this process was designed to select chemicals of importance on an area-wide basis. The use of both average and maximum values is appropriate in this context. The maximum value identifies that a potential risk exists while the average value serves as an indication of whether the chemical poses an area-wide risk. Chemicals with maximum values indicating potential risk but with low average values were subjected to a full evaluation of the data set to determine if the chemical posed a potential risk at a single site or was of area-wide significance.

189. Section 3.1.3, p. B-5, 1st and 2nd bullet. It would be helpful to state the criteria in this section.

Response: EPA Region 9 preliminary remediation goals (PRG) and NAWQC chronic criteria are widely accepted as conservative screening levels. Selection criteria are described in Section 2.3.

190. Section 3.1.4, p. B-5. See comment for Section 3.1.1, p. B-4.

Response: The data for aluminum from the referenced report will be included in the revised appendix.

191. Section 3.1.5, p. B-5. See comment for Section 3.1.1, p. B-4. Third sentence is incorrect; see comment for Section 3.1.2, p. B-4, last paragraph. This entire section requires revision based on the incorrect conclusions, and the initial incorrect reporting of the criteria.

Response: The data for aluminum from the referenced report will be included and the discussion will be revised in the appendix.

192. Section 3.2.1, p. B-6. See comment for Section 3.1.3, p. B-5 on appropriateness of comparison.

Response: See response to Specific Comment 188.

193. Section 3.2.2, p. B-7. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

194. Section 3.2.4, p. B-7. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

195. Section 3.2.4, p. B-7, 1st and 2nd bullet. It would be helpful to state the criteria in this section.

Response: Selection of criteria is described in Section 2.3.

196. Section 3.3.1, p. B-8. See comment for Section 3.1.3, p. B-5 on appropriateness of comparison.

Response: See response to Specific Comment 188.

197. Section 3.3.2, p. B-8. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

198. Section 3.3.4, p. B-9. See comment for Section 3.1.3, p. B-5. Also, state the criteria in the first and second bullets for clarification.

Response: See response to Specific Comments 188 and 189.

199. Section 3.4.2, p. B-10. See general comments on the elimination of constituents based upon waste rock concentrations only.

Response: The text will be clarified to explain that no chemical was eliminated solely on the basis of waste rock data. If the chemical was determined to be low compared to western U.S. background soil levels, the chemical was given a high probability of not posing a significant risk. The concentrations in all other media were evaluated and if that data did not indicate a significantly elevated concentration, the chemical was then dropped from consideration.

200. Section 3.5.1, p. B-11. Beryllium was analyzed for, and reported in Table 3-4, of the Draft – Summer 2001 Area-Wide Investigation Data Summary prepared by MWH.

Response: The data for beryllium from the referenced report will be included in the revised appendix.

201. Section 3.5.4, p. B-11, 1st sentence. The average impacted concentration is reported in Table B-4 as 0.96 mg/kg.

Response: The values will be checked and the inconsistency will be resolved in the revised appendix.

202. Section 3.5.5, p. B-12. See comment for Section 3.5.1, p. B-11. See comment for Section 3.1.3, p. B-5.

Response: Selection of criteria is described in Section 2.3.

203. Section 3.6.3, p. B-13. See comment for Section 3.1.3, p. B-5. State criteria in the first and second bullets for clarification.

Response: Criteria are described in Section 2.3. No ecological screening criterion for boron was available.

204. Section 3.6.4, p. B-14. See comment for Section 3.1.3, p. B-5. State criteria in the first and second bullets for clarification.

Response: See response to Specific Comments 188 and 189.

205. Section 3.6.5, p. B-15, 1st sentence. Clarify for which medium this sentence describes.

Response: The sentence in question is a discussion of surface water concentrations. The text will be revised to clarify the media.

206. Section 3.7.2, p. B-15. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

207. Section 3.7.3, p. B-16, 3rd sentence. Exceedance factor is wrong. Value should be 2. The second bullet is wrong, since the benchmark is incorrectly reported. The value for ecological surface water from the NOAA SQRT table is 2.2 µg/L. The max reported value was 0.31 µg/L for impacted areas.

Response: The exceedance factor is 18. The text will be corrected. The NAWQC chronic criterion concentration (CCC) for cadmium is a hardness-dependent value ranging from 1.1 to 2.2 µg/L. Since hardness values varied significantly in surface water across the Resource Area, the conservative screening level should have been set at 1.1 µg/L. This will not affect the results but the appendix will be revised to be accurate.

208. Section 3.7.5, p. B-17. See previous general comments on Appendix B and the use of site-specific background data. Also, the conclusion is wrong regarding surface water. See comment for Section 3.7.3, p. B-16, 3rd sentence.

Response: See response to Specific Comment 181. The text will be corrected in the revised appendix.

209. Section 3.8, p. B-17. No justification is provided for the use of different speciation for chromium. Based on communication with mining geologists from Monsanto, chromium (VI) is not known to exist naturally in soils found in the project area. Chromium (VI) can be found in serpentine layers, which are not found in the resource area. Further, there are not any industries that operate in the resource area that would introduce anthropogenic source of chromium (VI) from industrial processes. Provide clarification for the justification on the use of screening benchmarks for chromium (III) or chromium (VI).

Response: Hexavalent chromium (chromium VI) is not known to be a significant issue in the Resource Area. However, the physical conditions in the area tend to oxidize rather than reduce chemicals. Therefore, the existence of chromium VI in the area cannot be disregarded. Logistical constraints prevented sampling and analysis for chromium speciation during the 2001 sampling events. Therefore, based on the lack of data, conservative assumptions were made regarding screening levels for chromium species:

- *Waste Rock – Only total chromium data was available for western U.S. soils.*
- *Surface Water – Surface Water – The EPA Region 9 tap water PRG for chromium VI was used for human health considerations. The criterion for surface water for ecological receptors in Table B-3 is incorrect. It should be the NAWQC CCC for chromium of 11 mg/L. The table and affected text will be corrected. However, the conclusions concerning surface water will not change.*
- *Sediment – The available sediment benchmarks are based on total chromium. However, there is a typographic error in Table B-2. The criterion should be 37.3 mg/kg based on the TEL reported in Buchman 1999. The error will be corrected but does not affect the conclusions of the screening.*
- *Soils – The human health criteria for soils are based on the EPA Region 9 residential soil criteria for residential exposure for total chromium. The ecological screening criterion is based on the EPA ECO-SSLs for total chromium in soil.*

The text will be revised to provide additional explanation and footnotes will be added to the tables to clarify criteria sources.

210. Section 3.8.1, p. B-17. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

211. Section 3.8.3, p. B-18. State criteria for clarity in bulleted paragraphs.

Response: The criteria are described in Section 2.3.

212. Section 3.9.4, p. B-21, 2nd sentence. The value is incorrect for the average background value, compared with the reported value in Table B-4.

Response: The data in the tables will be reevaluated and the inconsistency will be corrected in the revised appendix.

213. Section 3.9.5, p. B-22. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

214. Section 3.10.2, p. B-23. See Appendix B general comments on the elimination of constituents based upon one medium only.

Response: See response to Specific Comment 181.

215. Section 3.11.2, p. B-24. This section does not logically follow the screening process outlined for the tiered evaluation. According the framework for the Tier 1 evaluation, if a constituent isn't elevated above background, it is eliminated from the screening process. However, IDEQ has ignored that process for manganese, and evaluated it further under the Tier 2 process. This is not clear and follows no logical pathway, completely disregarding the screening process. Please clarify the reason for discarding the outline of the tiered screening process.

Response: See response to Specific Comment 199.

216. Section 3.12.2, p. B-24, 1st sentence. This sentence reports the wrong values, compared to Table B-3. The values in Table B-3 are, maximum 0.23 mg/kg, and mean, 0.07 mg/kg. Please clarify this error.

Response: The data will be reevaluated and inconsistency will be corrected in the revised appendix.

217. Section 3.12.3, p. B-25. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

218. Section 3.12.4, p. B-25. Please clarify the units reported, see Table B-4, which reports units in mg/kg. Also, provide the benchmark criteria in the first and second bullets of this section for clarity.

Response: The units as reported are correct in Section 3.12.4. The units in Table B-4 will be corrected in the revised appendix.

219. Section 3.13.1, p. B-26. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

220. Section 3.13.2, p. B-27. Include units for all values in the first sentence. The third sentence exceedance factor is wrong. The value should be rounded to 4.

Response: The units will be added to the sentence. The value is actually 2.8 and will be rounded up to 3 in the revised appendix.

221. Section 3.13.4, p. B-27. See comment for Section 3.1.3, p. B-5. Provide criteria for first and second bullets for clarity.

Response: See response to Specific Comments 188 and 189.

222. Section 3.14.1, p. B-28. See comment for Section 3.1.3, p. B-5. Also, the exceedance factor is wrong; value should be rounded to 31.

Response: See response to Specific Comment 188. The exceedance factor is 30.7 and will be rounded up to 31 in the revised appendix.

223. Section 3.14.1, p. B-29—B-30. A word is missing in the third sentence between "of in" and should be included. Also, please provide the criteria for the first and second bullets for clarity. The second bullet states that the criterion for ecological receptors reported in the NOAA SQRT table is unadjusted for hardness. According to the footnote in that guidance document, "…the value entered is for 100 mg/L calcium carbonate." Please clarify this.

Response: The section number and page numbers in this comment do not match the report. IDEQ is unable to identify the specific portion of the report that is of concern and cannot address the comment. The revised documents will undergo a full editorial and technical review that should address these concerns.

224. Section 3.14.4, p. B-30. See comment for Section 3.1.3, p. B-5, and provide criteria for the first and second bullets for clarity.

Response: See response to Specific Comments 188 and 189.

225. Section 3.14.5, p. B-31, 2nd to last sentence. Please describe the soils as waste rock, riparian soils, or both.

Response: The soils will be identified as riparian soils in the revised appendix.

226. Section 3.15.1, p. B-31, 1st sentence. The first sentence reports the maximum value incorrectly. See Table B-1 for a different value, and provide the correct concentration in this sentence. Also, exceedance by 6 orders of magnitude is incorrect. This exceedance is closer to 3.8 orders of magnitude. It may also be helpful if exceedances were reported in similar manners, such as factors, or orders of magnitude, instead of choosing one or the other just for something different in the text. Also, see comment for Section 3.1.3, p. B-5.

Response: The actual maximum selenium concentration was 1,500 mg/kg in waste rock. The text will be corrected. The revised appendix will provide all exceedances as a factor rather than orders of magnitude. See response to Specific Comment 188.

227. Section 3.15.2, p. B-31. The exceedance factor should be rounded to 120. See comment for Section 3.1.3, p. B-5.

Response: The actual exceedance factor is 156.7. This figure will be rounded up to 157 in the revised appendix. See response to Specific Comment 188.

228. Section 3.15.3, p. B-32. The order of magnitude is incorrectly calculated. It should be closer to 3.2 orders of magnitude. Also, in the first bullet of this section, we strongly advise against the use of the description, "selenium is of significant concern for human health in surface water." This is an incorrect conclusion, because based upon the screening effort at this level; one cannot make that

judgement. Only at a latter portion of the risk assessment, after the evaluation of contaminant, pathway, and receptor can one determine if selenium has significant human health impacts. Further, it would be poor science to make that determination, based upon present conditions in the resource area, since to date, there have been no reported cases of selenium poisoning in humans. The last sentence should be rephrased to state that selenium is retained as a COPC for human health in surface water and should be consistent with the previous sections. See comment for Section 3.1.3,
p. B-5.

Response: See response to Specific Comment 226 concerning exceedances. IDEQ agrees that at this stage, it is premature to make a judgment of "significant concern." The text will be revised to state "selenium is of concern for human health in surface water." See response to Specific Comment 188.

229. Section 3.15.4, p. B-32. See comment for Section 3.1.3, p. B-5. Also, the exceedance factor should be rounded to 160. Please provide the criteria for the first and second bullets. See comment above on the wording of the last sentence in bulleted paragraph 1.

Response: The actual exceedance factor is 166.7. This figure will be rounded up to 167 in the revised appendix. See response to Specific Comment 188. Also see response to Specific Comment 298 concerning the wording of the sentence.

230. Section 3.15.5, p. B-33. Correct the exceedance factor, as in the previous section.

Response: See response to Specific Comment 229.

231. Section 3.16.3, p. B-34. Please provide the criteria for the first and second bullets, and see comment for Section 3.15.3, p. B-32 on the use of the inappropriate conclusion made in the last sentence of the first bullet. See comment for Section 3.1.3, p. B-5.

Response: See response to Specific Comments 188, 189, and 228.

232. Section 3.16.4, p. B-35. The exceedance factor should be rounded to 58, and provide the criteria in the first and second bullets for clarity. See comment #188. See comment #228 on the wording of the last sentence in the first bullet.

Response: The actual factor of 52 will be in the revised appendix. See response to Specific Comments 188, 189, and 228.

233. Section 3.16.5, p. B-36. Correct the exceedance factor.

Response: The exceedance factor will be corrected in the revised appendix.

234. Section 3.17, p. B-36. Provide the reason why this is inconsistent with Table B-1, since there are values reported, but these are not qualified as some value, such as one-half the detection limit. Eliminating certain constituents based on waste rock concentrations alone, by comparison to non-site-specific soil concentrations, at this initial stage in the screening can lead to incorrect conclusions, and increase uncertainty of potential risk in the different types of media that were not evaluated during the Tier 1 screening process (riparian soils, surface water, and sediment).

Response: See response to Specific Comment 199.

235. Section 3.18.1, p. B-37. See comment on Section 3.1.3, p. B-5.

Response: See response to Specific Comment 188.

236. Section 3.18.2, p. B-37. See comment on Section 3.1.3, p. B-5, and the exceedance factor is incorrect, and should be rounded to 6.6. The exceedance factor also does not have any consistency in the units with the other sections, whether using a whole integer or a decimal value.

Response: See response to Specific Comment 188. The actual exceedance factor is 4.5 and will be rounded up to 5 to be consistent with all other factors.

237. Section 3.19.1, p. B-38. See comment on Section 3.1.3, p. B-5, and the exceedance factor is wrong. The value is much closer to 17 than the reported value of 7.

Response: See response to Specific Comment 188. The exceedance factor will be changed to 17 to correct the typographical error.

238. Sections 3.19.2 and 3.19.4, p. B-39. See comment for Section 3.1.3, p. B-5. Also, provide the criteria for the first and second bullets on page B-40. See comment for Section 3.15.3, p. B-32 on the wording of the last sentence in the first bullet.

Response: See response for Specific Comments 188, 189, and 228.

239. Section 3.19.5, p. B-40. Provide clarity in the fifth sentence on what type of soils, either riparian or waste rock.

Response: The text will be revised to identify the media as riparian soils in the revised appendix.

240. Section 3.20.1, p. B-40. See comment on Section 3.1.3, p. B-5, and the exceedance factor is wrong. The value is much closer to 36, than the reported value of 19.

Response: See response to Specific Comment 188. The exceedance factor is actually 36.4. The text will be revised to report the exceedance as 36.

241. Section 3.20.2, p. B-41. See comment on Section 3.1.3, p. B-5. Also, provide an explanation for the use of the secondary values from the NOAA SQRT table usage, when the primary guidance, McDonald (2000), provides a criterion for both PEC and TEC.

Response: See response to Specific Comment 188. IDEQ used MacDonald and others (2000) as the source for the sediment screening values. Where a value was not available, the data presented in Buchman (1999) was used.

242. Section 3.20.4, p. B-41. See comment for Section 3.1.3, p. B-5, and provide the criteria in the first and second bullets on P. B-42 for clarity. See comment for Section 3.15.2, p. B-32 on the wording of the last sentence in the first bullet.

Response: See response to Specific Comments 188, 189, and 228.

243. Section 3.21, p. B-42. Radionuclides are discussed in this section, but are not included in Table B-1—B-5. Provide justification for omission from the screening tables. Also, the last sentence in the

second paragraph of this section on p. B-43 needs an explanation of indicator analyses, since it is not clear for what parameter or medium they are an indicator.

Response: The radionuclide data consist of indicator analyses such as gross alpha and beta. This type of data represents a summation of the activity of all alpha- or beta-emitting radionuclides present in a sample. Therefore, assessment of this data does not provide information on specific chemicals that may be of concern. This data is simply a basis for a yes or no decision on the need to conduct detailed radiochemical analyses to speciate the radionuclides. Additionally, this type of data has some different comparison issues than inorganic analyte analyses as discussed in Section 3.21. Therefore, it is not appropriate to put this material in the chemical-specific screening tables. However, the appendix will be revised to include additional tables to present this data.

244. Section 4.0, p. B-43. Provide the justification on why the eliminated COPCs will be reevaluated in this section and the results of the previous screening results ignored, because doing so invalidates the efforts of the previous screening. See Section 5.0 comments on the Tier 4 assessment.

Response: Chemicals that were eliminated as COPCs for other media were retained as plant tissue COPCs because no plant tissue-specific, risk-based screening levels are available. All chemicals retained as plant tissue COPCs are present at elevated concentrations in waste rock and in the medium in which the plants are growing. For example, terrestrial plants are assumed to grow in soil; therefore, in order for a chemical to be retained as a terrestrial plant COPC, the chemical must be present at elevated concentrations in soil and in terrestrial plant tissue. In the case of homegrown produce, because no background produce tissue concentrations are available, comparisons were made only for soil. In evaluating aquatic plant tissue COPCs, comparisons were made for sediment, not soil.

245. Section 4.1, p. B-43. Provide additional explanation for the third and fourth sentences on how this evaluation was conducted, as it is not clear. Also, provide an explanation for the list of secondary COPCs, and under what pathway vanadium and zinc are to be evaluated.

Response: Section 4.1 will be clarified consistent with the response to Specific Comment 244. Vanadium and zinc are evaluated as both terrestrial and aquatic plant tissue COPCs.

246. Section 4.2, p. B-44. Provide the screening process for the fugitive dust inhalations for clarity in appendix, and in the screening Table B portion of the risk assessment.

Response: The screening process used to identify all chemicals evaluated for the inhalation of fugitive dust exposure pathway will be clarified. Basically, all chemicals found to be present at elevated concentrations in waste rock were evaluated under the inhalation of fugitive dust exposure pathway.

247. Table B-1. Provide the units for the listed concentration, as well as the reference for the USGS western soils data. Put a zero in front of values less than 1.0. Other comments:

Response: Units and references will be added to the table.

- Aluminum was analyzed for, and should be included in the table.

Response: Aluminum data will be added to the table.

- Cd uses ND, but should use NA as a more appropriate value.

Response: The ND notation will be changed to NA.

- Use "YES" instead of "ND" in the first two screening columns in the comparison for Cd. ND usually means non-detect, and is not one of the choices that should be used for this column. It is more appropriate to use yes, no, or NA (not applicable).

Response: The ND notation will be changed to NA.

- Remove cobalt from the screening table, since it isn't appropriate to screen for a chemical in which there is no data. Although IMA does have archived Co data from the 1998 regional investigation.

Response: Additional data on cobalt has been collected since the draft risk assessment was submitted. This new data will be incorporated in the revised appendix and tables.

- Mercury, second to last column, should be "YES" instead of "ND."

Response: No range for western U.S. soils for mercury was available. Therefore, the notation will be changed to NA.

- Silver screening should not use NAF, since silver was obviously analyzed for. Use "YES" instead of "ND" since the decision choices are only yes or no.

Response: The NAF notation will be changed to NA.

- Thallium should be footnoted to provide clarity on detection levels.

Response: A footnote will be added to clarify the detection limits.

- This table uses footnotes a, b, and c in the Established Range column. Please provide these in the footnotes section of this table.

Response: Additional footnotes will be added to clarify the table.

248. Table B-2. The following constituents have mean values that are smaller than the minimum; this is impossible:

- Sb
- Be
- Cd
- Mo
- Se
- Ag.

Please provide justification for this type of statistical analysis, or clarify the concentrations with an explanation in the footnotes. Further, the use of uncensored data may remove this problem. Use significant figures consistently, and use a "0" for values less than 1.0. Other comments:

Response: The minimum value in the tables was the minimum value detected. The mean values were calculated using all data. For non-detects, one-half the detection limit was used to calculate the mean. The tables will be revised to show the minimum value as the lowest reported value or less than the method detection limit if non-detect values are present.

- Antimony HH and ECO screening values listed are incorrect. Consult the appropriate guidance document for correctness.

Response: The human health criterion will be changed to 15 µg/L and the ecological criterion will be changed to 30 µg/L. The change has no effect on the evaluation.

- Beryllium ECO screening value is incorrect. Consult the appropriate guidance document for correctness.

Response: The ecological criterion will be changed to 5.3 µg/L. The change has no effect on the evaluation.

- Boron HH screening value is incorrect. Consult the appropriate guidance document for correctness.

Response: The boron value will be changed from 3.30E+04 to 3.30E+03 µg/L. The change has no effect on the evaluation.

- Cadmium HH screening value is incorrect. Consult the appropriate guidance document for correctness.

Response: The cadmium value will be changed from 3.70E+01 to 1.80E+01 µg/L. The change has no effect on the evaluation.

- No explanation is provided for the inconsistent use of the different speciations for chromium (III) and chromium (VI) between the HH and ECO screening. Provide this justification.

Response: See response to Specific Comment 209.

- Remove cobalt from this screening since it isn't appropriate to screen for a constituent in which one has no data.

Response: See response to Specific Comment 247 pertaining to cobalt.

- Use COPC in the second to last column heading, as COPEC denotes ecological screening.

Response: The second to last column refers to ecological criteria; therefore, COPEC is correct.

- Molybdenum ecological screening decision should be "YES", since it is appropriate to carry forward a constituent in which one has no applicable screening criterion, and cannot be eliminated at this stage in the screening.

Response: The table will be revised to indicate that molybdenum should be retained as an area-wide COPEC.

- Footnote 2 should be changed, since the Region 3 EPA RBC's are for HH applications, not ecological.

Response: The footnote will be corrected to indicate the appropriate criteria source.

- No frequency of detection information is provided.

Response: Frequency of detection information will be added to the table.

249. Table B-3. The use of significant figures is inconsistent, and no frequency of detection information is provided. Clarify mean in COPEC Level 2 Screening heading. Other comments:

Response: The use of significant figures will be made consistent and frequency of detection information added to the table. The heading information was apparently converted incorrectly when the files were converted to PDF format. The revised tables will correct the headings.

- Aluminum ecological criterion is incorrect. See NOAA SQRT table. "YES" should be the decision made in the last column, since constituent should be carried forward if no criterion is available.

Response: The value will be changed to 25,500 mg/kg.

- Antimony has a mean value less than the minimum.

Response: See response to Specific Comment 248.

- Beryllium Level 3 Screening decision should be "YES."

Response: In waste rock, beryllium was determined to be elevated above the western U.S. mean values. The concentrations were determined not to be elevated in impacted sediments above background sediments. Beryllium was detected in less than 5 percent of the surface water and did not exceed applicable benchmarks. The maximum detected concentration of beryllium in impacted riparian area soils was not elevated above the background area average. Based on all available information, beryllium was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area.

- Remove cobalt from this screening, since it is inappropriate to screen a constituent for which one has no data.

Response: See response to Specific Comment 247 pertaining to cobalt.

- Mercury should preferably use the lower of the two values for screening. Provide clarity for this inconsistent use. The final decision should be changed to "YES."

Response: The screening value will be changed to 0.18 mg/kg; however, mercury was not retained as a COPC for human health or as a COPEC for ecological receptors for the Resource Area. In waste rock, mercury was determined to be elevated above the western U.S. mean value. The concentrations were determined to be elevated in impacted sediments but did not exceed the sediment screening benchmark. In surface water, mercury did not exceed either the human health

benchmark or the ecological screening benchmark. The maximum detected concentration of mercury in impacted riparian area soils did exceed the background area average by a factor of 20. However, this maximum value was an extreme outlier that was an order of magnitude higher than any other result. For soils, mercury exceeded the ecological screening criteria, but not the human health criteria. If the single outlier is removed, no mercury values exceed the ecological screening criterion for soils.

- See previous comment for nickel.

Response: The screening value will be changed to 22.7 mg/kg. This change does not affect the conclusions.

- A value was provided in Table 7-1 for selenium, but not in this table. Clarify this.

Response: The screening value will be changed to 4.0 mg/kg in Table B-2. This change does not affect the conclusions.

- Silver has an error code from Excel in the Mean row. Also, a criterion for silver is present in Table 7-1, but not listed here. Explain. Also, the final decision for Silver should be "NO" based on this new information.

Response: The conversion error will be corrected in the revised table. The screening value in Table B-3 will be changed to 4.5 mg/kg. The comparison to benchmarks column will be changed to NO.

- Uranium's minimum value in background samples is less than the mean. Please provide an explanation for this.

Response: See response to Specific Comment 248 concerning the calculation of the mean values.

- Zinc ecological criterion is not consistent with Table 7-1. Please explain this.

Response: The tables have been compared and the values used are both 123 mg/kg for zinc.

250. Table B-4. There is no consistency with the significant figures, and EDLs should be listed in the table for clarity, because no values are present. Other comments:

Response: The use of significant figures will be made consistent and frequency of detection and detection limit information added to the table. Detection limit information will be added for those elements that had nondetect values for some samples.

- Beryllium has a mean value lower than the minimum. Please explain this impossibility.

Response: See response to Specific Comment 248.

- Boron has a max value of 43 mg/kg, which is inconsistent with p. B-12, Section 3.6.1. Please explain.

Response: The data will be reevaluated and the inconsistency will be corrected.

- Provide footnote on chromium to clarify total, (III) or (IV) or (VI) form.

Response: See response to Specific Comment 209.

- Remove cobalt from this screening. See previous comments on tables that contain cobalt screening with a lack of data.

Response: See response to Specific Comment 247 pertaining to cobalt.

- Provide clarity on mercury units, whether they are mg/kg or µg/kg.

Response: The table will be revised to provide all concentrations in mg/kg.

- Provide clarity on molybdenum, since it appears that one-half the detection limit was used, but not footnoted.

Response: The requested footnote will be added to the table as well as detection limits.

- Selenium benchmark criterion for ecological soil is incorrect according to Table 7-1. Please clarify.

Response: The tables have been compared and the values used are both 0.8 mg/kg for selenium.

- Footnote section is incomplete, since it is missing the Region 9 PRG information, and the column headings use the same footnote "1." Please clarify.

Response: Additional footnotes will be added to the table to clarify the source of the criteria.

251. Table B-5 is not discussed in the text, however, there are several mistakes included in it:

- Significant figures usage is inconsistent. See beryllium.

Response: The use of significant figures in the table will be made consistent.

- Silver mean concentration is greater than the maximum. All figures should be rounded correctly, or explain how the mean is greater than the maximum.

Response: See response to Specific Comment 248.

- U or F column heading is inconsistent with what is listed in this column.

Response: The heading for the column will be changed to be consistent with the information.

- Mercury decision in the last column should be changed to "NO." The maximum value is lower than the screening criterion.

Response: The decision column will be changed to NO.

- Molybdenum decision in the last column should be changed to "YES" since it is inappropriate to eliminate a constituent until it can be properly eliminated.

Response: The decision column will be changed to YES and the appropriate revisions to the text incorporated.

- Vanadium decision in the last column should be changed to "YES."

Response: The decision column will be changed to YES and the appropriate revisions to the text incorporated.

- It is appropriate to pre-average duplicates or triplicates, since they are typically used to examine field and laboratory error. Please explain the justification for this rationale.

Response: The data set for the on-site surface water was used as a secondary check to ensure that chemicals of concern were not inappropriately eliminated. In some cases, duplicate samples have significant variations in results. Therefore, a decision was made to treat all data as single point samples.

- Please clarify the third to last footnote.

Response: The footnote will be revised to clarify the units used.

Appendix C – Development of Exposure Point Concentrations

252. General comments. In using a weighted sampling design, a map or maps should be provided that identifies the specific reaches and area used.

Response: Figures will be added to the revised appendix to identify the stream-specific impacted and unimpacted reaches used to calculate EPCs.

253. General comments. Where are the calculations for each medium?

Response: Medium-specific EPC calculations will be added to the risk assessments.

254. Section 2.0, p. C-2, 1st paragraph. The first three sentences are confusing. It is stated that media in the first sentence are to be used for "AWERA only," the two media in the second sentence are said to be used "for both the AWERA and the AWHHRA," and the "remaining media" in the third sentence are to be used "for the AWERA and the AWHHRA (CTE case only)." It is unclear which media were used for each assessment, and why they were selected. Please clarify.

Response: As noted in the comment, the text identifies the media used in each assessment. The text will be reviewed and, as appropriate, clarified.

255. Section 2.0, p. C-2, 2nd paragraph. It is obvious from the existing data that concentrations of Se differ seasonally in surface water and fish tissue.

Response: Comment noted.

256. Section 2.0, p. C-3, final paragraph. The word, 'reached,' should probably be revised to 'reaches.'

Response: The text will be revised as requested.

257. Section 2.1, p. C-3, 1st paragraph. Please explain how benthic invertebrate data were used in the AWHHRA.

Response: For those receptors that consume benthic invertebrates, an area-weighted EPC for benthic invertebrates was developed based on measured tissue concentrations. These EPCs were then used in the dose calculations.

258. Section 2.1, p. C-3, Equation (1). The equation is erroneously set equal to a summation sign, whereas it should be set equal to the WAC. The variable, AR, should be AR_j.

Response: The typographic error in Equation 1 will be corrected. The actual calculations conducted were correct.

259. Section 2.1, p. C-3, "Assumptions," 2nd bullet. For impacted reaches (i.e., reaches downstream of an historic or active phosphate mine lease) of a certain stream order, the mean concentration would be better represented by the WAC calculated from the data available for impacted streams of that stream order, rather than from all impacted analytical data (which hopefully includes stream data, only).

Response: Comment noted. The procedure used was a simplifying one. The uncertainty introduced by this assumption will be discussed in the revised appendix.

260. Section 2.1, p. C-3, "Assumptions," 3rd bullet. Apparently, this bullet indicates that the WACs for unimpacted reaches (i.e., background reaches, or those upstream of any phosphate mine lease) are not WACs. For consistency and comparability, these should be calculated with the same methodology used for impacted reaches.

Response: A single AWAC is calculated for each COPC in each watershed. The inputs to the weighting are mean concentrations in impacted and unimpacted reaches from each watershed. This bullet indicates that the unimpacted reaches in a given watershed were considered as a single reach with an average concentration calculated based on all available data for unimpacted reaches.

261. Section 2.l, p. C-4, final bullet. What are the average widths for the different stream orders? Please define subreach as used in the 3rd sub-bullet. How is total stream area defined for background streams?

Response: The average width of the different stream orders will be added to Appendix C. As discussed in the response to Specific Comment 260, the unimpacted reaches were evaluated as a single unimpacted reach. However, this composite unimpacted reach is comprised of reaches from different order streams. Therefore, the concept of subreach refers to the unimpacted reaches from different order streams. The total area of the composite unimpacted reach was calculated as described in the third sub-bullet.

262. Section 2.2, p. C-4, Equation (2). Please provide a citation for this equation. We can find no similar equations or methods in Gilbert (1987). It is inappropriate to include a weighted mean and an unweighted standard deviation in a single equation; the standard deviation should be weighted.

Response: Upon further review, it was decided that approaches described in the literature (for example, Gilbert 1987 and Cochran 1977) for calculating weighted means and confidence limits for simple random stratified designs are inappropriate for estimating these quantities using the

data from this investigation. In particular, estimates of the within-reach variability are required for these calculations, and many of the reaches in this study only contain a single observation. The approach described in Section 11.12.2 in Gilbert (1987) for estimating confidence limits for regional means has been adapted for use in this study. The regional means approach does not require an estimate of the variability within strata, but rather relies on an estimate of the standard error for the regional mean (that is, grand mean of all strata), calculated as the standard deviation of the means of the individual strata. For this investigation, weighting factors, based on the relative aerial extent of each stratum (reach), were used to calculate the weighted mean for each stratum and the weighted mean of all strata (sum of the weighted means for individual strata), and these means were used in equation 11.21 in Gilbert (1987). The report will be revised to reflect this change.

263. Section 2.2, p. C-4, "General Procedure," 1st bullet. How does the standard error equate to the standard deviation? Please provide a citation for this assumption. Standard error is defined mathematically in each of the more than two dozen statistical textbooks we've checked as the standard deviation divided by the square root of the number of samples. Another way to look at this parameter is that the standard error is the standard deviation of the mean—is this what the authors intended?

Response: See response to Specific Comment 262.

264. Section 2.2, p. C-4, "Assumptions," 1st bullet. Earlier in the appendix, it was stated that reach-specific means weren't calculated; rather, reach-specific means were approximated by the sole value for each reach that was available. Please clarify this apparent inconsistency.

Response: In some cases, only a single sampling point was located in a given reach. In these cases, reach-specific means were estimated based on analytical results from the single sample. That is, single observations were used as surrogate measures for the mean. In other instances, multiple sampling locations are present in a given reach. In these cases, the mean was calculated based on the available data. Appendix C will be reviewed and any inconsistencies clarified

265. Section 2.2, p. C-4, "Assumptions," 3rd bullet. That reach-specific values throughout a watershed are normally distributed is a poor null hypothesis. Widespread spatial variability in the environment is generally well characterized as lognormal.

Response: Using the modified regional means approach described in the response to Specific Comment 262, the assumption of normality is now applied to the distribution of the means for all reaches. It is not unreasonable to expect that the distribution of the means is normally distributed, even though the distribution of the individual measurements within individual reaches may not be.

266. Section 2.2, p. C-4, "Assumptions," 4th bullet. Of what relevance is an unweighted standard deviation (previously referred to by the authors as a standard error) within the context of a weighted mean? We question its validity.

Response: See response to Specific Comment 262.

267. Section 3.0, p. C-5, Equation (3). This equation should be based on area rather than length. Also, the equation is erroneously set equal to a summation sign, whereas it should be set equal to the WAC. A summation sign is not a variable; rather, it is an operator. Setting an equation equal to a summation sign would be equivalent and as nonsensical as setting an equation equal to an addition sign.

*Response: Because the riparian area is assumed to be 82-feet wide for all stream reaches, width need not be considered and AWACs may be calculated based only on length. The equal sign will be removed from Equation **3**.*

268. Section 3.0, p. C-5, "Assumptions," 1st bullet. While the riparian zone of the Blackfoot River may occasionally extend to 80 feet in total width (i.e., including both sides of the stream), that is twice what IMA has assumed in past efforts in laying out sampling quadrats. For 1st and 2nd order streams, IMA's total quadrat width was 10 feet. The equation used herein is going to result in an over-representation by small tributary streams.

Response: Comment noted. The uncertainty associated with the assumption will be discussed in the uncertainty section.

269. Section 3.0, p. C-5, "Assumptions," 2nd bullet. It appears that there is only one analytical result per reach per medium. Please clarify.

Response: See response to Specific Comment 264.

270. Section 3.0, p. C-5, "Assumptions," 3rd bullet. For impacted reaches (i.e., reaches downstream of an historic or active phosphate mine lease) of a certain stream order, the mean concentration would be better represented by the WAC calculated from the data available for impacted streams of that stream order rather than from all impacted analytical data (which hopefully just includes stream data). Even if the authors don't choose to use order-specific weighted means, an overall weighted mean would be far more representative than use of an overall unweighted mean, which is what this bullet is interpreted to indicate.

Response: See responses to Specific Comments 260 and 261.

271. Section 3.0, p. C-5, "Assumptions," 4th bullet. Apparently, this bullet indicates that the WACs for unimpacted reaches (i.e., background reaches, or those upstream of any phosphate mine lease) are not WACs. For consistency and comparability, these should be calculated with the same methodology used for impacted reaches.

Response: See response to Specific Comment 261.

272. Section 4.0, p. C-6, Equation (4). The equation is erroneously set equal to a summation sign, whereas it should be set equal to the WAC.

Response: Equation 4 will be revised.

273. Section 4.0, p. C-6, "Assumptions," 2nd bullet. If the data from the spring 2001 waste rock sampling was used in this equation, it was used inappropriately. These data are grossly biased toward high Se contents and undoubtedly high concentrations of other trace elements, too. This is because IDEQ representatives made sure that the samples were taken in a non-random manner with a distinct bias toward the relatively unweathered black shales, if any such shales could be observed on a dump surface. Statistics performed on these waste rock data have no credible meaning.

Response: The Agency disagrees with this assertion. In fact, the majority of the historic waste rock piles do have shales at the surface and the samples are representative. Measures were taken to ensure these conditions were not misrepresented in selecting sampling locations. Even though the

waste rock piles comprise thousands of acres, this is a very small percentage when averaged with background soils over the entire Resource Area. While this approach may not conform with rigid statistical analysis, the result is certainly within the accuracy of risk assessment needs and would not result in exposure areas that are "grossly biased toward high selenium contents."

274. Section 4.0, p. C-6, "Assumptions," 3rd bullet. What analytical data are available for unimpacted soils throughout the Resource Area, other than those obtained by IMA for undisturbed Phosphoria outcrops? How were these data spatially partitioned with regard to Equation (4)?

Response: Additional data on unimpacted soils was available from the TtEMI 2001 sampling and the IMA 2001 sampling associated with collection of vegetation, terrestrial invertebrates, and small mammals. This data was spatially partitioned using geographic information system (GIS) data to separate upland and riparian area soils and impacted soils. As described in the draft risk assessment, some simplifying assumptions regarding areal extent were used to provide area weightings. This data was then used to calculate area-weighted concentrations.

275. Section 4.0, p. C-6, "Assumptions," 4th bullet. Again, assuming that all riparian zones are 82-feet wide, regardless of stream order, biases any statistics in favor of the smaller streams.

Response: Comment noted. The uncertainty associated with this assumption will be discussed.

276. Section 4.0, p. C-6, "Assumptions," 5th bullet. What was the IDEQ's secondary source of pile area information?

Response: IDEQ obtained GIS data from the U.S. Geological Survey (USGS) that provided areal extent of numerous features associated with the mines in the area.

277. Section 5.0, p. C-7, Equation (5). There are two summation signs missing. Also, MUC and AURP should each include a subscripted j. Is residential property defined only as riparian property? Does residential property exclude federal-, tribal-, or state-owned property? Does residential property exclude water body areas? Are waste rock piles assumed to be residential property? What sampling program was residential property characterized under?

Response: Summation signs will be added and parameters subscripted as appropriate. Residential property is defined as property adjacent to a stream and including the riparian area and excludes federal-, tribal-, or state-owned property except if any land is deeded in a manner allowing for residential development. Residential property does exclude water body areas for the purpose of calculations. Waste rock piles are not considered residential property. Residential property was not the subject of a specific sampling plan. Rather, riparian area samples were used (among other purposes) to characterize potential residential locations.

278. Section 5.0, p. C-7, "Assumptions," 1st bullet. Again, an 82-foot riparian zone for all streams is not a good assumption.

Response: Comment noted. The uncertainty associated with this assumption will be discussed in the revised appendix.

279. Section 5.0, p. C-7, "Assumptions," 2nd bullet. Where is the subsistence lifestyle receptor's residential property located? No IMA personnel have ever observed such a property anywhere within the resource area. Why would a subsistence lifestyle receptor, someone of the like no IMA

personnel has ever observed in the area, feel constrained to subsist within a half acre of land? Subsistence endeavors generally entail the need to hunt, gather, and farm over large areas.

Response: The subsistence lifestyle receptor is assumed (for the purposes of the soil and homegrown produce calculations) to live on property adjacent to a stream (including a riparian area). As discussed elsewhere in the responses, the AWHHRA will be revised to clarify that no such residences have been observed in the Resource Area. The subsistence lifestyle receptor is not assumed to be confined to a 0.5-acre property. However, there may be members of a subsistence lifestyle family (young children and elderly individuals) who spend all or the majority of their time in an area immediately surrounding the residence. It is this area that is assumed to be limited to 0.5 acre.

280. Section 6.0, p. C-8, "Goal." In general, when making reference to a UCL, the parameter for which to confidence limit applies should be specified—in this case, the mean.

Response: Appendix C will be revised to specify the parameter for which the confidence limit applies.

281. Section 6.0, p. C-8, Equation (6). Why would anyone assume beef or elk tissue concentrations to be normally distributed? A far better a priori assumption is log normality.

Response: Equation 6 was presented only as an option. In presenting the equation, no a priori assumption was made regarding distribution of beef or elk tissue concentrations.

282. Section 6.0, p. C-8, Equation (7). This equation should be as follows:

$$UCL_{\bar{x},0.95} = e^{\bar{x}_T + 0.5s_T^2 + s_T H/\sqrt{n-1}}$$

The subscript 'T' denotes that the data are ln-transformed.

Response: Equation 7 will be revised to be consistent with EPA's "Calculating the Concentration Term" guidance (EPA 1992).

283. Section 6.0, p. C-8, 1st full paragraph. The number of cattle penned in on Henry Mine for nine weeks then carried through the depuration study is 15, not 14. Use of these data to represent beef consumed should be qualified as highly conservative as cattle aren't penned in on waste rock dumps under normal circumstances.

Response: The number of beef cattle will be corrected. With regard to the conservative nature of the seleniferous study, Section 6.2.7 of the AWHHRA will be revised to state that the steers were confined on a seleniferous pasture for the purpose of the study and that such confinement is not a normal practice. While cattle are not typically penned on waste rock piles, the reclaimed areas present the most palatable forage in the Resource Area and would appear to attract free ranging animals. The IDEQ would need further information to conclude this study represents a "worst case" scenario.

284. Section 6.0, p. C-8, 1st full paragraph. The "after-the-fact treatments" column of the elk data is how each elk was classified on an a posteriori (after-the-fact) basis—as either a background or a Se-elevated elk. In MW (2000), 26 of 91 elk were classified as Se-elevated, but for purposes of this

assessment, all 91 elk should be used, as all 91 came from the study area and the use of only those 26 that were deemed to be contaminated imparts an avoidable and unnecessary bias.

Response: The EPCs for elk tissue were based on the 26 elk identified as "after-the-fact treatments" because of the use of a FI value of 0.29 (see Table 6-1). This FI value represents the fraction of elk with elevated selenium tissue concentrations. Because this FI value is used, it is appropriate to base the elk tissue EPCs on the "after-the-fact treatment" elk results.

285. Section 6.0, p. C-8, "General Procedure," 1st bullet. A statistical hypothesis test requires a null and an alternative hypothesis. These are not apparent in the distribution-fitting scheme that was used.

Response: Comment noted.

286. Section 6.0, p. C-8, "General Procedure," 2nd bullet. Why are two different types of means mentioned here? A geometric mean of a lognormal distribution is meaningful only in that it is the median. This statistic has no significance for normal or other distributions.

Response: The second bullet under "General Procedure" will be revised to remove the parenthesis after the word "mean."

287. Section 6.0, p. C-9, "Assumptions," 1st bullet. The 91 elk, not 26 of 91, from 1999 accurately represent what hunters are exposed to.

Response: See response to Specific Comment 284.

288. Section 6.0, p. C-9, "Assumptions," 2nd bullet. While each distribution has a true mean, no distribution has a true upper confidence limit of said mean. Confidence limits are intended to bound true parameters with a specified level of confidence.

Response: Comment noted. The procedure followed is consistent with EPA guidance (EPA 1992).

<u>Appendix D – Human Health Toxicity Profiles</u>

289. General comments. There appears to be a font error, as indicated by the reference to a required Se intake of 100 µg per day. Selenium sulfide is an ingredient found in some medicated anti-dandruff shampoos that are available over the counter. Furthermore, SeS is not likely to be encountered in nature. Also, the epidemiological studies that USEPA used to derive their chronic oral RfD appear to show that adults, not children, are more susceptible to selenosis. In particular, adults who had experience previous selenosis seemed to be most susceptible. If the RfD is based on reintoxication of already intoxicated persons, its validity is questionable, as it should be based on the intoxication of unintoxicated persons. If intoxicated persons were defined to be the sensitive subpopulation, a zero dose would be sufficient to put them over the intoxication threshold (i.e., they are already intoxicated and the exercise is meaningless).

Response: The units of the required selenium intake will be corrected. The summary of the basis for the EPA RfD will be reviewed and revised, as necessary.

<u>Appendix F – Ecological Toxicity Profiles</u>

290. Section 1.1, p. F-1, 2nd paragraph, 2nd sentence. Cadmium is only a carcinogen by the inhalation pathway, and there is no evidence of carcinogenicity in either humans or animals by the oral route

(IRIS, 2002). This is an important distinction, since oral exposure pathways are most relevant to ecological receptors. Please clarify the statement to reflect that cadmium is only carcinogenic by the inhalation pathway.

Response: The text will be revised to clarify the issue of cadmium carcinogenicity.

291. Section 1.5.1, p. F-15, 2nd paragraph, 4h sentence. "Selenium is translocated to all parts of the plant, including the see, in low-molecular-weight compounds…" Should this say, "… including the seed, in low…"?

Response: The text will be revised to correct the typographical error.

292. Section 1.6.1, p. F-19, 3rd paragraph, 1st sentence. note extra ")".

Response: The text will be revised to correct the typographical error.

Appendix G – Area Wide Ecological Risk Assessment Hazard Calculations

293. Many of the tables are formatted in a manner such that they cannot be read when printed. The font is so small that it must be magnified by 800% to view the writing on screen. Please re-format the following tables for ease in reviewing electronic and printed forms:
   Table G-12 ERA Tier 1 HQ Mink.pdf
   Table G-18 ERA Tier 2 Blackfoot River HQ Mink.pdf
   Table G-25 ERA Tier 2 Blackfoot River HQ Raccoon.pdf
   Table G-31 ERA Tier 2 Salt River HQ Mink.pdf
   Table G-38 ERA Tier 2 Salt River HQ Raccoon.pdf
   Table G-44 ERA Tier 2 Georgetown Creek HQ Mink.pdf
   Table G-51 ERA Tier 2 Georgetown Creek HQ Raccoon.pdf
   Table G-57 ERA Tier 2 Background HQ Mink.pdf
   Table G-64 ERA Tier 2 Background HQ Raccoon.pdf

Response: See response to General Comment 3.

294. Table G-11 is formatted in a manner such that it requires 34 pages. Please reformat this table for ease in reviewing in the printed form.

Response: See response to General Comment 3.

Appendix H – 2001 Area Wide Sampling Data

295. General Comments. Appendix H 2001 Area Wide Sampling Data – is not included with the risk assessment. Per a voice mail from Tetra Tech EMI, Inc., this data will not be compiled and available until the end of June. Data used in the risk assessment should be appended to the risk assessment for purposes of review and interpretation of the methods and results of the risk assessment. The Society of Environmental Toxicology and Chemistry defines sound science as "organized investigations and observations…leading to verifiable results and conclusions." Without access to the data used, one cannot even begin to verify results and conclusions; therefore, by definition, the draft assessment cannot be regarded as sound science.

Response: Appendix H was provided during the public comment period as intended and an additional seven days were added to allow review. Please refer to response to General Comment 3.

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Responses to U.S. Environmental Protection Agency
Comments on the Area Wide Human Health Risk Assessment

IDEQ Response Foreword: *The Idaho Department of Environmental Quality (IDEQ) appreciates U.S. Environmental Protection Agency's (EPA) review of the draft Area Wide Human Health Risk Assessment (AWHHRA) and provides the following responses to the concerns raised in the Agency's comments. In order to explain the rationale behind some of the State's risk estimation approaches, the IDEQ feels it would be helpful to provide some background information that has been accumulated over the last several years. Of particular interest is IDEQ's decision to assess a hypothetical Area Wide subsistence use scenario to develop conservative upper bound risk estimates.*

The Resource Area is very sparsely populated by ranchers, none of whom rely solely on study area resources for subsistence. Impacted zones make up a small percentage of the overall study area and occur primarily on public lands that prohibit residential use. While the IDEQ is aware that selected members of the local population may rely on area resources for a significant supplement to their diets, we agree with the Idaho Department of Health's (IDH) previous health consultation conclusion that a subsistence lifestyle is unrealistic. However, with the lack of empirical data on the exact level of local resource use, the Department explicitly chose a significantly conservative scenario to eliminate risk concerns for lesser users.

It should also be noted that numerous meetings were held, both during the scoping process and subsequent to the publication of the draft risk assessment between the State and Tribal representatives to discuss the Native American scenarios. The reference values selected by the IDEQ are considered to represent reasonable maximums for regional Tribal use applications based on those discussions and we have received the general concurrence of the Tribes with respect to our direct physical health risk estimation approach and conclusions. Many of the EPA's recommendations, with regard to Tribal use scenarios, unreasonably compound the conservatism of already highly conservative area wide models, and tend to disregard the Agency's guidance to apply site-specific knowledge where appropriate. We hope the following responses to your comments will clarify our selected risk estimation approaches and allay many of your concerns.

Page 19, Use of Region 9 PRGs: For non-carcinogens, EPA Region 10 is using an HQ of 0.1 for comparison with Region 9 PRGs. It should be verified that an HQ of 0.1 was used.

> ***Response:*** *It is acknowledged that EPA Region 10 typically uses a hazard quotient (HQ) of 0.1 to compare with EPA Region 9 preliminary remediation goals (PRG). However, in the context of the AWHHRA, comparison of a HQ of 1 to EPA Region 9 PRGs was determined to be sufficiently conservative for the following reasons. First, the AWHHRA considered inorganic constituents as chemicals of potential concern (COPC) for all media if they were identified as a COPC in any one medium. This step is often not taken in many risk assessments and adds a layer of conservatism. Second, use of the EPA Region 9 tap water PRGs as the basis for comparison to surface water concentrations is considered to be very conservative because study area streams are not used as drinking water sources and receptors are assumed to be exposed to surface water through ingestion only on a limited basis while engaged in outdoor recreational activities. Third, the comparison to EPA Region 9 PRGs was not the driving factor in selecting COPCs for many of the media. Specifically, all chemicals identified in waste rock above regional concentrations were selected as COPCs. Also, all chemicals found at concentrations above background levels in soil and sediment were selected as COPCs for terrestrial (including homegrown produce) and aquatic plants. Fourth, several media, including ingestion of beef and elk tissue, do not have EPA Region 9 PRGs. Therefore, a modification in the HQ used would not impact the media-specific COPC selection for these media. Fifth, beef tissue samples were analyzed only for selenium, and elk tissue samples were analyzed only for selenium and cadmium; use of an*

HQ of 0.1 would not impact the COPCs considered for these media since selenium and cadmium were selected as COPCs in the AWHHRA.

The media most likely to be impacted by using an HQ of 0.1 rather than 1 for comparison to benchmarks are fish and surface soil. It should be noted that fish tissue concentrations were compared to compound-specific values equal to one-tenth of EPA Region 3 risk-based concentrations (RBC) for fish ingestion. In addition to selenium and cadmium, the concentrations of aluminum, copper, iron, and zinc exceeded their compound-specific values. These compounds are present at maximum concentrations in fish tissue equal to about 10, 14, 60, and 30 percent of their respective RBCs. Similarly, comparison of surface soil concentrations to values equal to one-tenth of EPA Region 9 PRGs identified only four additional COPCs: antimony, nickel, uranium, and vanadium. These compounds are present at maximum concentrations in soil equal to only about 50, 20, 50, and 90 percent of their respective PRGs. Therefore, addition of these compounds (aluminum, antimony, copper, iron, nickel, uranium, vanadium, and zinc) as COPCs would not significantly impact the results of the AWHHRA. Finally, the Region 9 PRGs are based on residential scenarios. There are no human receptors known to reside in the areas exhibiting maximum concentrations for any media tested. Maximum soil and vegetation levels occur on reclaimed waste rock piles within mine lease boundaries and predominantly on public lands. These areas are not and will not be developed for residential use. The highest water column and fish tissue concentrations occur in 1st order streams on public lands. Because of the observed conditions, these streams have been subject to a high frequency of inspection and sampling over the last several years by interagency representatives. There has never been any observed fishing on the highly impacted 1st order streams and the areas are relatively inaccessible during winter. Therefore, the use of a maximum observed concentration for COPC screening and Tier 1 reasonable maximum exposure (RME) purposes has already assumed an ultra-conservative upper bound risk estimate.

Given the minimal impact a revision of comparing an HQ of 0.1 rather than 1 to EPA benchmarks would have on the results of the AWHHRA, and the multiple layers of conservatism that already exist in the current approach, the COPCs selection methodology comparing medium-specific concentrations to EPA benchmarks based on an HQ of 1 is deemed to be appropriate and protective in identifying upper bound risks.

Page 22, 6.1.1 Tier I, Exposure Point Concentrations (EPCs): How was it determined that a particular stream could not support subsistence resource use?

Response: *For the purpose of Tier 1, the only streams that were eliminated (that is, from which maximum contaminant concentrations were not selected) were streams such as Maybe Creek that have been observed to be currently devoid of aquatic life and East Mill Creek that is located on public lands and has been subject to several years of close observation through which time fishing has never been observed. East Mill Creek is currently being processed for a precautionary fish consumption advisory by the IDH. These are both small 1st order streams and are basically inaccessible for half the year. It should be noted that even though fish tissue concentrations from these streams were not considered under Tier 1, fish ingestion was retained for further analysis under Tiers 2 and 3. For the purpose of calculating EPCs under Tiers 2 and 3, stream segments that currently do not support aquatic life were considered to be impacted and were used to weight the analytical results from fish tissue samples collected from watershed-specific impacted reaches.*

How was transport from waste rock piles to fluvial or riparian soils evaluated?

Response: *Conceptually the potential transport of compounds from waste rock piles to fluvial or riparian soils was assumed to occur through several release and transport (R/T) mechanisms including erosion, surface runoff, and fugitive emissions and subsequent deposition (see the human health conceptual site model [CSM] - Figure 3). Quantitatively, the AWHHRA did not model the migration of compounds from waste rock piles to fluvial or riparian soils. Rather, the AWHHRA calculated potential exposures to compounds in surface soil based on analytical results for fluvial or riparian surface soil samples collected from the study area. To the extent compounds have migrated from waste rock piles to fluvial or riparian areas, the analytical results considered in the AWHHRA will reflect this migration. However, subsequent site-specific investigations will continue to assess local migration paths through runoff, sediment and riparian/fluvial soil sampling.*

Page 24, 6.1.3 Tier 3, Detail: Though a stream may not support aquatic life now, a determination should be made as to potential future resource availability if the site is remediated. It is circular reasoning to say that cleanup is unnecessary because pollution has eliminated biota that would pose health risks when ingested by humans.

Response: *The referenced section does not state that cleanup is unnecessary; it refers to the existing human health risks posed by the streams. It is presumed that streams remediated to meet federal and state regulatory standards, as is the State's intent, would no longer present any human health risks. As noted under the response to the comment on Section 6.1.1, the fact that streams currently do not support aquatic life meant that no tissue samples were available to consider under Tier 1. Nonetheless, fish ingestion was retained for further analysis under Tiers 2 and 3. For the purpose of calculating EPCs under Tier 3, stream segments that currently do not support aquatic life were considered to be impacted and were used to weight the analytical results from fish tissue samples collected from watershed-specific impacted reaches. Future stream-specific evaluations will be performed, as necessary, during the planned site-specific investigations and individual impacted stream segments will be addressed in the EE/CA process.*

The potential for exposure to biota containing contaminants from a particular stream should also be evaluated. Angler behavior should be considered. Individuals may frequent specific fishing areas. In particular, any information on tribal fish consumption patterns should be evaluated. Combination of concentration data from multiple streams in a watershed may result in an underestimate of exposure concentrations.

Response: *The primary purpose of the AWHHRA was to evaluate exposures and to characterize risks and hazards across the study area. It is acknowledged that combining concentration data across watersheds could underestimate exposure concentrations if individual receptors fished from impacted stream reaches at a greater frequency than predicted by the relative presence of impacted and unimpacted stream reaches. However, the average exposure point concentration used for each watershed evaluation is heavily influenced by the high concentrations observed in a relatively few individual 1st order streams that we know are not subject to subsistence level use through frequent site inspections. Additionally, the fish tissue concentrations are based on whole body analytical results to allow for potential tribal use in stews or soups; however, edible fish tissue would more frequently consist of muscle tissue or skin-on fillets exhibiting much lower concentrations than those represented in whole body analysis. As noted in the AWHHRA, the potential for any stream reach to support the fish ingestion exposure scenario should consider at least the following factors: the number, type, size, and species of fish present (or likely to be present in the future), stream accessibility, and whether spawning has been observed in a stream. (Note: the presence of spawning increases the likelihood of sizeable fish in a stream). Based on our application of a hypothetical subsistence scenario model, the use of whole body analytical results, and disproportionate weighting of watershed averages by a limited number of highly impacted 1st order streams known to have limited access and low, if any, fishing use, the State believes the calculated EPCs represent highly conservative estimates of potential human exposure.*

Page 32, 6.4.2 Exposure Pathways Evaluated Quantitatively: What's the distinction between the Native American plant ingestion pathway that is being evaluated quantitatively vs. the Native American plant ingestion pathway that is being evaluated qualitatively?

> ***Response:*** *The quantitative risk estimates for plant ingestion pathways were based on six common traditional plant species selected as surrogates in collaboration with Tribal Risk Assessment Committee representatives during the scoping process. Subsequently, the State agreed to address other potential plant ingestion Tribal use pathways qualitatively due to the diverse and proprietary nature of medicinal, ceremonial and cultural traditional uses by the Tribes. The State believes direct ingestion health risks are well represented by the existing quantitative evaluation process but acknowledges the potential for increased risks from unspecified Tribal uses.*

<u>Comments on Exposure Parameters in Table 6-1</u>

Terrestrial and Aquatic Plant Ingestion Rates: Were tribal representatives contacted regarding ingestion rates of native plants? Using general population ingestion rates of native plants is an inappropriate surrogate for ingestion of these plants by Native Americans.

> ***Response:*** *Meetings were held with tribal representatives on March 16, 2001 and April 25, 2001 to discuss the proposed Native American risk assessment process, exposure pathways and surrogate species. Meeting attendees included Jeanette Wolfley, Shoshone Bannock Tribal Counsel; Dan Christopherson, Tribal Wildlife Staff, Sam Hernandez, U.S. Bureau of Indian Affairs; Jeff Jones, U.S. Forest Service; Rick Clegg, IDEQ; and Joe Davis and Mike Puett, Tetra Tech EM Inc (TtEMI). In the initial meeting, the risk assessment process was discussed and the State's goal of respecting existing treaty rights and incorporating tribal hunting, fishing and gathering aspects in the process. It was also explained that the Area Wide risk assessment was intended to represent regional level use common to all mining areas and not unique conditions from any one individual mine, particularly Gay Mine, which is on the Reservation. Jeanette informed the State of upcoming meetings with the Tribal Council and EPA, and a follow-up meeting was scheduled. At the subsequent meeting, Jeanette provided a list of common traditional species developed with the assistance of Tribal Risk Assessment Committee members. We discussed the generic uses for the plant species and were informed that some members of the Tribe occasionally use the Resource Area for hunting, fishing and gathering. However, due to the distance from the Reservation and the presence of other productive hunting, fishing and gathering areas in the vicinity of the Reservation, the Committee did not believe any Tribal members exclusively used the Resource Area at a subsistence level. Based on these conversations, the use of general population ingestion rates for produce was deemed an acceptable surrogate for ingestion of native plants by Native American receptors. Subsequently, the Tribes have provided their general concurrence on the risk assessment approach and conclusions within the limitations of direct physical health hazards.*

Plant-Based Tea Ingestion Rate: The proposal to use twice the CTE ingestion rate for RME seems inappropriate given the fact that RME tea ingestion rates are available. A more appropriate value would be something in the vicinity of 0.6 L/day, approximately the 95% UCL on the mean. These values might be modified based on consultation with members of the Shoshone-Bannock tribe.

> ***Response:*** *As discussed in footnote 8 to Table 6-1, Hopkins and Ellis (1980) reported the results of a study of Great Britain receptors. These results are not considered representative of study area receptors, because individuals from Great Britain are expected to drink more tea than study area receptors and the study area receptors are not relying solely on Resource Area, let alone plants exclusively from impacted areas for subsistence level use. Therefore, because the 95th percentile tea ingestion rate (0.630 liters [L] per day) reported by Ershow and others (1991) is similar to the 95 percent upper confidence limit (UCL_{95}) of the mean*

reported by Hopkins and Ellis (1980) (see footnote 8 to Table 6-1), the use of an ingestion rate of 0.630 L/day was assumed to be sufficiently conservative in the context of evaluating RME conditions. However, in lieu of increasing the ingestion rate estimate, exposure frequency (EF) values will be increased from 91 days/year to 365 days/year. The increase in EF values, while retaining the existing ingestion rates for the Native American adult and child receptors, applies an additional level of conservatism to the RME conditions.

Fraction Plant Ingested: Disagree with use of fraction of plant ingested value of 0.75 for subsistence produce consumers. Subsistence produce consumers will take 100% of their consumption from their home gardens. It is anticipated that produce would be canned/preserved and used outside of the growing season. The discussion of growing season doesn't seem relevant.

Response: *It is possible that subsistence lifestyle receptors could can or preserve produce for consumption outside the growing season. However, the State is currently unaware of any home gardens in the vicinity of impacted zones and had included this subsistence level pathway only as a precaution. To assume all produce ingested by local residents comes from homegrown gardens is unrealistic, and the short growing season limits the ability to grow many foodstuffs. Nonetheless, Table 6-1 will be revised to present a fraction plant ingested (FI) of 1. The text will be revised accordingly; a discussion of the Resource Area-specific growing season will be included to provide context for the assumption that produce might be canned.*

EPA disagrees with a use of 0.25 for the fraction for Native Americans consuming vegetation harvested from mining areas. A value of 1.0 should be assumed unless consultation with the Shoshone-Bannock Tribe indicated the 0.25 value. Foraging individuals may return to areas where plants were previously obtained.

Response: *Based on formal discussions with Tribal representatives, it is apparent that the Resource Area is not used exclusively for subsistence use. Changing the value to 1 assumes not only that an individual may return to an area where a plant was previously obtained but that they would return to every area of every plant obtained for all dietary needs and that every plant and area is located in an impacted zone. As stated in footnote 14 to Table 6-1, while Native American receptors may be expected to return, in some instances, to known locations of native plants in the study area, there are certainly other locations and sources of traditional plants outside the limited locations in the study area potentially impacted by mine releases. The Fort Hall Indian Reservation is about 60 miles from Soda Springs and the western side of the study area. While it is possible that receptors may gather native plants from locations potentially impacted by mine releases, an "all or none" assumption is inconsistent with an RME approach as described in EPA guidance. Therefore, the assumption that Native American receptors gather no more than a fourth of their native plants from locations potentially impacted by mine releases is considered by the State to be an adequately conservative assumption.*

Fraction of Cattle Ingested: EPA disagrees with a value of 0.157. Supporting information from the Montgomery Watson "Final – '98 Regional Investigation Report" should be supplied. Ranchers with herds grazing on Se bearing lands would be expected to obtain 100% of their beef consumption from contaminated land.

Response: *The basis for the cattle FI used in the AWHHRA is summarized in footnote 15 to Table 6-1. It is acknowledged that if a rancher raised beef cattle that ranged only on seleniferous pastures in the study area, that rancher would be expected to ingest beef with elevated selenium concentrations at a rate likely to be higher than 15.7 percent (FI = 0.157). However, we are also aware that the majority of seleniferous vegetation occurs on reclaimed waste rock dumps and in some riparian zones that may be part of allotted grazing area but would not present exclusive forage. Therefore, ranchers raising beef that graze only on seleniferous pastures in the study area is highly unlikely. Also, as noted in footnote 15 to Table 6-1 (adopted from Montgomery Watson [MW] [1999]), 16.7 percent of the cattle grazing on leases in the Soda Springs*

District of the Caribou National Forest have the potential to be exposed to seleniferous pastures. While these cattle have the potential to be exposed to seleniferous pastures, it is unlikely that the cattle will graze exclusively on seleniferous pastures.

The FI value used in the AWHHRA was calculated by merging beta distributions for the general public and ranchers, with the distribution for the general population being given 100 times greater weight (based on the assumed relative number of individuals in each population). Therefore, the FI was calculated in a manner similar to the way in which medium-specific EPCs were calculated. Similar to the response regarding angler behavior, it is noted that there may be individuals that experience an FI greater than 0.157. However, the AWHHRA is intended to be a regional study based on exposure throughout the study area. The potential for individuals to be exposed at a higher FI value is more appropriately evaluated in mine-specific risk assessments if an adjacent rancher is determined to have exceptionally high use of seleniferous pasture areas.

As discussed in Sections 6.7 and 6.8 of the AWHHRA, the highest receptor-specific hazard associated with ingestion of skeletal muscle and offal from beef cattle was re-calculated as 1.9E-01 for the Native American child receptor under Tier 1 (based on maximum detected COPC concentrations) (see Section 6.7.1.2). Under Tier 2, which is based on EPCs calculated as UCL_{95} values, the highest receptor-specific hazard associated with ingestion of skeletal muscle and offal from beef cattle was calculated as 1.2E-01 for the Native American child. Even if the FI value were revised from 0.157 to 1, the hazard for the Native American child would still be less than 1 (0.83).

Therefore, the State believes the FI used in the AWHHRA should remain at 0.157. However, the potential for individuals to be exposed to skeletal muscle and offal from only beef grazed on seleniferous pastures in the study area (FI = 1) and the resulting impact on receptor-specific hazards will be discussed in the uncertainty section.

Wild Game Ingestion Rate: The utility of Exposure Factors Handbook values should be evaluated. Comments from the Shoshone Bannock Tribe should be elicited as to the amount of wild game consumed. Harper and Harris, in evaluating Spokane Tribe subsistence exposures (Risk Analysis, 2001), are advocating a small game consumption rate of 50 g/day or approximately 0.6 to 0.7 g/kg/day. This is in stark contrast to the subsistence rate of 0.026 used in the risk assessment.

Response: *Based on discussions with the Tribal representatives, the Resource Area is not used exclusively for subsistence due to the presence of local resources. For the purposes of the regional assessment, subsistence lifestyle receptors are assumed to obtain the majority of their foodstuffs from their immediate environment and a smaller portion of their foodstuffs from commercial sources. This would seem to particularly apply to hunting and consuming small game, whereas, larger game with longer hunting periods may warrant the additional travel. In the AWHHRA, subsistence lifestyle receptors are not conceived of as an individual living in isolation entirely off of nature. Furthermore, subsistence lifestyle receptors are assumed to ingest elk, which is a large game animal. Therefore, the use of a subsistence wild game ingestion rate based on a study of subsistence ingestion of small game is expected to be overly conservative given that a true subsistence receptor is considered unrealistic in the study area.*

Nonetheless, the AWHHRA used the same RME wild game ingestion rate for both recreational hunters/fishers and subsistence lifestyle receptors. In order to reflect the potential that subsistence lifestyle receptors are expected to obtain the majority of their foodstuffs from their immediate environment, in contrast to recreational hunters/fishers who are expected to ingest different foodstuffs at rates consistent with general population ingestion rates, the wild game ingestion rate for subsistence lifestyle receptors will be revised as follows. Currently, the wild game ingestion rates for both recreational hunters/fishers and subsistence lifestyle receptors are based on the 95th percentile for the general population (see footnote 18 to Table 6-1).

In order to reflect the potentially higher ingestion rate of subsistence lifestyle receptors as compared with recreational hunter/fishers, the wild game ingestion rate for subsistence lifestyle receptors under RME conditions will be based on the 99th percentile. This change represents an approximate 10-fold increase in wild game ingestion rates for subsistence lifestyle receptors (0.026 g/kg/day versus 0.32 g/kg/day). It should be noted that even with this increase, hazards associated with ingestion of elk (wild game) remain less than 1. The table is correct.

Fraction Wild Game Ingested: It would be good to be able to review the Montgomery Watson study on Se content of elk meat. How was a figure of 29% arrived at? The variability of Se contamination with different land tracts should be assessed. 58% may or may not be a good estimate of the fraction of elk with elevated Se levels in other resource management areas.

Response: *As stated in MW's "1999 Interim Investigation Data Report," the IMA Selenium Committee and the Idaho Department of Fish and Game cooperated to collect elk tissues samples from elk hunters who harvested from game management units 76 and 66A. These two game management units overlap the majority of the study area (MW 2000). Therefore, evaluation of tissue concentrations from elk harvested in these game management units is a good indicator of the potential variability of tissue concentrations that receptors may be exposed to through ingestion of elk (game) tissue from throughout the study area.*

A total of 91 animals had both liver and skeletal muscle samples analyzed. MW statistically evaluated the analytical results from the liver and skeletal muscle samples using several different techniques. Primary among the techniques used were principal components analysis (PCA) and a minimum variance cluster analysis (MVCA). Based on these techniques (see Section 4.3.2 and Appendix I of MW's "1999 Interim Investigation Data Report), 26 of the 91 animals (29 percent) were defined as mine area or potentially elevated elk.

As stated in footnote 20 to Table 6-1, it was assumed that recreational and Native American receptors will hunt throughout the study area (as represented by game management units 76 and 66A), and will, therefore, have an approximately 29 percent chance of encountering and taking (harvesting) an elk with elevated selenium levels. It was also assumed that a subsistence receptor would potentially hunt closer to home (assumed to be in areas of elevated selenium concentrations) and would, therefore, presumably encounter elk with elevated selenium concentrations more frequently than recreational or Native American receptors. In order to account for the potentially greater frequency that subsistence lifestyle receptors may encounter elk with elevated selenium concentrations, an FI value of 0.58 (or twice the value for recreational and Native American receptors) was assigned to the subsistence lifestyle receptor. The potential uncertainties associated with the FI values used will be discussed in the uncertainty section of the AWHHRA.

Inhalation Rate: Please verify the elk hunting methods. Individuals freely ranging over the land to hunt elk would be expected to have higher inhalation rates than those using blinds.

Response: *Agreed; the final document has been revised to include free ranging hunters. The inhalation rate has been changed from a light level of activity to moderate, and the duration of exposure has been increased from 4 hrs/day to 8 hrs/day. The text of the AWHHRA and footnote 21 of Table 6-1 will be revised to more clearly document the conditions under which exposure through inhalation of particulates is evaluated.*

Exposure Frequency Plant Based Tea: What is the basis for assuming that a three month supply is collected at a time? Have Shoshone-Bannock Tribal members been contacted to determine the feasibility of this point? Do tribal members collect and store material for use during times of year outside the growing season?

Response: *Based on available information, it is acknowledged that while the native plants potentially used by Native American receptors to brew teas (sage and red willow) are present for several weeks in the spring, Native American receptors may gather plant material for use during other times of the year. The surrogate species used for plant-based teas in the risk assessment were identified by Tribal representatives; however, the exact recipes, frequencies, uses and gathering methods were considered proprietary and certain assumptions were required. Based on the surface water data collected by MW in 1998 and 1999, only about 0.4, 26.5, and 8.5 percent of the riparian areas in the Salt, Blackfoot/ Little Blackfoot, and Georgetown watersheds are considered to be impacted by mine releases. If it is assumed that sage and red willow (which are present throughout the study area in the spring) are present at equal frequency in potentially impacted and unimpacted riparian areas throughout the study area, use of the percentage of impacted riparian area in the most contaminated watershed (the Blackfoot/Little Blackfoot) represents a conservative estimate of the fraction of plant material used to brew teas that may be harvested from mine-impacted riparian areas. It should be noted that this assumption ignores the possibility that Native American receptors ingest teas brewed from non-native materials (including commercial blends).*

Therefore, Table 6-1 will be revised to (1) indicate an exposure frequency plant-based tea (EF_{pt}) of 365 days per year; footnote 22 will be revised accordingly and (2) add a fraction of plant ingested (FI_{pt}) will be added to the equation used to calculate exposures through this exposure pathway (see Figure 4); footnote 14 will be revised to explain the differing basis for assuming a value of 0.25 associated with ingestion of plant material and ingestion of tea brewed from plant material.

Exposure Frequency-Particulates: Shoshone Bannock Tribe should be contacted for verification of hunting frequency. Are there other outdoor activities that might result in particulate exposure? It seems inappropriate to use elk hunting as the basis for child exposures.

Response: *It is not uncommon for children to occasionally accompany their parents during hunting trips even in the recreational population. There are certainly other outdoor activities that might result in exposure through inhalation of particulates; however, waste rock piles, which are assumed to be the primary source of exposure, are not located in areas where unaccompanied children would be expected to occur. Therefore, consideration of the length of the hunting season in conjunction with meteorological conditions (e.g. snow cover) was determined to be an appropriate basis for estimating the upper bound frequency of exposure for children. This assumption is believed to be conservative because if young children are assumed to not accompany adults while hunting, the inhalation exposure pathway would be incomplete or de minimis for these young receptors.*

Exposure Duration: 30 year exposure durations are based on time spent in a single residence. It is assumed that if individuals move away from a Superfund site, that exposure will end. However, individuals may relocate and continue to use natural resources that are affected by contamination. For this reason, an exposure duration of greater than 30 years is recommended, particularly for tribal members. A more appropriate exposure duration would be 70 years.

Response: *It is acknowledged that individuals may relocate and continue to use natural resources that are affected by mine-related releases. However, it should be noted that increasing the exposure duration would impact only lifetime average daily doses (LADD) associated with potential carcinogenic risks and would not impact average daily doses (ADD) associated with potential noncarcinogenic hazards. The primary COPC for the study area, selenium, is a noncarcinogen; therefore, a change in the exposure duration would not impact any selenium-related exposures or hazards.*

Also, while individuals may relocate and continue to use natural resources potentially impacted by mine-releases (for example, harvesting and ingesting fish from contaminated stream reaches), increasing the

exposure duration must be consistent with exposure pathway assumptions. For example, the two exposure pathways associated with the greatest potential risks and hazards are ingestion of fish and ingestion of surface soil. For the purposes of the AWHHRA, it was assumed that receptors ingested only fish from study area watersheds. That is, aquatic life ingested (FI_{al}) of 1 was assumed. An increase of the exposure duration from 30 to 70 years would require the assumption that an individual would ingest fish from only study area watersheds for their entire life. This seems unrealistic and inconsistent with an RME approach. Similarly, exposure through ingestion of surface soil was assumed to occur only among hypothetical subsistence lifestyle receptors living in residences constructed along contaminated stream reaches. Exposure among these receptors is assumed to occur only at their residences. If these individuals relocate, while they may continue to enjoy study area resources, they would not be exposed to contaminated surface soil at their new residence.

Finally, an increase of the exposure duration from 30 to 70 years would result in at most an increase in estimated carcinogenic risks by a factor of about 2. In the context of the multiple levels of conservatism already incorporated into the AWHHRA, a factor of 2 is considered relatively minor. Therefore, the AWHHRA should retain the use of a reasonable exposure duration of 30 years under RME conditions. However, the potential for individuals to be exposed for a greater period of time (up to 70 years or their entire lives) will be discussed in the uncertainty section.

Comments on Exposure Parameters in Table 6-2

Cattle Ingestion Rate: In table 6-1, it was necessary to use mean ingestion rates to adjust total 95th percentile ingestion rates to reflect consumption rates for adults and children. Since CTE values are being dealt with in 6-2, it isn't necessary to develop factors to adjust the mean consumption rate for adult or child specific consumption. Time weighted averages can be used directly:

Adults: (0.789 g/kg/day [20 to 39 years] x 20 years) / 50 years + (0.667 g/kg/day [40 to 69 years] x 30 years) / 50 years = 0.7158 g/kg/day

Children: (0.941 g/kg/day [<1 year] x 1 year)/6 years + (1.46 g/kg/day [1 to 2 years] x 2 years) / 6 years + (1.392[3 to 5 years] x 3 years)/6 years = 1.34 g/kg/day

Response: *It is acknowledged that time-weighted averages can be computed directly as described above for the recreational and subsistence lifestyle receptors under the assumption that these receptor groups can be represented by general population values. However, information for Native Americans is presented in EPA's "Exposure Factors Handbook" (EPA 1997) are only for the overall population and not broken out for adults and children. Therefore, adult and child Native American beef ingestion values must be calculated using adult and child factors as presented in footnote 9 to Table 6-2. Footnote 9 will be revised accordingly.*

Cattle Ingestion Offal: EPA recommends using the 10% of skeletal muscle consumption employed in the RME scenario to compute a CTE offal consumption rate. These values would therefore be: 0.072 g/kg/day for adults and 0.134 g/kg/day for children.

Response: *Use of 10 percent of the skeletal muscle consumption to represent offal consumption was based on a study of Native American receptors. Therefore, this approach was used to calculate offal consumption by Native American adult and child receptors. The alternate approach applied to recreational hunter/fisher and subsistence lifestyle receptors is based on best professional judgement. It should be noted that the proposed change would result in less than a 2-fold increase in exposure for adult receptors and a 1.5-fold decrease for child receptors. Neither change would significantly impact the AWHHRA results.*

Aquatic Life Ingestion Rate: If tribal rates are on average 50 to 100% higher than general population rates, the percentage used should be 75% not 50%. This would lead to a value of 14 g/day.

> ***Response:*** *As discussed in footnote 11 to Table 6-2, EPA's "Exposure Factors Handbook" (EPA 1997), fish ingestion among Native American populations can range from "similar to 100 percent higher than for the general population." This range is in contrast to the range of "50 to 100 percent higher than the general population" identified by the reviewer. For the purpose of the AWHHRA, it was assumed that Native American receptors ingested fish at a rate 50 percent higher than the general population. The value of 50 percent represents the midpoint of the range identified in EPA's "Exposure Factors Handbook" of similar (assumed to be 0) to 100 percent higher (EPA 1997).*

Exposure Duration: See Table 6-1 comment. Because individuals may relocate over small distances and still continue to use affected resources, an exposure duration of 70 years is recommended. This is particularly true of Native Americans residing on reservation lands.

> ***Response:*** *See response to Table 6-1 comment. Also, the primary purpose of evaluating central tendency exposure (CTE) conditions is to present a range of potential outcomes to risk managers. CTE conditions generally represent average or typical conditions. While individuals may be exposed over a longer period than the 9 years assumed for adults, an exposure duration of 70 years certainly does not represent average or typical conditions. Therefore, the exposure duration values presented in Table 6-2 should be retained. It should also be noted that other than the Gay Mine, none of the study area is on, or even in the vicinity of, Fort Hall Reservation. Tribal residents would be required to travel approximately 180 miles round trip to access resources in the rest of the mining area. It is unlikely that any individual would support a subsistence lifestyle over 70 years under these conditions.*

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Water Resources Division
Western Region
345 Middlefield Road, MS 435
Menlo Park, CA 94025

July 5, 2001

TO: Rick Clegg, Idaho Department of Environmental Quality, Soda Springs, Idaho
FROM: Theresa Presser, U.S. Geological Survey, Water Resources Division, National Research Program, Menlo Park, California
SUBJECT: Technical comments on (1) *Draft Area Wide Human Health and Ecological Risk Assessment*; (2) summaries given in *News Release* and *Notice for Public Comment*; and (3) *Idaho Department of Environmental Quality Risk Management Statement* for the Selenium Project, Southeast Idaho Phosphate Resource Area, prepared for the Idaho Department of Environmental Quality by Tetra Tech EM Inc.

I appreciate the opportunity to comment on the *Area Wide Human Health and Ecological Risk Assessment* for southeast Idaho because of the **U.S. Geological Survey's continuing interest in understanding the biogeochemical processes associated with selenium (Se) contamination of aquatic ecosystems in areas of California and other western states**. Selenium is especially enriched in organic-rich shales, such as in the Coast Ranges of California, that are source rocks for oil, coal, and phosphate ores. **As you know, USGS has re-activated the Blackfoot River gaging station near Henry to help fulfill the need for long-term monitoring of Se discharges associated with the regional geology of southeastern Idaho**. These data will help quantify exposure and risk from Se. My comments on the (1) *Area Wide Human Health and Ecological Risk Assessment* (dated April 2002); (2) summaries given in the *News Release* and *Notice for Public Comment* of May 23, 2002; and (3) the Technical Memorandum, *IDEQ Risk Management Statement: Area Wide Remediation Goals and Objectives for Selenium Impacts from Historic Phosphate Mining Operations in Southeast Idaho* (dated May 15, 2002), focus on the analysis of Se effects, as opposed to effects from other elements of concern, such as cadmium.

IDEQ Response Foreword: *The Idaho department of Environmental Quality (IDEQ) appreciates USGS's comments and the continuing support provided by the Service's representatives for this project. USGS was instrumental in helping us to design the initial target analyte list for screening purposes, and has provided extensive research in characterizing shales, wetland conditions and detailed mapping of the area. We also recognize your expertise in selenium-related issues and encourage any future involvement.*

I. Draft Area Wide Human Health Assessment

The summaries of the *Human Health Assessment* pertaining to impacts of Se releases in southeast Idaho state that the ***"draft Risk Assessment document indicates negligible human***

***health risks from Se…..*"** The only detailed information given in the summary is that regional evaluations were of "*recreational hunters and fishers, modified subsistence lifestyles, and Native American exposures scenarios*".

It may be helpful to add an *Executive Summary* to these notices and news releases that encompasses some of the actual findings concerning Se and guidance information on consumption of fish. According to data collected by Montgomery-Watson, **fish in the area of the Blackfoot River watershed do exceed the 2-mg Se/kg wet-weight guideline for human consumption of fish flesh, especially during the spring months**. According to the *Risk Assessment*, **the greatest receptor-specific hazards were identified associated with potential ingestion of fish from the Georgetown watershed, followed by the Blackfoot/Little Blackfoot watershed, and the Salt watershed** (page 82). Significant total hazards were identified for the adult (1.9 to 2.3) and child (3.4 to 5.7) subsistence lifestyle receptor and were driven by ingestion of fish tissue (page 83). Although, the *Risk Assessment* ultimately describes this as a limited hazard that can be expected to increase to the extent that people fish more frequently in impacted stream reaches (page 86), **the subsistence-lifestyle-receptor was identified as at significant risk.**

Response: *As suggested, the final document will include an Executive Summary to more clearly outline the findings of the assessment. It should be noted that the assessment utilized a hypothetical subsistence lifestyle scenario to provide an upper bound estimate of risks for evaluation of lesser users such as the sparse rancher population in the area. Fish ingestion risks were identified for this scenario but were primarily driven by a few significantly elevated 1st order, headwater streams that do not have the productivity, accessibility or observed fishery use to support a true subsistence scenario. The risk assessment process incorporates very conservative assumptions and is measured against a no observed adverse effects level threshold that is intentionally over conservative to ensure a high level of protectiveness. These factors must be taken into account when evaluating the results of risk estimation and has led the Agency to conclude that negligible human health risks actually exist in the Resource Area based on current conditions.*

Guidelines for public health warnings specific to Se have been developed in other areas of the western United States and are available in a **guidelines document** as part of National Irrigation Water Quality Program of the U.S. Department of the Interior. **Advisories are issued when Se concentrations in flesh reach or exceed 2-mg Se/kg wet weight [6-12 mg Se/kg dry weight, assuming 65-85% moisture].** They restrict human consumption to not exceed 112 grams of flesh per one- or two-week period or 20 grams of fish or bird muscle per day in addition to the regular daily intake. **Children (less than age 15) and pregnant women are advised not to consume any fish or game from the posted areas. When edible tissues exceed 5 mg Se/kg on a wet weight basis, a complete ban on human consumption of fish is recommended.**

Human health advisories against consuming tissue of fish (bluegill and largemouth bass) and birds (ducks and coots) are presently posted for the San Joaquin Valley in California. Advisories also exist for eating ducks (scoter and scaup) from the San Francisco Bay-Delta. In addition, the Salton Sea area of California and four other states (Colorado, Texas, Utah, and North Carolina) have fish consumption advisories because of Se. **In the San Joaquin Valley of California, the**

posting are provided in several languages because the subsistence lifestyle provided the greatest risk, as found for southeast Idaho.
[Reference: Information Report No. 3, Guidelines for interpretation of the biological effects of selected constituents in biota, water, and sediment: U.S. Department of the Interior, Washington, DC, p. 139-184. Available at www.usbr.gov/niwqp/guidelines.html]

Response: *The IDEQ appreciates this information and has discussed the issue with the Idaho Division of Health and Idaho Fish & Game representatives. The issue was referred to the State's Fish Advisory Program for review of relevant data and advisory level determinations. Based on State protocols, the Idaho Fish Consumption Advisory Program Committee, which includes a USGS representative, has recommended a temporary advisory be issued for East Mill Creek, the most impacted stream segment supporting a fishery. A letter from IDH is attached.*

II. Draft Area Wide Ecological Risk Assessment

The summaries of the *Ecological Risk Assessment* pertaining to impacts of Se releases in southeast Idaho state that ***"population-level ecological risks are unlikely based on current area-wide observances, although the potential for localized effects is possible for some species"***. No detailed information is given in the summary.

Again, similar to above, it may be helpful to add an *Executive Summary* to these notices and news releases that encompasses some of the actual findings concerning Se and the hazard quotients (quotients >1 indicate potential risks to ecological receptors) that were generated. **Some of the information and issues that were identified in the *Risk Assessment* that you may wish to bring forward in an effort to provide context and scale to the analysis are**:

1) Similar to the risk to humans, **Se was of primary concern** and affected the greatest number of receptors throughout the three assessed watersheds (page 131-133).
2) The Tier 1 and Tier 2 analyses **only addressed terrestrial mammals and birds**. To assess potential risks to aquatic receptors such as fish or benthic invertebrates comparisons were made to guidelines for surface water and sediment and reported tissue concentrations at which effects have been documented (page 133). Based on these comparisons **the potential risk to aquatic receptors cannot be ruled out** (page 144-145).
3) The hazard quotients (HQ) for all terrestrial receptors were greater than 1.0.from **exposure to maximum concentrations of Se** (**Tier 1**). Potential risk was highest to small mammalian receptors, with a maximum HQ of 2,302 for the meadow vole in the riparian habitat and 1,423 for the eastern cottontail in the overall habitat. The maximum HQ for an avian receptor was 1,442 for the song sparrow (page 126). The extremely high HQs (>2,000) for some receptors indicate that **there is a high probability of significant risk to terrestrial receptors occurring in some localized areas** (page 144).
4) Potential risk resulting from **exposure to area-weighted average concentrations of Se** (**Tier 2**) was highest to small mammalian receptors, with a maximum HQ of 19.4 for the deer mouse. The maximum HQ for an avian receptor was 9.1 for the American robin. Risk to both avian and mammalian receptors was highest in the Blackfoot River watershed (page 131). **Based on the Tier 2 analyses, the risk to overall populations of**

terrestrial receptors in the Resource Area is expected to be low. However, the risks calculated from the Tier 2 assumptions may significantly underestimate exposure to localized subpopulations of various species (page 144).

5) Data used in the analysis showed that the **average impacted surface water exceeded the selected ecological screening criterion of 5 mg Se/L, by a factor of approximately 13** (page 137). The **average impacted sediment exceeded the selected ecological screening criterion of 4 mg Se/kg, by a factor of approximately 5** (page 137). The maximum Se concentration reported for a surface water (1,140 µg Se/L) **exceeded the hazardous Se waste criterion for a waste extract of 1,000 mg Se/L, if this criterion was applied to mining waste**. The maximum Se concentration reported for a sediment (188 mg Se/kg) **exceeded the hazardous Se waste criterion for a solid of 100 mg Se/kg, wet weight, if it was assumed the sediment contained 40% moisture and that this criterion applied to mining waste**.

[Reference:US Department of Health and Human Services, Toxicological profile for selenium (Agency for Toxic Substances and Disease Registry, Public Health Service, US Department of Health and Human Services, Atlanta, Georgia, 1996).

Response: *The IDEQ will give consideration to these comments in developing our Executive Summary. However, it should be noted that the maximum concentrations observed occur in relatively few areas and represent a very small percentage of the overall area. These concentrations have a significant influence on the average impacted area exposure point concentrations and overestimate concentrations in most waters classified as impacted due to the extrapolation of EPCs to any stream segments exhibiting temporal exceedances of water quality standards throughout the 6-year investigation timeframe. Therefore, the Agency does conclude that population level impacts are unlikely while localized subpopulation impacts are possible and the continued focus of future corrective action processes.*

III. Technical Memorandum, IDEQ Risk Management Statement: Area Wide Remediation Goals and Objectives for Selenium Impacts from Historic Phosphate Mining Operations in Southeast Idaho

The *Area Wide Remedial Action Goals and Objectives* described in the memo are based, in part, on the above *Risk Assessment* results. **If the maintenance of the *status quo* in terms of Se exposure is an objective (see RAO 1.1 and 2.1), then results of the assessment become even more important**. **An additional component of the goals and objectives that concern continued long-term monitoring on a regional basis could be to further refine the *Risk Assessment* by resolving the data limitations and assumptions identified in that assessment.** Although the memo declares confidence in the results of the *Risk Assessment*, factors for calculating risk through the food chain are complex, temporal and areal variations exist, extrapolations of the data were made, and **aquatic ecology was not addressed.**

The *Technical Memo* also gives results of specific surveys of Se concentrations in elk, birds, fish, and vegetation. **These data are excerpted below and help illustrate the need to develop long-term monitoring on a regional basis**. A systematic program would sample critical environmental components at a frequency necessary to determine trends in Se contamination or

changes in processes that determine the fate and effects of Se. **Such a program is crucial to understanding the impact of management changes in regards to the biotransfer of Se**.

General: "….Sampling results in the vicinity of the mine sites indicate elevated levels of Se in virtually every media and species of wildlife tested."

Elk: "Elk surveys conducted by Idaho Fish & Game and Idaho Mining Association in 1999 show a direct correlation between elevated concentrations of Se in elk liver versus the distance of harvested elk from the nearest phosphate mine. Approximately 70% of the elk harvested within 2 miles of historic reclaimed mining areas exhibit elevated Se accumulations in their organs. These results also demonstrate upper range subpopulation elk-liver accumulations (~38 mg Se/kg dry weight) approaching referenced toxic threshold liver concentration ranges (20-60 mg Se/kg dry weight) for other large mammals in a limited number of the individual elk tested."

Birds: "…Over 10% of the 117 bird eggs collected in the mining areas exceeded 10 mg/kg (dry weight) egg-shell Se concentration even though the collection effort appears to have missed a significant portion of the higher impacted riparian zones. **The mean egg Se (MES) effects threshold (EC10) for Se is reported to occur between 6 and 16 mg/kg, however, effects are universally accepted to be both site- and species-specific…."**

Fish: "…**Whole body fish samples collected by IDEQ in impacted stream segments also ranged up to 33 mg/kg (dry weight) Se as compared to typical reported background levels of 1 to 4 mg/kg."** (see Guidelines reference, pg 2: **substantive risk threshold for fish occurs at >6 mg Se/kg**.)

Small Mammal: **Small mammal whole body sample concentrations in impacted areas were up to 7 mg/kg (wet weight) with reported background levels typically from 1-4 mg/kg (dry weight)…"**

Vegetation: **"….**The former practice of increasing forage productivity on reclaimed sites has inadvertently resulted in providing an enhanced pathway for wildlife exposure….. **All reclaimed waste rock piles are exhibiting vegetation concentrations well in excess of the typical 5 mg/kg grazing recommendations**…The Agency considers continued livestock grazing losses of the magnitude observed in the past to be unacceptable…. It appears that efforts to delineate elevated vegetation boundaries or to define specific regional criteria for different domestic species has been limited and inconclusive…"

A **clear picture of future monitoring to address aquatic receptors and to provide a comprehensive understanding of the physical, chemical, and biological processes that affect Se bioavailability and uptake in food webs would be a valuable addition** to future risk assessment documentation especially in view of the following statements from the *Technical Memo*:

- "The Agency is concerned that the likelihood for future subpopulation effects is much greater and, even with new Best Management Practices, **future mining will have additive effects** that should be considered in addressing existing historic mining impacts"; and

- "Proposed Best Management Practices do not eliminate similar exposure pathways at future sites. Therefore, the Agency suggests **addressing a selected portion of the historic operation area in remedial activities to help offset the cumulative exposures that will result from increased reclamation for future mining operations**."

Response: *The Risk Management Technical Memorandum is currently under revision by IDEQ to establish regional action levels and will be subject to an additional round of public comment upon completion of the revised draft. It certainly is not the intent of the Agency to maintain the "status quo" with regards to selenium exposure as implied in the comments. The technical memo clearly states our goals, which include reestablishing compliance with water quality standards in impacted areas, reducing current wildlife exposures and continuing the development of new and effective best management practices for future phosphate mining, among others.*

The Area Wide Investigation scope of work developed by interagency representatives and agreed to by the Companies also includes a long term monitoring component to assess the effectiveness of future remedial actions. This area wide monitoring plan will be integrated with site-specific requirements and will be designed at the time corrective action alternatives are selected. In most cases, the cited comments above refer to localized impacted areas that can be easily monitored for exposure reductions and bioavailability effects. It should be noted that a number of the guidelines referenced by the USGS are subject to some controversy regarding selenium speciation issues, warm vs. cold water biota effects, and underlying methods and assumptions for development of the criteria. The IDEQ has given all due respect to the work of selenium experts at historic sites around the U.S. and has deferred to these guidelines for initial screening purposes. But we also understand the importance of assessing site-specific data in the risk management process and the diversity of technical expert opinions regarding selenium issues. Accordingly, we will continue to review and consider feedback from all credible sources in addressing these issues. We appreciate your input and look forward to your future involvement in the project.

Thank you for forwarding the data files and appendices for the *Risk Assessment*. Once all of the files are downloaded and completely reviewed, other issues concerning data analysis and adequacy of criteria to determine hazard may arise. Additional comments may be forwarded to you. If you have any questions, do not hesitate to call (650-329-4512, 650-329-4538 FAX, tpresser@usgs.gov).